ΕΦΗΜΕΡΙΔΑ
ΤΗΣ ΚΥΒΕΡΝΗΣΕΩΣ
ΤΗΣ ΕΛΛΗΝΙΚΗΣ ΔΗΜΟΚΡΑΤΙΑΣ

20 Φεβρουαρίου 2026 | ΤΕΥΧΟΣ ΤΕΤΑΡΤΟ | Αρ. Φύλλου **121**

ΑΠΟΦΑΣΕΙΣ

Αριθμ. 33191

Άδεια αποθήκευσης CO_2.

Η ΕΛΛΗΝΙΚΗ ΔΙΑΧΕΙΡΙΣΤΙΚΗ ΕΤΑΙΡΕΙΑ ΥΔΡΟΓΟΝΑΝΘΡΑΚΩΝ ΚΑΙ ΕΝΕΡΓΕΙΑΚΩΝ ΠΟΡΩΝ

Λαμβάνοντας υπόψη:

1. Τις διατάξεις:

α) Του ν. 5261/2025 «Ρυθμίσεις για τη δέσμευση, χρήση, μεταφορά και αποθήκευση διοξειδίου του άνθρακα - Ενσωμάτωση της Οδηγίας 2009/31/ΕΚ του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου της 23ης Απριλίου 2009 σχετικά με την αποθήκευση διοξειδίου του άνθρακα σε γεωλογικούς σχηματισμούς και για την τροποποίηση της οδηγίας 85/337/ΕΟΚ του Συμβουλίου, των οδηγιών του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου 2000/60/ΕΚ, 2001/80/ΕΚ, 2004/35/ΕΚ, 2006/12/ΕΚ και 2008/1/ΕΚ και του κανονισμού (ΕΚ) 1013/2006 (L 140).» (Α΄ 231) και ιδίως την περ. λε΄ του άρθρου 3 καθώς και την παρ. 1 του άρθρου 35 του νόμου αυτού,

β) του ν. 4964/2022 «Διατάξεις για την απλοποίηση της περιβαλλοντικής αδειοδότησης, θέσπιση πλαισίου για την ανάπτυξη των Υπεράκτιων Αιολικών Πάρκων, την αντιμετώπιση της ενεργειακής κρίσης, την προστασία του περιβάλλοντος και λοιπές διατάξεις» (Α΄ 150) και ιδίως το άρθρο 173 αυτού,

γ) του ν. 4001/2011 «Για τη λειτουργία Ενεργειακών Αγορών Ηλεκτρισμού και Φυσικού Αερίου, για Έρευνα, Παραγωγή και δίκτυα μεταφοράς Υδρογονανθράκων και άλλες ρυθμίσεις» (Α΄ 179) και ιδίως των άρθρων 145 έως 164 αυτού,

δ) του Μέρους Α΄ του ν. 4014/2011 «Περιβαλλοντική αδειοδότηση έργων και δραστηριοτήτων, ρύθμιση αυθαιρέτων σε συνάρτηση με δημιουργία περιβαλλοντικού ισοζυγίου και άλλες διατάξεις αρμοδιότητας Υπουργείου Περιβάλλοντος, Ενέργειας και Κλιματικής Αλλαγής» (Α΄ 209),

ε) του Μεταλλευτικού Κώδικα (ν.δ. 210 της 3/5.10.1973, Α΄ 227) και ιδίως των άρθρων 143 και 144 αυτού.

2. Την υπό στοιχεία ΥΠΕΝ/ΔΥΔΡ/16936/292/13.02.2026 κοινή απόφαση των Υπουργών Εθνικής Οικονομίας και Οικονομικών, Περιβάλλοντος και Περιβάλλοντος και Ενέργειας «Καθορισμός τύπου χρηματικών εγγυήσεων, εχεγγύων ισοδυνάμων με την προβλεπόμενη χρηματική εγγύηση και κάθε άλλου θέματος για την εφαρμογή του άρθρου 24 του ν. 5261/2025 (Α΄ 231), σύμφωνα με την παρ. 8 του άρθρου 40 του ίδιου νόμου», (Β΄ 757),

3. Την υπό στοιχεία ΥΠΕΝ/ΔΚΑΠΑ/86227/2245/06.08.2024 κοινή απόφαση των Υπουργών Εθνικής Οικονομίας και Οικονομικών, Υποδομών και Μεταφορών, Περιβάλλοντος και Ενέργειας, Ανάπτυξης, Ναυτιλίας και Νησιωτικής Πολιτικής «Αντικατάσταση της υπ΄ αρ. 181478/965/2017 (Β΄ 3763) κοινής απόφασης των Υπουργών Οικονομίας και Ανάπτυξης - Περιβάλλοντος και Ενέργειας - Υποδομών και Μεταφορών - Κατάργηση: α) Της υπ΄ αρ. 6517/425/2019 (Β΄ 390) κοινής απόφασης των Υπουργών Οικονομίας και Ανάπτυξης - Περιβάλλοντος και Ενέργειας - Υποδομών και Μεταφορών και β) της υπ΄ αρ. 105040/2297/14.11.2019 (Β΄ 4315) κοινής απόφασης των Υπουργών Ανάπτυξης και Επενδύσεων-Περιβάλλοντος και Ενέργειας - Υποδομών και Μεταφορών - Ενσωμάτωση: α) της Οδηγίας (ΕΕ) 2023/958 του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου της 10ης Μαΐου 2023 ''για την τροποποίηση της οδηγίας 2003/87/ΕΚ όσον αφορά τη συμβολή των αεροπορικών μεταφορών στον στόχο της Ένωσης για μείωση των εκπομπών στο σύνολο της οικονομίας και για την κατάλληλη εφαρμογή ενός παγκόσμιου αγορακεντρικού μέτρου'' (L 130/115) και β) της Οδηγίας (ΕΕ) 2023/959 του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου της 10ης Μαΐου 2023 ''για την τροποποίηση της οδηγίας 2003/87/ΕΚ σχετικά με τη θέσπιση συστήματος εμπορίας δικαιωμάτων εκπομπής αερίων θερμοκηπίου εντός της Ένωσης και της απόφασης (ΕΕ) 2015/1814 σχετικά με τη θέσπιση και τη λειτουργία αποθεματικού για τη

σταθερότητα της αγοράς όσον αφορά το σύστημα εμπορίας δικαιωμάτων εκπομπής αερίων θερμοκηπίου της Ένωσης” (L 130/134) (Β’ 4674).

4. Το π.δ. 14/2012 αναφορικά με την σύσταση της ΕΛΛΗΝΙΚΗΣ ΔΙΑΧΕΙΡΙΣΤΙΚΗΣ ΕΤΑΙΡΕΙΑΣ ΥΔΡΟΓΟΝΑΝΘΡΑΚΩΝ ΚΑΙ ΕΝΕΡΓΕΙΑΚΩΝ ΠΟΡΩΝ Α.Ε. (ΕΔΕΥΕΠ Α.Ε.), και την κατάρτιση του καταστατικού αυτής (Α’ 21).

5. Το Καταστατικό της «ΕΛΛΗΝΙΚΗΣ ΔΙΑΧΕΙΡΙΣΤΙΚΗΣ ΕΤΑΙΡΕΙΑΣ ΥΔΡΟΓΟΝΑΝΘΡΑΚΩΝ ΚΑΙ ΕΝΕΡΓΕΙΑΚΩΝ ΠΟΡΩΝ Α.Ε.» με διακριτικό τίτλο «ΕΔΕΥΕΠ Α.Ε.», το οποίο δημοσιεύθηκε στο Γ.Ε.ΜΗ. στις 17-07-2025, όπως εγκρίθηκε με την απόφαση της Τακτικής Γενικής Συνέλευσης του Μετόχου της 23ης Ιουνίου 2025.

6. Την υπ’ αρ. 3692306/01-09-2025 Ανακοίνωση Καταχώρισης στο Γ.Ε.ΜΗ. με Κωδικό Αριθμό Καταχώρησης 5477189 του Τμήματος Δ’ Χρηματοπιστωτικών Ιδρυμάτων, Ασφαλιστικών Ανωνύμων Εταιρειών και ΔΕΚΟ, της Διεύθυνσης Εταιρειών, της Γενικής Διεύθυνσης Αγοράς και προστασίας του καταναλωτή, της Γενικής Γραμματείας Εμπορίου του Υπουργείου Ανάπτυξης αναφορικά με την εκπροσώπηση της ΕΔΕΥΕΠ Α.Ε.

7. Την 14577/11.10.2022 απόφαση της ΕΔΕΥΕΠ «Ενεργοποίηση Δικαιώματος Διερεύνησης για την Αποθήκευση CO_2 (Β’ 5247).

8. Την από 28.06.2024 (Α.Π. ΕΔΕΥΕΠ 22781/2024) κοινή αίτηση των εταιρειών υπό την επωνυμία «Energean Oil & Gas - Ενεργειακή Αιγαίου Ανώνυμη Εταιρεία Έρευνας και Παραγωγής Υδρογονανθράκων» και «Enearth Greece Μονοπρόσωπη Α.Ε.»,

9. Την υπό στοιχεία ΥΠΕΝ/ΔΙΠΑ/97416/6779/07.11.2025 (ΑΔΑ:Ρ3Ι74653Π8-ΤΙ6), Απόφαση Έγκρισης Περιβαλλοντικών Όρων (ΑΕΠΟ) του έργου αποθήκευσης CO_2 στον Πρίνο Καβάλας,

10. Το γεγονός ότι, σύμφωνα με την Αρχή υπ’ αρ. 1 της Αρχής περί μη πρόκλησης σημαντικής βλάβης (DNSH), δεν θα λαμβάνει χώρα άμεση παραγωγή πετρελαίου στις υδραυλικές μονάδες όπου εγχέεται το CO_2, εκτός αν πρόκειται για υποπροϊόν κατά την παραγωγή υφάλμυρου νερού ως μέρος της στρατηγικής έγχυσης, καθώς και ότι δεν θα πραγματοποιείται ενισχυμένη ανάκτηση πετρελαίου (EOR),

11. Την από 13.02.2026 (Α.Π. ΕΔΕΥΕΠ 33155/2026) Υπεύθυνη Δήλωση της νομίμου εκπροσώπου της εταιρείας «ENEARTH GREECE ΜΟΝΟΠΡΟΣΩΠΗ Α.Ε.», περί ακρίβειας των υποβληθέντων στοιχείων,

12. Την από 13.02.2026 (Α.Π. ΕΔΕΥΕΠ 33156/2026) Υπεύθυνη Δήλωση της νομίμου εκπροσώπου της εταιρείας «ENEARTH GREECE ΜΟΝΟΠΡΟΣΩΠΗ Α.Ε.», σχετικά με την τήρηση της απαίτησης της Μη Πρόκλησης Σημαντικής Βλάβης (Do Not Significant Harm),

13. Την από 28.01.2026 γνώμη της Ευρωπαϊκής Επιτροπής C(2026) 410 final,

14. Την υπ’ αρ. 161/13.02.2026 απόφαση του Διοικητικού Συμβουλίου της ΕΔΕΥΕΠ Α.Ε., αναφορικά με την έκδοση της παρούσας απόφασης και τη χορήγηση εξουσιοδότησης στον Διευθύνοντα Σύμβουλο της ΕΔΕΥΕΠ Α.Ε. για την υπογραφή αυτής,

15. Το γεγονός ότι οι διατάξεις της παρούσας δεν αφορούν σε διοικητική διαδικασία για την οποία υπάρχει υποχρέωση καταχώρισης στο ΕΜΔΔ-ΜΙΤΟΣ.

Ορισμοί:

1) Αρμόδια Αρχή CCS (Carbon Capture and Storage): η ανώνυμη εταιρεία με την επωνυμία «Ελληνική Διαχειριστική Εταιρεία Υδρογονανθράκων και Ενεργειακών Πόρων Α.Ε.» (ΕΔΕΥΕΠ Α.Ε.), η λειτουργία της οποίας διέπεται από το Κεφάλαιο Α’ της Ενότητας Β’ του ν. 4001/2011 (Α’ 179), περί σύστασης της Ελληνικής Διαχειριστικής Εταιρείας Υδρογονανθράκων και Ενεργειακών Πόρων Α.Ε.

2) Βέβαιες υποχρεώσεις: οι υποχρεώσεις που είναι βέβαιο ότι θα επέλθουν.

3) Μη βέβαιες υποχρεώσεις: οι υποχρεώσεις των οποίων η επέλευση δεν είναι βεβαία.

4) Διαρροή: οποιαδήποτε διαρροή CO_2 από συγκρότημα αποθήκευσης.

5) Σημαντική ανωμαλία: οποιαδήποτε ανωμαλία στις εργασίες έγχυσης ή αποθήκευσης ή στην κατάσταση του ίδιου του συγκροτήματος αποθήκευσης, η οποία υποδηλώνει κίνδυνο διαρροής ή κίνδυνο για το περιβάλλον ή την ανθρώπινη υγεία, σύμφωνα με τα οριζόμενα στην Οδηγία 2009/31/ΕC του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου.

6) Σχέδιο Αποθήκευσης (Φάση Αδειοδότησης): Το Σχέδιο και όλα τα σχετικά υποβληθέντα έγγραφα από τον Φορέα Εκμετάλλευσης, τα οποία έχουν εγκριθεί από την Αρμόδια Αρχή CCS πριν την έκδοση της άδειας αποθήκευσης.

7) Σχέδιο Αποθήκευσης (Φάση Έγχυσης): Το Σχέδιο που περιέχει όλα τα σχετικά επικαιροποιημένα και οριστικά υποβληθέντα έγγραφα από τον Φορέα Εκμετάλλευσης στην Αρμόδια Αρχή CCS το αργότερο έξι (6) μήνες πριν την προγραμματισμένη έναρξη της διαδικασίας έγχυσης. Τα ανωτέρω αποτελούν προϋπόθεση για την εκκίνηση της διαδικασίας έγχυσης.

8) Σχέδιο Αποθήκευσης (Φάση Κλεισίματος): Το Σχέδιο που περιέχει όλα τα σχετικά επικαιροποιημένα, κατάλληλα και οριστικά υποβληθέντα έγγραφα από τον Φορέα Εκμετάλλευσης στην Αρμόδια Αρχή CCS το αργότερο έξι (6) μήνες πριν την προγραμματισμένη λήξη της διαδικασίας έκχυσης. Τα ανωτέρω αποτελούν προϋπόθεση για την εκκίνηση της διαδικασίας κλεισίματος.

9) Συνολική χρηματική εγγύηση: η χρηματική εγγύηση καλής εκτέλεσης για την κάλυψη των υποχρεώσεων που απορρέουν από την άδεια αποθήκευσης CO_2 και των «Βέβαιων υποχρεώσεων» και των «Μη βέβαιων υποχρεώσεων».

Άρθρο 1
Καταλληλότητα γεωλογικού σχηματισμού - Άδεια Αποθήκευσης CO_2

1. Με την παρούσα απόφαση, κατόπιν ολοκληρωμένης και τεκμηριωμένης αξιολόγησης, όπως αυτή αποτυπώνεται στο Παράρτημα Ι της παρούσας, διαπιστώνεται ότι ο γεωλογικός σχηματισμός που περιγράφεται στο άρθρο 2 της παρούσας, είναι κατάλληλος για να χρησιμοποιηθεί ως τόπος αποθήκευσης CO_2, καθώς δεν υπάρχει σημαντικός κίνδυνος διαρροής, ούτε σημαντικός κίνδυνος για το περιβάλλον ή την υγεία, βάσει των προϋποθέσεων χρήσης.

2. Ενεργοποιείται το δικαίωμα του φορέα εκμετάλλευσης για αποθήκευση CO_2 στον γεωλογικό σχηματισμό του άρθρου 2 της παρούσας και χορηγείται άδεια αποθήκευσης στην εταιρεία υπό την επωνυμία «Enearth Greece Μονοπρόσωπη Α.Ε.» και τον διακριτικό τίτλο «Enearth Greece» (εφεξής ο «Φορέας Εκμετάλλευσης»), που εδρεύει στην Ελλάδα και δη στο Μαρούσι Αττικής, επί της Λεωφόρου Κηφισίας αρ. 32, Τ.Κ. 15125, (με αριθμό Γ.Ε.ΜΗ. 177955001000) για την αποθήκευση διοξειδίου του άνθρακα (CO_2) και άλλων αερίων, άμεσα συνδεόμενων με την πηγή, τη σύλληψη, τη μεταφορά και την αποθήκευση του CO_2, καθώς και άλλα ίχνη ουσιών, που τυχόν προστίθενται για τη διευκόλυνση της παρακολούθησης και της επαλήθευσης της μετανάστευσης του CO_2, σύμφωνα με τους όρους της παρούσης.

3. Η διάρκεια της άδειας αποθήκευσης ορίζεται σε είκοσι πέντε (25) έτη από την έκδοση της παρούσας. Η άδεια αποθήκευσης δύναται να ανανεώνεται ανά πέντε (5) έτη με απόφαση του αρμοδίου οργάνου του Υπουργείου Περιβάλλοντος και Ενέργειας, κατόπιν εισήγησης της Αρμόδιας Αρχής CCS, ύστερα από αίτηση του φορέα εκμετάλλευσης, που υποβάλλεται προς το όργανο αυτό και την Αρμόδια Αρχή CCS, έξι (6) τουλάχιστον μήνες πριν από τη λήξη της ισχύουσας άδειας.

4. Ο Φορέας Εκμετάλλευσης υποχρεούται να θέτει στη διάθεση της Αρμόδιας Αρχής CCS, κατόπιν σχετικού αιτήματός της, όλα τα έγγραφα και εκθέσεις που σχετίζονται με την άδεια αποθήκευσης, καθώς και κάθε συναφή πληροφορία, συμπεριλαμβανομένων πλήρων τεχνικών μοντέλων και δεδομένων.

Άρθρο 2
Τόπος Αποθήκευσης

1. Η άδεια αποθήκευσης καλύπτει τον τόπο και το συγκρότημα αποθήκευσης, οι οποίοι ορίζονται εντός των ορίων της περιοχής παραχώρησης του Πρίνου, όπως περιγράφεται κατωτέρω.

2. Ο τόπος αποθήκευσης συνίσταται σε εξαντλημένο κοίτασμα πετρελαίου με τον υποκείμενο υδροφόρο ορίζοντα. Ο τόπος αποθήκευσης περιλαμβάνει τον οριοθετημένο όγκο εντός της οικείας γεωλογικής ενότητας που προορίζεται για τη γεωλογική αποθήκευση CO_2, καθώς και τις συναφείς επιφανειακές εγκαταστάσεις έγχυσης και παραγωγής.

Σχεδιάγραμμα απεικόνισης των ορίων του τόπου αποθήκευσης του Πρίνου σε επιφανειακή προβολή.

3. Οι υδραυλικές ενότητες του τόπου αποθήκευσης εντοπίζονται στη Μειοκαινική Προ-Εβαποριτική ακολουθία τουρβιδιτικών ψαμμιτών A1, A2, B και C.

4. Ο τόπος αποθήκευσης περιλαμβάνει το κοίτασμα πετρελαίου του Πρίνου και οριοθετείται πλευρικά προς την ανώτερη δομή από τα χαρτογραφημένα τεκτονικά ρήγματα και το όριο αποσφήνωσης (pinch-out), και προς την κατώτερη δομή, από τα χαρτογραφημένα τεκτονικά ρήγματα καθώς και από το σημείο υπερχείλισης (spill point) μεταξύ των κοιτασμάτων του Πρίνου και Έψιλον. Τα όρια του τόπου αποθήκευσης ορίζονται από τις ακόλουθες συντεταγμένες, όπως απεικονίζονται στο γεωδαιτικό σύστημα «WGS84 UTM Zone 35N»:

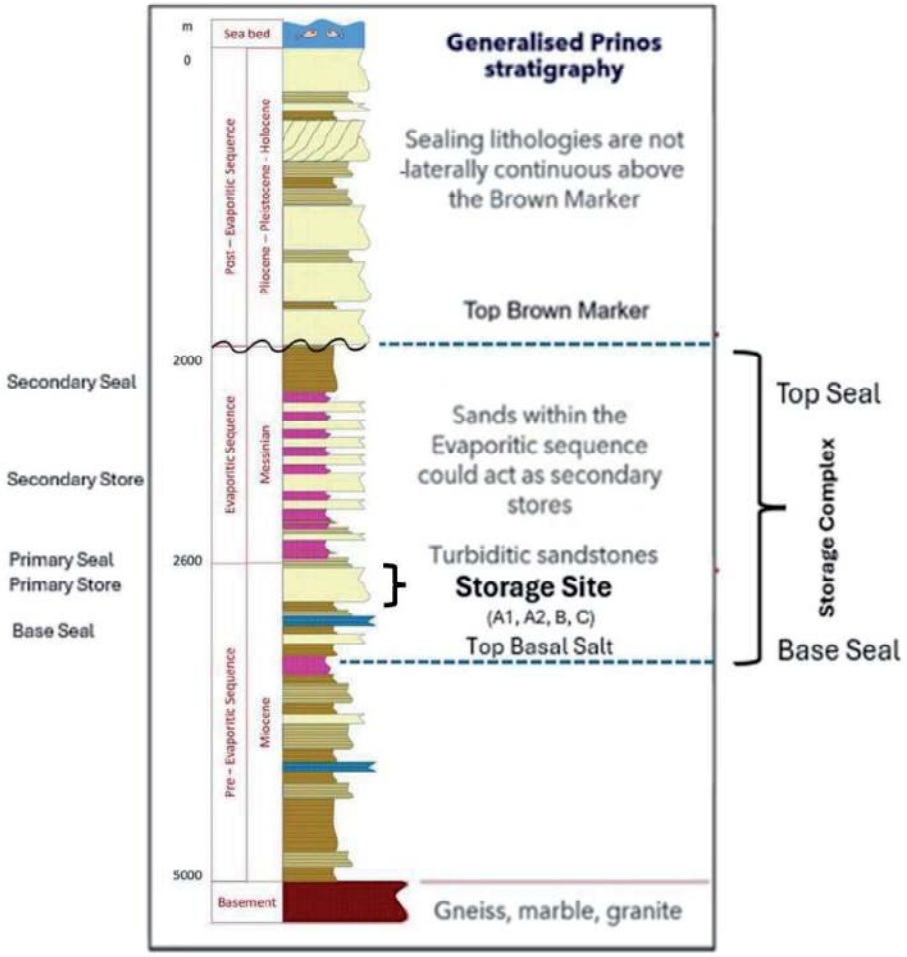
X (m)	Y (m)
287,440	4,520,973
288,869	4,520,942
289,910	4,520,035
290,442	4,519,452
290,570	4,519,050
290,701	4,518,811
290,882	4,517,990
291,267	4,517,628
291,283	4,517,404
291,022	4,516,509
290,801	4,515,497
290,614	4,515,299
290,651	4,515,239
290,384	4,515,056
289,568	4,516,105
289,069	4,516,421
288,419	4,517,304
288,203	4,517,970
287,928	4,518,153
287,528	4,518,095
287,287	4,518,369
287175	4,518,612
287,091	4,518,763
287,066	4,518,889
286,931	4,519,091
286,789	4,519,603
286,805	4,519,805
286,817	4,520,160
286,904	4,520,504
287,251	4,520,833
287,440	4,520,973

Ο τόπος αποθήκευσης καλύπτει επιφανειακή έκταση περίπου 14,7 km^2, με περίμετρο 16,3 km.

5. Το συγκρότημα αποθήκευσης αποτελείται από τον τόπο αποθήκευσης και τον περιβάλλοντα γεωλογικό σχηματισμό. Ο περιβάλλων γεωλογικός σχηματισμός περιλαμβάνει την οροφή του γεωλογικού συμπλέγματος, που αντιστοιχεί στην οροφή της Μεσσηνιακής Εβαποριτικής Ακολουθίας, όπως ορίζεται από τον «Καφέ Στρωματογραφικό Δείκτη» (Brown Marker), καθώς και τη βάση του γεωλογικού συμπλέγματος, η οποία αντιστοιχεί στο Κάτω Κάλυμμα (Base seal), όπως ορίζεται από την κορυφή των κατώτερων Αλατούχων Αποθέσεων (Top Basal Salt) εντός της Μειοκαινικής Προ-Εβαποριτικής Ακολουθίας.

6. Το κύριο πέτρωμα-κάλυμμα της γεωλογικής δομής του Πρίνου (Prinos Primary Seal) συνίσταται από το αργιλολιθικό κάλυμμα (claystone caprock) που απαντάται στη βάση της Μεσσηνιακής Εβαποριτικής ακολουθίας και επικαλύπτεται από την ακολουθία του Κατώτερου Κύριου Άλατος (Lower Main Salt). Το δευτερεύον πέτρωμα-κάλυμμα της γεωλογικής δομής του Πρίνου (Prinos Secondary Seal) συνίσταται από το υπόλοιπο

τμήμα της Μεσσηνιακής Εβαποριτικής Ακολουθίας έως και τον ορίζοντα «Brown Marker», συμπεριλαμβανομένης της ακολουθίας του Άνω Κύριου Άλατος (Upper Main Salt), η οποία επικαλύπτεται από έξι (6) επιμέρους εβαποριτικές ακολουθίες, με ενστρώσεις ψαμμιτών και αργιλολιθικών πετρωμάτων.



Στρωματογραφική Στήλη του Τόπου και του Συγκροτήματος Αποθήκευσης

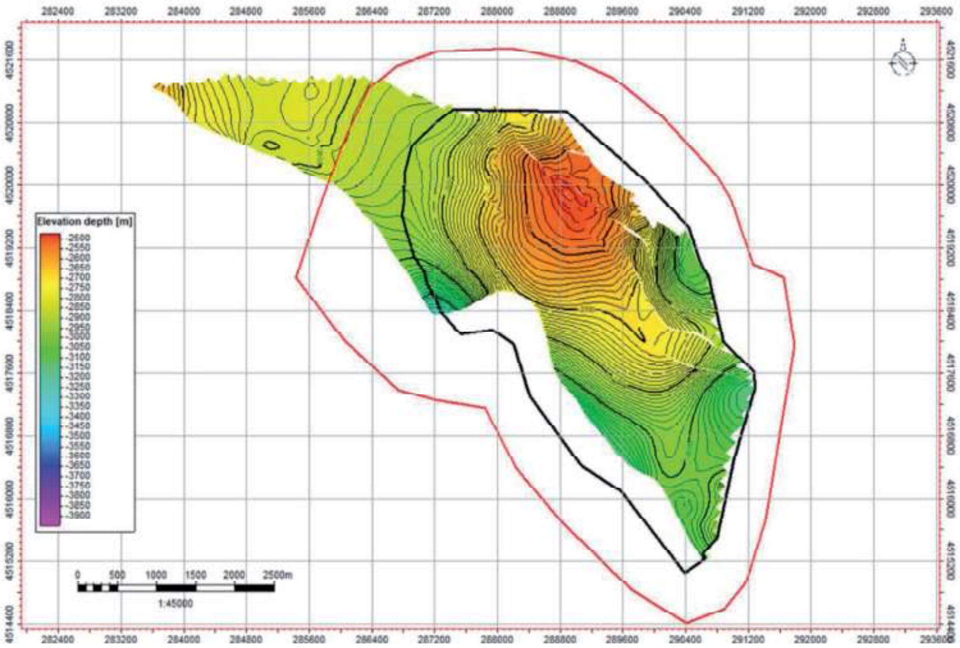
7. Το συγκρότημα αποθήκευσης περιλαμβάνει τον τόπο αποθήκευσης με επιπρόσθετη χωρική επέκταση προκειμένου να λαμβάνεται υπόψη η χαρτογραφημένη αβεβαιότητα του υπεδάφους και να καθίσταται δυνατή η ανίχνευση και παρακολούθηση τυχόν μετανάστευσης του CO_2 εκτός του τόπου αποθήκευσης, με σκοπό την έγκαιρη προειδοποίηση σε περίπτωση ενδεχόμενης διαρροής από το συγκρότημα αποθήκευσης.

8. Τα όρια του συγκροτήματος αποθήκευσης καθορίζονται από τις ακόλουθες συντεταγμένες, όπως ορίζονται στο γεωδαιτικό σύστημα «WGS84 UTM Zone 35N» (εφεξής η περιοχή του «Συγκροτήματος»):

X (m)	Y (m)
286,712	4,521,517
287,228	4,521,698
288,163	4,521,746
289,006	4,521,579
289,472	4,521,364
290,101	4,520,877
290,778	4,520,142
290,969	4,519,827

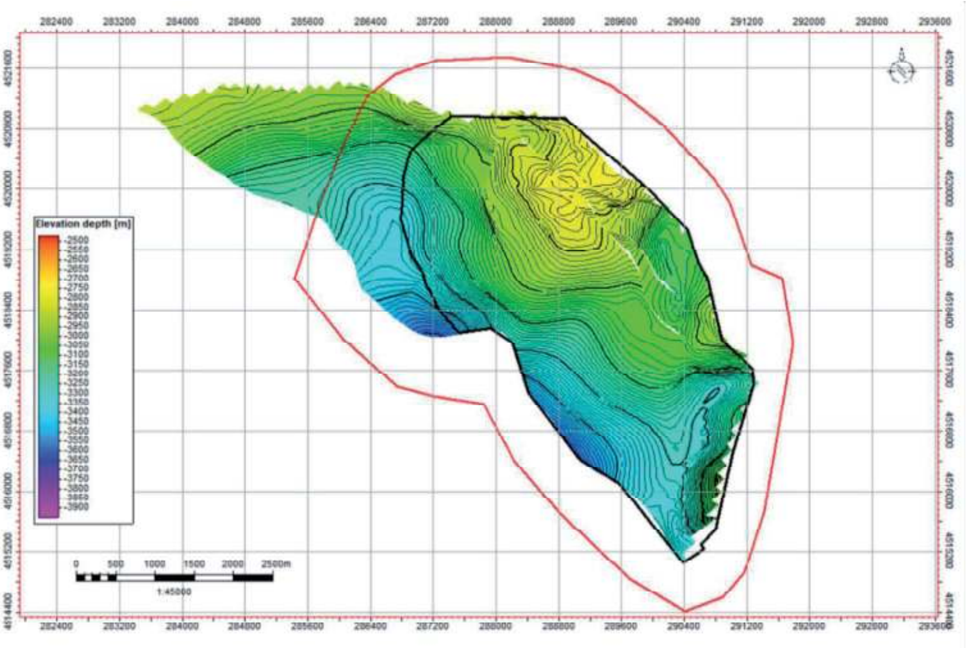
291,256	4,518,988
291,647	4,518,825
291,790	4,517,957
291,418	4,515,733
291,173	4,514,933
290,893	4,514,597
290,406	4,514,415
289,709	4,514,835
288,812	4,515,714
288,239	4,516,391
287,843	4,517,156
287,212	4,517,258
286,734	4,517,388
286,052	4,518,020
285,424	4,518,816
285,767	4,519,847
286,076	4,520,638
286,359	4,521,231
286,712	4,521,517

9. Το συγκρότημα αποθήκευσης καλύπτει επιφάνεια περίπου 28,93 km^2, με περίμετρο περίπου 21,20 km.



Τόπος Αποθήκευσης CO₂ (μαύρο περίγραμμα) και Συγκρότημα Αποθήκευσης (κόκκινο περίγραμμα). Κάτοψη γεωλογικής δομής του Πρίνου – Οροφή του ταμιευτήρα.

Η κόκκινη χρωματική κλίμακα αποτυπώνει το ρηχότερο ορίζοντα της οροφής της γεωλογικής δομής του Πρίνου, σε βάθος περίπου 2.500 μέτρων.



Τόπος Αποθήκευσης CO_2 (μαύρο περίγραμμα) και Συγκρότημα Αποθήκευσης (κόκκινο περίγραμμα). Κάτοψη γεωλογικής Δομής του Πρίνου – Βάση Ταμιευτήρα.

Η κίτρινη χρωματική κλίμακα αποτυπώνει το ρηχότερο ορίζοντα της βάσης της γεωλογικής δομής του Πρίνου, σε βάθος περίπου 2.800 μέτρων.

Άρθρο 3

Περίοδος έγχυσης

1. Η περίοδος έγχυσης θα εκκινήσει το νωρίτερο την 1η Μαρτίου 2027 και μόνο κατόπιν επικύρωσης από την Αρμόδια Αρχή CCS της πλήρωσης των σχετικών υποχρεώσεων του Φορέα Εκμετάλλευσης, όπως περιγράφονται στα άρθρα 8 παρ. 2, 10 παρ. 2, 11 παρ. 2, 12 παρ. 2 και 18 παρ. 1, καθώς και της παραγράφου 3 του παρόντος άρθρου. Η περίοδος έγχυσης θα έχει διάρκεια έως είκοσι (20) έτη. Σε περίπτωση τροποποίησης της διάρκειας της άδειας αποθήκευσης, η περίοδος έγχυσης δύναται να τροποποιείται αναλόγως.

2. Η έναρξη της έγχυσης CO_2 επιτρέπεται μόνο εφόσον η Αρμόδια Αρχή CCS εγκρίνει το Σχέδιο Αποθήκευσης (Φάση Έγχυσης), το αναθεωρημένο σχέδιο διαχείρισης κινδύνου, το σχέδιο παρακολούθησης, το σχέδιο διορθωτικών μέτρων, καθώς και το προσωρινό σχέδιο παύσης λειτουργίας και περιόδου κλεισίματος.

3. Ο Φορέας Εκμετάλλευσης διασφαλίζει ότι η γεώτρηση PA-3 αποκαθίσταται, σφραγίζεται και εγκαταλείπεται μόνιμα πριν από την έναρξη της έγχυσης, σύμφωνα με τα τεχνικά, λειτουργικά και κανονιστικά πρότυπα. Η ολοκλήρωση αυτής της υποχρέωσης αποτελεί προϋπόθεση για την έναρξη της διαδικασίας έγχυσης.

4. Ο Φορέας Εκμετάλλευσης υποχρεούται να ενημερώνει εγγράφως την Αρμόδια Αρχή CCS τουλάχιστον εξήντα (60) ημέρες πριν από την έναρξη και τη λήξη της περιόδου έγχυσης για το ακριβές χρονοδιάγραμμα των προγραμματισμένων ενεργειών.

Άρθρο 4

Μέγιστος Επιτρεπόμενος Ρυθμός Έγχυσης

1. Ο μέγιστος επιτρεπόμενος ρυθμός έγχυσης για τον τόπο αποθήκευσης ορίζεται κατά μέσο όρο σε ένα (1) εκατομμύριο τόνους ανά έτος (MTPA), που αντιστοιχεί κατά προσέγγιση σε μέσο όρο 2.740 τόνους ανά ημέρα, με την προϋπόθεση ότι πληρούνται πλήρως οι γεωμηχανικές απαιτήσεις. Για οποιαδήποτε αύξηση του Μέγιστου Επιτρεπόμενου Ρυθμού Έγχυσης έως 3 MTPA, σε σχεδιαζόμενη μεταγενέστερη φάση του έργου, εφαρμόζεται η παρ. 3 του άρθρου 5 της παρούσας.

2. Ο Μέγιστος Επιτρεπόμενος Ρυθμός Έγχυσης σε κάθε πηγάδι ορίζεται κατά μέσο όρο σε 0,5 εκατομμύρια τόνους ανά έτος (MTPA), που αντιστοιχεί κατά προσέγγιση σε μέσο όρο 1.370 τόνους ανά ημέρα, με την προϋπόθεση ότι πληρούνται πλήρως οι γεωμηχανικές απαιτήσεις.

Άρθρο 5
Μέγιστη Αποθηκευτική Χωρητικότητα

1. Το αποθηκευτικό δυναμικό ορίζεται σύμφωνα με τη Στρατηγική Έγχυσης, όπως περιγράφεται στο άρθρο 13 της παρούσας.

2. Το μέγιστο αποθηκευτικό δυναμικό CO_2 υπό την ισχύουσα Στρατηγική Έγχυσης ανέρχεται σε 18,5 εκατομμύρια τόνους.

3. Οποιαδήποτε επαύξηση του αποθηκευτικού δυναμικού, σε σχεδιαζόμενη μεταγενέστερη φάση του έργου, έως τους 60 εκατομμύρια τόνους, υπάγεται στη διαδικασία του άρθρου 173 του ν. 4964/2022, όπως ισχύει.

Άρθρο 6
Μέγιστα Επιτρεπόμενα Όρια Πίεσης

Κατά τη διάρκεια και μετά την περίοδο έγχυσης, η πίεση του ταμιευτήρα θα πρέπει να παραμένει κάτω από 6.200 psia σε βάθος αναφοράς -2711 μέτρων ΠΚΥΒ (Πραγματικό Κατακόρυφο Υποθαλάσσιο Βάθος - TVDSS True Vertical Depth Subsea) σε όλο το εύρος του τόπου αποθήκευσης, ώστε να πληρούνται οι γεωμηχανικές απαιτήσεις.

Άρθρο 7
Κριτήρια Αποδοχής Ρεύματος Διοξειδίου του Άνθρακα

1. Το ρεύμα CO_2 πρέπει να αποτελείται κατά κύριο λόγο από διοξείδιο του άνθρακα. Για το σκοπό αυτό, δεν επιτρέπεται να προστίθενται απόβλητα ή άλλες ύλες με σκοπό τη διάθεση των εν λόγω αποβλήτων ή άλλων υλών. Ωστόσο, ένα ρεύμα CO_2 δύναται να περιέχει ίχνη συναφών ουσιών από την πηγή, τη δέσμευση ή τη διεργασία έγχυσης καθώς και ιχνηλατικών ουσιών που προστίθενται για την παρακολούθηση και την επαλήθευση της μετανάστευσης CO_2. Οι συγκεντρώσεις των ουσιών αυτών πρέπει να είναι κάτω από τα επίπεδα τα οποία:

α) Επηρεάζουν αρνητικά την ακεραιότητα του τόπου αποθήκευσης ή τη σχετική υποδομή μεταφοράς·

β)ενέχουν σημαντικό κίνδυνο για το περιβάλλον ή την ανθρώπινη υγεία, ή

γ)παραβιάζουν τις απαιτήσεις της εθνικής και ενωσιακής νομοθεσίας.

2. Ο Φορέας Εκμετάλλευσης υποχρεούται:

α) Να δέχεται την έγχυση ρευμάτων CO_2 μόνο εφόσον έχει γίνει ανάλυση της σύνθεσης αυτών, συμπεριλαμβανομένων των διαβρωτικών ουσιών, είναι σύμφωνη με τους όρους της παρ. 1 του παρόντος και το ρεύμα CO_2 πληροί τα πρότυπα του άρθρου 14, με συνεχή παρακολούθηση για την εξασφάλιση της συμμόρφωσης με τα επιτρεπόμενα επίπεδα προσμίξεων.

β) Να τηρεί μητρώο των ποσοτήτων, των ιδιοτήτων και της σύστασης των παραδιδόμενων και εγχυόμενων ρευμάτων CO_2.

Άρθρο 8
Σχέδιο Παρακολούθησης και Αναφορές

1. Το εγκεκριμένο από την Αρμόδια Αρχή CCS Σχέδιο Παρακολούθησης (Φάση Αδειοδότησης) έχει καταρτιστεί από τον Φορέα Εκμετάλλευσης σύμφωνα με τις απαιτήσεις του Παραρτήματος IV του ν. 5261/2025, και επισυνάπτεται στο Παράρτημα ΙΙ της παρούσας.

2. Πριν την έναρξη της έγχυσης, ο Φορέας Εκμετάλλευσης οφείλει να επικαιροποιήσει το Σχέδιο Παρακολούθησης, σύμφωνα με τις απαιτήσεις του Παραρτήματος IV του ν. 5261/2025, το οποίο επικαιροποιείται ανά πέντε (5) έτη, ώστε να λαμβάνονται υπόψη οι μεταβολές του εκτιμώμενου κινδύνου διαρροής, οι αλλαγές στους εκτιμώμενους κινδύνους για το περιβάλλον και την υγεία, οι νέες επιστημονικές γνώσεις και οι βελτιώσεις της εξασφάλισης βέλτιστης διαθέσιμης τεχνολογίας. Τα επικαιροποιημένα σχέδια επανυποβάλλονται στην Αρμόδια Αρχή CCS. Σε κάθε περίπτωση, πριν την έναρξη της περιόδου έγχυσης, ο Φορέας Εκμετάλλευσης επικαιροποιεί το Σχέδιο Παρακολούθησης. Το επικαιροποιημένο Σχέδιο Παρακολούθησης (Φάση Έγχυσης) υποβάλλεται προς έγκριση στην Αρμόδια Αρχή CCS τουλάχιστον έξι (6) μήνες πριν την έναρξη της έγχυσης, και επικαιροποιείται ανά πέντε (5) έτη. Το Σχέδιο Παρακολούθησης (Φάση Έγχυσης) εξειδικεύεται πλήρως από τον Φορέα Εκμετάλλευσης και εφαρμόζεται για την παρακολούθηση των εγκαταστάσεων έγχυσης, του Συγκροτήματος Αποθήκευσης (συμπεριλαμβανομένου, όπου είναι εφικτό, του θυσάνου CO_2) και, όπου ενδείκνυται, του περιβάλλοντος χώρου για σκοπούς:

1) Σύγκρισης μεταξύ της πραγματικής και της αναπαριστώμενης με ψηφιακό μοντέλο προσομοίωσης συμπεριφοράς του CO_2 και του ύδατος του σχηματισμού στον τόπο αποθήκευσης,

2) ανίχνευσης σημαντικών ανωμαλιών,

3) ανίχνευσης μετανάστευσης του CO_2,

4) ανίχνευσης διαρροής του CO_2,

5) ανίχνευσης σημαντικών αρνητικών επενεργειών στο γύρω περιβάλλον, μεταξύ άλλων ιδίως στο πόσιμο νερό, τους ανθρώπινους πληθυσμούς ή χρήστες της γύρω βιόσφαιρας,

6) αξιολόγησης της αποτελεσματικότητας τυχόν διορθωτικών μέτρων,

7) επικαιροποίηση της αξιολόγησης της βραχυπρόθεσμης και μακροπρόθεσμης ασφάλειας και ακεραιότητας του συγκροτήματος αποθήκευσης, συμπεριλαμβανομένης της αξιολόγησης τού κατά πόσον το αποθηκευμένο CO_2 θα παραμείνει πλήρως και μονίμως απομονωμένο.

3. Ο Φορέας Εκμετάλλευσης υποβάλλει στην Αρμόδια Αρχή CCS, μηνιαίες εκθέσεις για τα πρώτα πέντε (5) έτη, και τριμηνιαίες εκθέσεις έκτοτε, οι οποίες περιλαμβάνουν τουλάχιστον:

1) Όλα τα αποτελέσματα παρακολούθησης της παραγράφου 3, συμπεριλαμβανομένων των πληροφοριών για τη χρησιμοποιούμενη τεχνολογία παρακολούθησης,

2) τις ποσότητες και τα χαρακτηριστικά, συμπεριλαμβανομένης της σύνθεσής τους, των ρευμάτων CO_2 που παραδόθηκαν και εγχύθηκαν, κατά την χρονική περίοδο που καλύπτει η έκθεση, τα οποία καταχωρούνται σε μητρώα, σύμφωνα με την περ. β) της παρ. 2 του άρθρου 17 του ν.5261/2025,

3) αποδεικτικό αρχικής έκδοσης και διατήρησης της χρηματικής εγγύησης κατά το άρθρο 15 της παρούσης,

4) οποιαδήποτε άλλη πληροφορία την οποία η Αρμόδια Αρχή CCS θεωρεί σχετική για τους σκοπούς της αξιολόγησης της συμμόρφωσης με τους όρους της άδειας αποθήκευσης και της βελτίωσης των γνώσεων σχετικά με τη συμπεριφορά του CO_2 στον τόπο αποθήκευσης.

4. Το Σχέδιο Παρακολούθησης επικαιροποιείται σύμφωνα με το Παράρτημα IV του ν.5261/2025 με βάση νέα δεδομένα παρακολούθησης, μεταβολές του εκτιμώμενου κινδύνου διαρροής, μεταβολές στους εκτιμώμενους κινδύνους για το περιβάλλον και την υγεία, νέα τεχνικό-επιστημονική γνώση, καθώς και τυχόν βελτιώσεις στις διαθέσιμες τεχνικές λύσεις. Κατά τα πρώτα πέντε (5) έτη μετά την έναρξη της έγχυσης απαιτείται ετήσια επικαιροποίηση του Σχεδίου Παρακολούθησης, ενώ στη συνέχεια το Σχέδιο Παρακολούθησης επικαιροποιείται ανά πέντε (5) έτη. Τα εν λόγω επικαιροποιημένα σχέδια παρακολούθησης κατατίθενται προς έγκριση στην Αρμόδια Αρχή CCS.

5. Το Σχέδιο Παρακολούθησης υποχρεούται να περιλαμβάνει, ανά πάσα στιγμή, τις λεπτομερείς διαδικασίες παρακολούθησης που θα εγκαθιδρυθούν στα κύρια στάδια του έργου (παρακολούθηση αναφορά βάσης, παρακολούθηση κατά τη διάρκεια λειτουργίας και παρακολούθηση μετά το κλείσιμο). Για κάθε φάση καθορίζονται τα ακόλουθα:

1) Οι παράμετροι που παρακολουθούνται,

2) η χρησιμοποιούμενη τεχνολογία παρακολούθησης και η αιτιολόγηση της επιλογής της,

3) οι θέσεις παρακολούθησης και η λογική επιλογής αυτών των θέσεων,

4) η συχνότητα εφαρμογής και η λογική επιλογής της συγκεκριμένης χρονικής δειγματοληψίας.

Οι προς παρακολούθηση παράμετροι προσδιορίζονται ώστε να εκπληρώνουν τους σκοπούς της παρακολούθησης. Το σχέδιο, σε κάθε περίπτωση, περιλαμβάνει συνεχή ή διακεκομμένη παρακολούθηση των εξής αντικειμένων: διαφεύγουσες εκπομπές CO_2 από τον εξοπλισμό έγχυσης, ογκομετρική ροή CO_2 στις κεφαλές των φρεάτων έγχυσης, πίεση και θερμοκρασία του CO_2 στις κεφαλές των φρεάτων έγχυσης για τον προσδιορισμό της ροής μάζας, χημική ανάλυση του εγχεόμενου υλικού, θερμοκρασία και πίεση ταμιευτήρα για την παρακολούθηση της φασικής συμπεριφοράς και κατάστασης του CO_2.

Η επιλογή της τεχνολογίας παρακολούθησης βασίζεται στη βέλτιστη διαθέσιμη πρακτική τη στιγμή της μελέτης. Οι ακόλουθες επιλογές εξετάζονται και χρησιμοποιούνται, όπως κρίνεται ενδεδειγμένο: τεχνολογίες ικανές να ανιχνεύουν την παρουσία, τη θέση και τις υπόγειες κι επιφανειακές οδούς μετανάστευσης CO_2, τεχνολογίες ικανές να παρέχουν πληροφορίες σχετικά με τη συμπεριφορά όγκου - πίεσης και την κατανομή επιφανειακού/κατακόρυφου κορεσμού του θυσάνου CO_2 για την ακριβέστερη προσαρμογή της ψηφιακής τρισδιάστατης προσομοίωσης στα τρισδιάστατα γεωλογικά μοντέλα του σχηματισμού αποθήκευσης, τεχνολογίες ικανές να παρέχουν ευρύ χωρικό φάσμα, ώστε να λαμβάνονται πληροφορίες σχετικά με τυχόν προηγουμένως μη ανιχνευθείσες δυνητικές οδούς διαρροής, εντός των χωρικών ορίων του πλήρους συγκροτήματος αποθήκευσης και πέραν αυτού, σε περίπτωση σημαντικών ανωμαλιών ή μετανάστευσης του CO_2 εκτός του συγκροτήματος αποθήκευσης.

6. Σε περίπτωση διαπίστωσης, από τα δεδομένα της παρακολούθησης, σημαντικής απόκλισης μεταξύ της παρατηρούμενης και της προσομοιωμένης (προβλεφθείσας) συμπεριφοράς, το τρισδιάστατο γεωλογικό μοντέλο αναπροσαρμόζεται προκειμένου να αντανακλά την παρατηρούμενη συμπεριφορά. Η εν λόγω αναπροσαρμογή βασίζεται στα δεδομένα και τις παρατηρήσεις που προκύπτουν από το Σχέδιο Παρακολούθησης και, εφόσον απαιτείται, συνοδεύεται από συλλογή πρόσθετων δεδομένων, καθώς και από εκτέλεση

συμπληρωματικών σεναρίων κινδύνου και προσομοιώσεων ρυθμών ροής, με σκοπό την αναθεώρηση και επικαιροποίηση της αξιολόγησης κινδύνων.

7. Όπου εντοπίζονται νέες πηγές CO_2, δίοδοι ή ρυθμοί ροής ή παρατηρούνται σημαντικές αποκλίσεις από τις προηγούμενες εκτιμήσεις ύστερα από την αντιπαραβολή του ιστορικού των μετρήσεων πεδίου με τα αποτελέσματα προσομοίωσης και την ιστορική αντιστοίχιση (history matching) του τρισδιάστατου μοντέλου, επικαιροποιείται αντίστοιχα το Σχέδιο Παρακολούθησης.

8. Ο Φορέας Εκμετάλλευσης οφείλει να συντάσσει και να τηρεί πλήρη διαχειριστικά αρχεία όλων των τροποποιήσεων των εγκεκριμένων Σχεδίων Παρακολούθησης συμπεριλαμβανομένων των λόγων για την εκάστοτε αναθεώρηση και των κατάλληλων υποστηρικτικών τεχνικών μελετών. Τα αρχεία της παρούσας πρέπει να τηρούνται κατά τρόπο που να μπορεί να γίνει ιχνηλάτηση και έλεγχος και να είναι ανά πάσα στιγμή διαθέσιμα στην Αρμόδια Αρχή CCS.

9. Κατά την περίοδο έγχυσης και παρακολούθησης, η γεώτρηση PA-3 υπόκειται στο εγκεκριμένο Σχέδιο Παρακολούθησης, το Σχέδιο Διαχείρισης Κινδύνου και το Σχέδιο Διορθωτικών Μέτρων. Σε περίπτωση που τα δεδομένα παρακολούθησης δείξουν σημαντική ανωμαλία, κίνδυνο διαρροής, απώλεια ακεραιότητας ή άλλη απόκλιση, ο Φορέας Εκμετάλλευσης εφαρμόζει άμεσα τα εγκεκριμένα μέτρα και όσα επιπλέον ζητηθούν από την Αρμόδια Αρχή CCS. Τα μέτρα αυτά δεν υποκαθιστούν ούτε μειώνουν την υποχρέωση του Φορέα Εκμετάλλευσης να ολοκληρώσει την οριστική αποκατάσταση της PA-3 πριν από την έναρξη της έγχυσης.

10. Ο Φορέας Εκμετάλλευσης παραμένει υπεύθυνος για την παρακολούθηση μέχρι τη μεταβίβαση της ευθύνης για τον τόπο αποθήκευσης στην Αρμόδια Αρχή CCS σύμφωνα με το άρθρο 23 του ν. 5261/2025, είτε μέχρι την τυχόν ανάκληση της άδειας κατά το άρθρο 17 της παρούσας.

Άρθρο 9
Επιθεωρήσεις

1. Ο Φορέας Εκμετάλλευσης διασφαλίζει την ύπαρξη συστήματος τακτικών και έκτακτων επιθεωρήσεων για την προώθηση και έλεγχο της συμμόρφωσης προς την εφαρμοστέα εθνική και ενωσιακή νομοθεσία και ιδίως την παρακολούθηση των επιπτώσεων στο περιβάλλον και στην ανθρώπινη υγεία.

2. Η Αρμόδια Αρχή CCS, σε συνεργασία με την κατά περίπτωση αρμόδια υπηρεσία για τη διεξαγωγή περιβαλλοντικών επιθεωρήσεων του Υπουργείου Περιβάλλοντος και Ενέργειας, οργανώνει και συντονίζει σύστημα τακτικών και έκτακτων επιθεωρήσεων του συγκροτήματος αποθήκευσης που εμπίπτουν στο πεδίο εφαρμογής του ν. 5261/2025, με σκοπό τον έλεγχο και τη διασφάλιση της συμμόρφωσης προς τις απαιτήσεις αυτού, καθώς και την παρακολούθηση των επιπτώσεων στο περιβάλλον και την υγεία.

3. Οι επιθεωρήσεις διενεργούνται από:

1) Την Αρμόδια Αρχή CCS ή

2) μικτό κλιμάκιο επιθεωρητών, που συγκροτείται με απόφαση του Υπουργού Περιβάλλοντος και Ενέργειας και του κατά περίπτωση συναρμόδιου Υπουργού από υπαλλήλους της Αρμόδιας Αρχής CCS και υπαλλήλους του Υπουργείου Περιβάλλοντος και Ενέργειας. Στο κλιμάκιο επιθεωρητών δύνανται να συμμετέχουν και ειδικοί επιστήμονες, εκπρόσωποι άλλων υπουργείων ή δημόσιων φορέων ή των αρμοδίων Οργανισμών Τοπικής Αυτοδιοίκησης, ανάλογα με τις περιστάσεις.

4. Οι επιθεωρήσεις περιλαμβάνουν επισκέψεις των επιφανειακών εγκαταστάσεων, συμπεριλαμβανομένων των εγκαταστάσεων έκχυσης, αξιολόγηση των εργασιών έγχυσης και παρακολούθησης που πραγματοποιούνται από τον φορέα εκμετάλλευσης, και έλεγχο των σχετικών αρχείων που τηρεί ο φορέας εκμετάλλευσης. Ο φορέας εκμετάλλευσης παρέχει στην Αρμόδια Αρχή CCS ή στα κλιμάκια επιθεωρητών, ακώλυτη πρόσβαση στους χώρους των εγκαταστάσεών του.

5. Οι τακτικές επιθεωρήσεις διενεργούνται: α) τουλάχιστον μία (1) φορά τον χρόνο για το διάστημα λειτουργίας της εγκατάστασης και έως τρία (3) έτη από το κλείσιμο της εγκατάστασης, β) μετά από το κλείσιμο της εγκατάστασης ανά πέντε (5) έτη, έως ότου μεταβιβαστεί η ευθύνη της εγκατάστασης στην Αρμόδια Αρχή CCS.

Στο πλαίσιο των επιθεωρήσεων αυτών, εξετάζονται οι εγκαταστάσεις έγχυσης και παρακολούθησης, καθώς και το πλήρες φάσμα των συναφών επενεργειών του συγκροτήματος αποθήκευσης στο περιβάλλον και στην υγεία.

6. Έκτακτες επιθεωρήσεις διενεργούνται:

1) Αν έχουν γνωστοποιηθεί στην Αρμόδια Αρχή CCS ή στην αρμόδια υπηρεσία κατά το άρθρο 20 του ν. 4014/2011 (Α’ 209) για τη διεξαγωγή περιβαλλοντικών επιθεωρήσεων του Υπουργείου Περιβάλλοντος και Ενέργειας ή στην αρμόδια για την υπεράκτια ασφάλεια αρχή σύμφωνα με το άρθρο 8 του ν. 4409/2016 (Α’ 136), ή έχουν περιέλθει σε γνώση τους διαρροές ή σημαντικές ανωμαλίες, σύμφωνα με την παρ. 1 του άρθρου 21 του ν. 5261/2025,

2) αν από τις εκθέσεις του άρθρου 19 του ν. 5261/2025 αποδεικνύεται ανεπαρκής συμμόρφωση προς τις προϋποθέσεις ισχύος της άδειας,

3) για να διερευνηθούν σοβαρές καταγγελίες σχετικά με το περιβάλλον ή την υγεία,

4) σε οποιαδήποτε άλλη περίπτωση κρίνει η Αρμόδια Αρχή CCS.

7. Μετά από κάθε επιθεώρηση, η Αρμόδια Αρχή CCS, από κοινού με την αρμόδια υπηρεσία κατά το άρθρο 20 του ν. 4014/2011 για τη διεξαγωγή περιβαλλοντικών επιθεωρήσεων του Υπουργείου Περιβάλλοντος και Ενέργειας ή την Αρμόδια για την υπεράκτια ασφάλεια Αρχή, συντάσσουν έκθεση με τα αποτελέσματα της επιθεώρησης. Στην έκθεση αξιολογείται η συμμόρφωση προς τις απαιτήσεις του παρόντος και αναφέρεται το κατά πόσο είναι αναγκαία η λήψη περαιτέρω μέτρων. Η έκθεση κοινοποιείται στον ενδιαφερόμενο φορέα εκμετάλλευσης και αναρτάται στον ιστότοπο της Αρμόδιας Αρχής CCS μέσα σε δύο (2) μήνες από τη διεξαγωγή της επιθεώρησης.

Άρθρο 10
Σχέδιο Κλεισίματος και Περιόδου μετά το Κλείσιμο

1. Το εγκεκριμένο προσωρινό Σχέδιο Κλεισίματος και Περιόδου μετά το κλείσιμο (Φάση Αδειοδότησης) έχει εκπονηθεί από τον Φορέα Εκμετάλλευσης σύμφωνα με τις απαιτήσεις του Παραρτήματος IV του ν. 5261/2025 και προσαρτάται ως Παράρτημα ΙΙΙ της παρούσας.

2. Πριν την έναρξη της περιόδου έγχυσης, ο Φορέας Εκμετάλλευσης επικαιροποιεί το προσωρινό Σχέδιο Κλεισίματος (ήτοι παύσης έγχυσης) και Περιόδου μετά το κλείσιμο και το υποβάλλει για έγκριση στην Αρμόδια Αρχή CCS τουλάχιστον έξι (6) μήνες πριν την έναρξη της έγχυσης. Η έγκριση παρέχεται εντός ευλόγου χρόνου, ενώ τυχόν άρνηση χορήγησης αυτής αιτιολογείται ειδικώς.

3. Το Σχέδιο Κλεισίματος και Περιόδου μετά το κλείσιμο (closure and post-closure plan) περιλαμβάνει αναλυτικό σχέδιο παροπλισμού (decomissioning plan) και εστιάζει στην παρακολούθηση μετά την παύση έγχυσης, η οποία θα συμπληρώσει τα δεδομένα παρακολούθησης που προσκτήθηκαν πριν και κατά τη διάρκεια της έγχυσης ώστε να αποδεικνύεται πλήρης και συνεπής συμμόρφωση πριν από τη μεταβίβαση ευθύνης στην Αρμόδια Αρχή CCS. Το σχέδιο περιλαμβάνει δεδομένα σχετικά με:

1) Τη συμφωνία μεταξύ πραγματικής και προσομοιωμένης συμπεριφοράς CO_2,

2) την απουσία ανιχνεύσιμων διαρροών,

3) την πορεία του τόπου αποθήκευσης προς μακροπρόθεσμη σταθερότητα.

4. Τα σχέδια παρακολούθησης για το κλείσιμο και την περίοδο μετά το κλείσιμο στηρίζονται στην εκτίμηση κινδύνου, στην αξιολόγηση και στα δεδομένα παρακολούθησης που έχουν συλλεχθεί έως το κλείσιμο, ενώ μπορεί να απαιτηθεί πρόσθετη ή νέα συλλογή δεδομένων (τεχνικές, συχνότητα, τεχνολογία) για περαιτέρω αξιολόγηση. Τα σχέδιο παρακολούθησης πρέπει να είναι επαρκώς ολοκληρωμένο ώστε να παρέχει τις πληροφορίες που απαιτούνται για την επιτυχή μεταβίβαση ευθύνης στην Αρμόδια Αρχή CCS.

5. Τουλάχιστον έξι (6) μήνες πριν από την παύση έγχυσης, ο Φορέας Εκμετάλλευσης επικαιροποιεί και υποβάλλει το Οριστικό Σχέδιο Κλεισίματος και Περιόδου μετά το κλείσιμο για έγκριση στην Αρμόδια Αρχή CCS.

6. Το Οριστικό Σχέδιο Κλεισίματος και Περιόδου μετά το κλείσιμο παραδίδεται με πλήρη λεπτομέρεια από τον Φορέα Εκμετάλλευσης.

7. Ο τόπος αποθήκευσης κλείνει: α) Εάν έχουν τηρηθεί οι απαιτήσεις που καθορίζονται στην παρούσα άδεια αποθήκευσης, β) κατόπιν τεκμηριωμένου αιτήματος του Φορέα Εκμετάλλευσης και έγκρισης του αρμοδίου οργάνου του Υπουργείου Περιβάλλοντος και Ενέργειας, κατόπιν εισήγησης της Αρμόδιας Αρχής CCS, ή γ) εάν η Αρμόδια Αρχή CCS αποφασίσει το κλείσιμο του τόπου αποθήκευσης μετά από ανάκληση της άδειας, σύμφωνα με το άρθρο 17.

8. Ο τόπος αποθήκευσης θα παραδοθεί στην Αρμόδια Αρχή CCS όταν ο Φορέας Εκμετάλλευσης έχει συμμορφωθεί με τις απαιτήσεις μεταβίβασης ευθυνών, όπως ορίζονται στο Σχέδιο Κλεισίματος και Περιόδου μετά το κλείσιμο και στην αντίστοιχη ισχύουσα εθνική και ενωσιακή νομοθεσία. Κατά τη στιγμή αυτή, η άδεια αποθήκευσης και οι συναφείς ευθύνες του Φορέα Εκμετάλλευσης παύουν να ισχύουν.

Άρθρο 11
Σχέδιο Διαχείρισης Κινδύνου

1. Ο Φορέας Εκμετάλλευσης εκπονεί και εφαρμόζει Σχέδιο Διαχείρισης Κινδύνου προσαρμοσμένο στο έργο αποθήκευσης Πρίνου, σύμφωνα με το πρότυπο ISO 27914:2017 περ. 6.6, ως βέλτιστη πρακτική, το οποίο παρέχει ένα ολοκληρωμένο περιγραφικό πλαίσιο για τη συνολική διαχείριση κινδύνου.

2. Τουλάχιστον έξι (6) μήνες πριν την έναρξη της έγχυσης, ο Φορέας Εκμετάλλευσης υποβάλλει το σχέδιο συνοδευόμενο από ανεξάρτητη επαλήθευση κατά πρότυπο ISO 27914:2017 για έγκριση στην Αρμόδια Αρχή CCS. Η έγκριση παρέχεται εντός ευλόγου χρόνου, ενώ τυχόν άρνηση χορήγησης αυτής αιτιολογείται ειδικώς.

3. Το σχέδιο επικαιροποιείται βάσει νέων δεδομένων παρακολούθησης, μεταβολών στην εκτίμηση κινδύνων και στην εκτιμώμενη πιθανότητα διαρροής, νέων επιστημονικών στοιχείων και βελτιώσεων στις διαθέσιμες τεχνολογίες, το αργότερο πέντε (5) έτη από την έκδοση της παρούσας και στη συνέχεια ανά πενταετία, και θα υποβάλλεται για έγκριση στην Αρμόδια Αρχή CCS.

Άρθρο 12
Σχέδιο Διορθωτικών Μέτρων

1. Το εγκεκριμένο Σχέδιο Διορθωτικών Μέτρων (Φάση Αδειοδότησης) έχει εκπονηθεί από τον Φορέα Εκμετάλλευσης σύμφωνα με το Παράρτημα ΙΙΙ του ν. 5261/2025 και προσαρτάται ως Παράρτημα IV της παρούσας.

2. Πριν την έναρξη της περιόδου έγχυσης, ο Φορέας Εκμετάλλευσης επικαιροποιεί το σχέδιο και το υποβάλλει για έγκριση στην Αρμόδια Αρχή CCS τουλάχιστον έξι (6) μήνες πριν από την έναρξη της ανωτέρω περιόδου. Η έγκριση παρέχεται εντός ευλόγου χρόνου, ενώ τυχόν άρνηση χορήγησης αυτής αιτιολογείται ειδικώς.

3. Το Σχέδιο Διορθωτικών Μέτρων (Φάση Έγχυσης) εκπονείται λεπτομερώς και εφαρμόζεται πλήρως από τον Φορέα Εκμετάλλευσης.

4. Το σχέδιο επικαιροποιείται το αργότερο ανά πενταετία από την έκδοση της παρούσας άδειας και στη συνέχεια ανά πενταετία, βάσει νέων δεδομένων παρακολούθησης, μεταβολών εκτίμησης κινδύνων διαρροής ή περιβαλλοντικών και υγειονομικών κινδύνων, νέας επιστημονικής γνώσης και βελτιώσεων διαθέσιμης τεχνολογίας, και υποβάλλεται στην Αρμόδια Αρχή CCS προς έγκριση.

Άρθρο 13
Στρατηγική Έγχυσης

1. Η στρατηγική έγχυσης στην παρούσα φάση του έργου βασίζεται στην αρχική έγχυση CO_2 στις υδραυλικές ενότητες B και C και στη συνέχεια στις υπερκείμενες υδραυλικές ενότητες A1 και A2 (εφεξής η «Στρατηγική Έγχυσης»). Η υλοποίησή της θα επιτευχθεί με τη διάτρηση δύο (2) γεωτρήσεων έγχυσης CO_2. Οι εργασίες διάτρησης διενεργούνται σύμφωνα με τους όρους και προϋποθέσεις του Παραρτήματος V, κατ’ εφαρμογή του ν. 4409/2016, όπως ισχύει, λαμβάνοντας υπόψη τις ειδικές συνθήκες και απαιτήσεις του έργου δέσμευσης και αποθήκευσης CO_2. Οποιαδήποτε ουσιώδης μεταβολή της Στρατηγικής Έγχυσης υποβάλλεται με πλήρη τεκμηρίωση προς έγκριση ενώπιον της Αρμόδιας Αρχής CCS, ενώ η παροχή έγκρισης είναι αναγκαία προϋπόθεση για την υλοποίησή της.

2. Το προτεινόμενο σχέδιο έγχυσης έχει ως εξής:

Έτος	Ρυθμός Έγχυσης - Μέσος Όρος
	(MTPA)
1	0.25
2	0.50
3	0.75
4	1.00
5	1.00
6	1.00
7	1.00
8	1.00
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00

19	1.00
20	1.00
Total (MT)	18.50

3. Σε περίπτωση που η απόδοση του ταμιευτήρα καθιστά αναγκαία ουσιώδη τροποποίηση της Στρατηγικής Έγχυσης, το Σχέδιο Έγχυσης θα επικαιροποιείται, θα τεκμηριώνεται επαρκώς και θα υποβάλλεται στην Αρμόδια Αρχή CCS για έγκριση προτού εφαρμοστεί.

4. Για την επίτευξη του ανωτέρω σχεδίου έγχυσης, η πίεση του ταμιευτήρα θα ρυθμίζεται μέσω υιοθέτησης στρατηγικής παραγωγής υφάλμυρου νερού, ευθυγραμμισμένης με τη Στρατηγική Έγχυσης. Η στρατηγική αυτή θα υλοποιηθεί με τη διάτρηση δύο (2) γεωτρήσεων παραγωγής υφάλμυρου νερού.

5. Το σχέδιο παραγωγής υφάλμυρου νερού έχει ως εξής:

Έτος	Ρυθμός Παραγωγής - Μέσος Όρος (χιλιάδες βαρέλια υφάλμυρου νερού ανά ημέρα - kbwpd)
1	15.00
2	15.00
3	15.00
4	15.00
5	15.00
6	18.00
7	18.00
8	18.00
9	18.00
10	18.00
11	18.00
12	18.00
13	18.00
14	18.00
15	18.00
16	18.00
17	18.00
18	18.00
19	18.00
20	18.00
Σύνολο (εκατομμύρια βαρέλια υφάλμυρου νερού, million bw)	125.92

6. Σε περίπτωση που η απόδοση του ταμιευτήρα απαιτήσει την ουσιώδη τροποποίηση της στρατηγικής παραγωγής υφάλμυρου νερού, το σχέδιο παραγωγής υφάλμυρου νερού επικαιροποιείται σύμφωνα με τις οδηγίες και κατόπιν έγκρισης της Αρμόδιας Αρχής CCS.

Άρθρο 14
Σύσταση των μιγμάτων έγχυσης και παραγωγής

1. Το μίγμα έγχυσης CO_2 συμμορφώνεται κατ’ αρχήν με τις οριακές τιμές του κάτωθι πίνακα:

Κλάση	Συστατικό	Προδιαγραφές	
		Όριο	Μονάδα
	Διοξείδιο του άνθρακα	≥ 99,7	mol%
	Νερό	≤ 30	ppm mol
Μη συμπυκνώσιμα αέρια	Οξυγόνο	≤ 10	ppm mol
	Υδρογόνο	≤ 750	ppm mol
	Μονοξείδιο του άνθρακα	≤ 1.000	ppm mol
	Σύνολο μη συμπυκνώσιμων αερίων (συμπεριλαμβανομένων των παραπάνω και άλλων: N2, Ar κ.λπ.)	≤ 3.000	ppm mol
Οργανικές ενώσεις	Προπάνιο & άλλοι αλειφατικοί υδρογονάνθρακες	≤ 0,12	mol%
	Υδροκυάνιο (HCN)	≤ 100	ppm mol
	Αρωματικοί Υδρογονάνθρακες (τύπου BTEX)	≤ 15	ppm mol
	Μεθανόλη	≤ 40	ppm mol
	Αιθανόλη	≤ 1	ppm mol
	Φορμαλδεΰδη	≤ 20	ppm mol
	Ακεταλδεΰδη	≤ 20	ppm mol
	Αιθυλένιο	≤ 50	ppm mol
	Άλλες πτητικές οργανικές ενώσεις (VOCs) πέραν των αναφερομένων ξεχωριστά	≤ 10	ppm mol
Ενώσεις αζώτου	Οξείδια του Αζώτου (Nox)	≤ 1,5	ppm mol
Ενώσεις θείου	Υδρόθειο (H_2S)	≤ 10	ppm mol
	Οξείδια του Θείου (Sox)	≤ 10	ppm mol
	Σύνολο ενώσεων θείου	≤ 20	ppm mol
Άλλες οργανικές ενώσεις	Αμίνες	≤ 10	ppm mol
	Αμμωνία	≤ 10	ppm mol
	Μονοαιθυλενογλυκόλη (MEG)	≤ 5	ppm mol
	Τριαιθυλενογλυκόλη (TEG)	≤ 1	ppm mol
Μέταλλα	Υδράργυρος (Hg)	≤ 3	ppb mol
Σωματίδια	Χλωριούχο νάτριο (NaCl)	≤ 1	ppm wt
	Σωματίδια	≤ 1 ppm wt Σωματίδια μεγαλύτερα από 1 μικρόμετρο (micron)	

Σύσταση ρεύματος έγχυσης CO_2 Πρίνου

2. Ο κατάλογος των συστατικών που αναφέρονται στην παράγραφο 1 θεωρείται ενδεικτικός της αναμενόμενης σύστασης του ρεύματος CO_2 που θα παραδίδεται στο χερσαίο τερματικό σταθμό CO_2 και, εντέλει, θα εγχύεται στον τόπο αποθήκευσης. Εντούτοις, η παρουσία και άλλων συστατικών που δεν περιλαμβάνονται επί του παρόντος μπορεί να γίνει αποδεκτή, υπό την προϋπόθεση ότι οι εν λόγω αποκλίσεις:

- Προκύπτουν από φυσικές διακυμάνσεις της τροφοδοσίας CO_2 ή των σχετικών διεργασιών,
- αποδεικνύεται, μέσω τεκμηριωμένων στοιχείων που υποβάλλει ο Φορέας Εκμετάλλευσης, ότι δεν θίγουν την ασφάλεια, την περιβαλλοντική ακεραιότητα, τη λειτουργικότητα του συστήματος έγχυσης και αποθήκευσης, ούτε και την ορθολογική αξιοποίηση της δυναμικότητας αποθήκευσης CO_2.

3. Σε περίπτωση που η σύσταση του CO_2 προς έγχυση αποκλίνει από τα προβλεπόμενα στην παράγραφο 1 του παρόντος στο βαθμό που η συμμόρφωση με τις απαιτήσεις του άρθρου 7 παραβιάζεται ή τίθεται υπό αμφισβήτηση, ο Φορέας Εκμετάλλευσης υποχρεούται να ενημερώσει αμελλητί την Αρμόδια Αρχή CCS. Ο Φορέας Εκμετάλλευσης οφείλει:

- Να τεκμηριώσει τη φύση και τα αίτια της απόκλισης,
- να παράσχει τα απαιτούμενα υποστηρικτικά στοιχεία και τεχνικές αξιολογήσεις, και
- να αποδείξει ότι η απόκλιση δεν επιφέρει δυσμενή επίπτωση στην ασφάλεια και ακεραιότητα του συστήματος ή στη διαδικασία αποθήκευσης.

4. Το παραγόμενο μίγμα υφάλμυρου νερού συμμορφώνεται κατ’ αρχήν με τις ενδεικτικές τιμές του πίνακα που ακολουθεί. Τα παραγόμενα ρευστά δειγματοληπτούνται και αναλύονται σε τακτική βάση, πριν και κατά τη διάρκεια της έγχυσης CO_2, για τον εντοπισμό τυχόν μεταβολών στη σύστασή τους, όπως:

- Φυσικές διακυμάνσεις του νερού του υδροφορέα,
- ανάμειξη νερού υδροφορέα με εγχυόμενο θαλασσινό νερό από την ανάπτυξη του Πρίνου,
- ανάμειξη νερού υδροφορέα με εγχυόμενο θαλασσινό νερό και πετρέλαιο/αέριο Πρίνου,
- ανάμειξη νερού υδροφορέα με εγχυόμενο θαλασσινό νερό, πετρέλαιο/αέριο Πρίνου και εμφάνιση εισροής CO_2 (CO_2 breakthrough).

Οι παρατηρούμενες μεταβολές στη σύσταση από τις γεωτρήσεις παραγωγής υφάλμυρου νερού και από τις γεωτρήσεις παρακολούθησης συγκρίνονται με τις προβλέψεις που προκύπτουν από τα δυναμικά μοντέλα προσομοίωσης ταμιευτήρα. Τα αποτελέσματα των συγκρίσεων αυτών χρησιμοποιούνται ως δεδομένα ιχνηθετών (tracer data) για την υποστήριξη της διαδικασίας ιστορικής προσαρμογής (history matching), την αξιολόγηση της προσαρμογής του μοντέλου και την εκτίμηση της συνολικής απόδοσης του συγκροτήματος αποθήκευσης CO_2.

Τα ευρήματα καταγράφονται συστηματικά και υποβάλλονται στην Αρμόδια Αρχή CCS σύμφωνα με το εφαρμοστέο κανονιστικό πλαίσιο, αποτελώντας αναπόσπαστο μέρος του Σχεδίου Παρακολούθησης.

Ανάλυση Νερού												
Πεδίο	**Φρέαρ**	**Έτος**	**Ζώνη**	**Cl**	**SO4**	**HCO3**	**Na+**	**K+**	**Ca+**	**Mg++**	**Sr++**	**Ba++**
				(mg/L)								
Πρίνος	P-3	1980	A	161500	3900	100	95400	44	3400	4600		

5. Κάθε απόκλιση στη σύσταση των εγχυόμενων ρευμάτων CO_2 και/ή των παραγόμενων ρευστών αξιολογείται και αναφέρεται σύμφωνα με το Σχέδιο Παρακολούθησης, όπως αυτό έχει εγκριθεί από την Αρμόδια Αρχή CCS.

Άρθρο 15

Χρηματική Εγγύηση

1. Ο Φορέας Εκμετάλλευσης υποχρεούται να παράσχει την χρηματική εγγύηση καλής εκτέλεσης που εγκρίνεται από την Αρμόδια Αρχή CCS, σύμφωνα με την αίτησή του, προκειμένου να διασφαλισθεί ότι καλύπτεται δεόντως το σύνολο των υποχρεώσεών του που απορρέουν από την παρούσα άδεια, συμπεριλαμβανομένων των απαιτήσεων του κλεισίματος και της περιόδου μετά το κλείσιμο, καθώς και των υποχρεώσεων που απορρέουν από την υπαγωγή του τόπου αποθήκευσης στο εφαρμοστέο εθνικό και ενωσιακό δίκαιο.

2. Τα χρηματικά ποσά για τα οποία παρέχεται η χρηματική εγγύηση για τα πρώτα πέντε (5) έτη από την έναρξη της περιόδου έγχυσης ανέρχονται σε:

Εκτίμηση Χρηματικής Εγγυήσεως (σε € εκατ. - τιμές 2025)					
	Έτος 1	Έτος 2	Έτος 3	Έτος 4	Έτος 5
Βέβαιες υποχρεώσεις					
Σχέδιο Διαχείρισης Κινδύνων (Risk Management Plan)	0,1235	0,1235	0,1235	0,1235	0,1235
Παρακολούθηση (Monitoring)	3,646	3,646	3,646	3,646	3,646
Απενεργοποίηση και παύση λειτουργίας/κλείσιμο (Dismantling and Closure)	5,339	5,339	5,339	5,339	5,339
Κόστος εποπτείας από την Αρμόδια Αρχή (CA oversight)	0,050	0,050	0,050	0,050	0,050
Αναφορά (Reporting)	0,0975	0,0975	0,0975	0,0975	0,0975
Σύνολο βέβαιων υποχρεώσεων	9,256	9,256	9,256	9,256	9,256

Μη βέβαιες υποχρεώσεις					
Διορθωτικά Μέτρα[1] (Corrective Measures)	29,565	29,565	29,565	29,565	29,565
Παράδοση Δικαιωμάτων Εκπομπών CO_2 (Surrender of Allowances CO_2)	0	0	0	0	0
Ενεργοποιούμενη παρακολούθηση (Triggered Monitoring)	0,039	0,039	0,039	0,039	0,039
Σύνολο μη βέβαιων υποχρεώσεων	29,604	29,604	29,604	29,604	29,604
ΓΕΝΙΚΟ ΣΥΝΟΛΟ	38,86	38,86	38,86	38,86	38,86

3. Η χρηματική εγγύηση για τις «Βέβαιες υποχρεώσεις» παρέχεται υπό τη μορφή αμετάκλητης και ανεπιφύλακτης εγγύησης μητρικής εταιρείας, σύμφωνα με το εγκεκριμένο υπόδειγμα του Παραρτήματος VI της παρούσας.

4. Η χρηματική εγγύηση για τις «Μη βέβαιες υποχρεώσεις» παρέχεται υπό τη μορφή ασφαλιστικής καλύψεως, δυνάμει της από 17.11.2025 επιστολής του Φορέα Εκμετάλλευσης, που επισυνάπτεται στο Παράρτημα VII.

5. Ο Φορέας Εκμετάλλευσης οφείλει να υποβάλει στην Αρμόδια Αρχή CCS τη συνολική χρηματική εγγύηση, η οποία περιλαμβάνει την εγγύηση μητρικής εταιρείας για τις «Βέβαιες υποχρεώσεις» και το ασφαλιστικό μέσο για τις «Μη βέβαιες υποχρεώσεις», το αργότερο δώδεκα (12) μήνες πριν την έναρξη της περιόδου έγχυσης. Η συνολική χρηματική εγγύηση πρέπει να είναι ανεπιφύλακτη, έγκυρη, σε ισχύ και εκτελεστή σε όλα τα στάδια του έργου, συμπεριλαμβανομένου του σταδίου προ της έγχυσης, την έγχυση, το κλείσιμο και την περίοδο μετά το κλείσιμο, ενώ θα πρέπει να βρίσκεται σε ισχύ έξι (6) μήνες πριν από την έναρξη της έγχυσης. Η νομική εγκυρότητα, δεσμευτικότητα και εκτελεστότητα της συνολικής χρηματικής εγγύησης στην Ελλάδα τόσο κατά τη διάρκεια όλων των φάσεων όσο και σε περίπτωση ανάκλησης της άδειας, θα πιστοποιείται από ανεξάρτητη νομική γνωμοδότηση και συντάκτη εγνωσμένου κύρους εξειδικευμένου στην παροχή εγγυήσεων και στο εμπορικό δίκαιο.

6. Η υποβολή και έγκριση της συνολικής χρηματικής εγγυήσεως εντός της προθεσμίας της παραγράφου 5 αποτελεί αναγκαία προϋπόθεση για την πιστοποίηση της ετοιμότητας του Φορέα Εκμετάλλευσης για την έναρξη της έγχυσης.

7. Κριτήρια και ειδικότεροι όροι για την αποδοχή χρηματικών εγγυήσεων και ισοδύναμων εχέγγυων αναφορικά με τους εκδότες των μέσων χρηματικής εγγυήσεως καθορίζονται στο άρθρο 4 της υπ’ αρ. ΥΠΕΝ/ΔΥΔΡ/16936/292/13.02.2026 (Β’ 757) κοινής υπουργικής απόφασης και στο Παράρτημα VIII, το οποίο αποτελεί αναπόσπαστο μέρος της παρούσας απόφασης.

8. Το ποσό της συνολικής χρηματικής εγγυήσεως αναπροσαρμόζεται εν όλω ή εν μέρει:

α) Ανά πενταετία από την έκδοση της παρούσας, ώστε να λαμβάνονται υπόψη οι μεταβολές του εκτιμώμενου κινδύνου διαρροής και το κατ’ εκτίμηση κόστος όλων των σχετικών υποχρεώσεων, ή

(β) κατόπιν αιτήματος της Αρμόδιας Αρχής CCS ή του Φορέα Εκμετάλλευσης όταν επέρχονται ουσιώδεις αλλαγές στο εκτιμώμενο κόστος των υποχρέων που απορρέουν από την παρούσα ή σε κρίσιμες παραμέτρους (όπως εκτίμηση κινδύνου διαρροής, επικαιροποιημένα γεωλογικά μοντέλα, τεχνολογικές εξελίξεις, μεταβολές του κανονιστικού πλαισίου ή σημαντικές διακυμάνσεις στις τιμές δικαιωμάτων εκπομπής CO_2).

Η αναπροσαρμογή τεκμηριώνεται με επικαιροποιημένα στοιχεία που υποβάλλονται από τον Φορέα Εκμετάλλευσης και εγκρίνονται από την Αρμόδια Αρχή CCS ή διενεργείται απευθείας από την Αρμόδια Αρχή CCS.

9. Η χρηματική εγγύηση είναι έγκυρη και παραμένει σε ισχύ:

α) Στην περίοδο μετά το κλείσιμο ενός τόπου αποθήκευσης, σύμφωνα με τις περ. α) και β) της παρ. 1 του άρθρου 22 του ν. 5261/2025, έως ότου μεταβιβαστεί στην Αρμόδια Αρχή CCS η ευθύνη για τον τόπο αποθήκευσης, σύμφωνα με τις παρ. 1 έως 5 του άρθρου 23 του ν. 5261/2025,

β) μετά την ανάκληση άδειας αποθήκευσης:

βα) μέχρι να εκδοθεί νέα άδεια αποθήκευσης,

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[1] Το ποσό των διορθωτικών μέτρων αφορά το εκτιμώμενο συνολικό απαιτούμενο κόστος για την αποκατάσταση μιας παλιάς γεώτρησης μέσω βαθιάς τέμνουσας γεώτρησης (deep intersection well).

ββ) εάν κλείνει ο τόπος αποθήκευσης, σύμφωνα με την περ. β) της παρ. 1 του άρθρου 22 του ν. 5261/2025, μέχρι να πραγματοποιηθεί η μεταβίβαση της ευθύνης, σύμφωνα με την παρ. 9 του άρθρου 23, εφόσον έχουν τηρηθεί οι οικονομικές υποχρεώσεις του άρθρου 26 του ν. 5261/2025.

10. Σε περίπτωση μη συμμόρφωσης του Φορέα Εκμετάλλευσης προς τις υποχρεώσεις του, η χρηματική εγγύηση καταπίπτει υπέρ του Ελληνικού Δημοσίου.

11. Η Αρμόδια Αρχή CCS δικαιούται να ζητήσει την τροποποίηση της συχνότητας αναπροσαρμογής της συνολικής χρηματικής εγγύησης, εφόσον το προβλέπει η ισχύουσα νομοθεσία.

12. Μετά το κλείσιμο του τόπου αποθήκευσης σύμφωνα με το άρθρο 10 της παρούσας, και πριν από τη μεταβίβαση της ευθύνης, ο Φορέας Εκμετάλλευσης υποχρεούται να καταβάλλει χρηματοδοτική συνεισφορά, σε ειδικό λογαριασμό υπέρ του Πράσινου Ταμείου του ν. 3889/2010, η οποία καθορίζεται με απόφαση της Αρμόδιας Αρχής CCS και συναρτάται με το ύψος των δαπανών παρακολούθησης του συγκεκριμένου τόπου αποθήκευσης μετά την μεταβίβαση της ευθύνης. Η συνεισφορά του Φορέα Εκμετάλλευσης λαμβάνει υπόψη τα στοιχεία που σχετίζονται με το ιστορικό της αποθήκευσης CO_2 και καλύπτει τις αναμενόμενες δαπάνες παρακολούθησης επί 30 έτη καθώς και συμπληρωματικά τις διατάξεις του π.δ. 148/2009 (Α΄ 190). Μετά τη μεταβίβαση της ευθύνης, η χρηματοδοτική αυτή συνεισφορά χρησιμοποιείται για την κάλυψη των δαπανών που βαρύνουν την αρμόδια αρχή, προκειμένου να εξασφαλίζεται η μόνιμη και ασφαλής απομόνωση του CO2 σε τόπους αποθήκευσης σε γεωλογικούς σχηματισμούς. Το ύψος της χρηματοδοτικής συνεισφοράς καθορίζεται με απόφαση της Αρχής CCS, η οποία εκδίδεται μετά το κλείσιμο του τόπου αποθήκευσης και πριν από τη μεταβίβαση της ευθύνης, μετά από εισήγηση του φορέα αποθήκευσης, σχετικά με τη μεθοδολογία υπολογισμού, λαμβάνοντας υπόψη τις δαπάνες παρακολούθησης του συγκεκριμένου τόπου αποθήκευσης.

Άρθρο 16
Μέτρα για διαρροές ή σημαντικές ανωμαλίες

1. Σε περίπτωση διαρροών ή σημαντικών ανωμαλιών, ο φορέας εκμετάλλευσης ειδοποιεί αμέσως την Αρμόδια Αρχή CCS και λαμβάνει χωρίς καθυστέρηση τα αναγκαία διορθωτικά μέτρα, συμπεριλαμβανομένων μέτρων για την προστασία της δημόσιας υγείας. Σε περίπτωση σημαντικών ανωμαλιών που ενέχουν τον κίνδυνο διαρροής, ο φορέας εκμετάλλευσης ειδοποιεί επίσης αμέσως την Αρμόδια Αρχή CCS.

2. Τα διορθωτικά μέτρα λαμβάνονται, σύμφωνα με το σχέδιο διορθωτικών μέτρων που έχει εγκριθεί από την Αρμόδια Αρχή CCS.

3. Η Αρμόδια Αρχή CCS μπορεί να απαιτήσει από τον φορέα εκμετάλλευσης να λάβει τα αναγκαία διορθωτικά μέτρα. Τα μέτρα αυτά μπορεί να είναι πρόσθετα ή διαφορετικά από εκείνα που ορίζονται στο σχέδιο διορθωτικών μέτρων.

4. Η Αρμόδια Αρχή CCS μπορεί να λαμβάνει τα αναγκαία ή πρόσθετα διορθωτικά μέτρα, αν ο φορέας εκμετάλλευσης τα παραλείπει.

5. Για τη λήψη των διορθωτικών μέτρων της παρ. 4, η Αρμόδια Αρχή CCS χρησιμοποιεί, ιδίως, τη χρηματική εγγύηση του άρθρου 15 της παρούσης, καθώς και τις ποινικές ρήτρες της παρ. 4 του άρθρου 40 του ν. 5261/2025.

Άρθρο 17
Μεταβολές, αναθεώρηση, επικαιροποίηση και ανάκληση άδειας αποθήκευσης

1. Ο Φορέας Εκμετάλλευσης ενημερώνει χωρίς αδικαιολόγητη καθυστέρηση το αρμόδιο όργανο του Υπουργείου Περιβάλλοντος και Ενέργειας και την Αρμόδια Αρχή CCS για κάθε προγραμματισμένη μεταβολή στη λειτουργία του τόπου αποθήκευσης, καθώς και στην εταιρική του δομή, στη μετοχική του σύνθεση ή στην ανώτερη διοίκηση του, συμπεριλαμβανομένων μεταβολών που αφορούν τον ίδιο τον Φορέα Εκμετάλλευσης. Η Αρμόδια Αρχή CCS εξετάζει τυχόν αλλαγές που έχουν προγραμματιστεί στη λειτουργία του τόπου αποθήκευσης.

2. Το αρμόδιο όργανο του Υπουργείου Περιβάλλοντος και Ενέργειας επανεξετάζει και, εάν απαιτείται, κατόπιν εισήγησης της Αρμόδιας Αρχής CCS, επικαιροποιεί ή, αν συντρέχει σοβαρή παραβίαση του παρόντος ή υποτροπή, ως έσχατο μέτρο ειδικώς για τις περ. α), β) και γ), ανακαλεί την άδεια αποθήκευσης αν:

α) Έχουν διαπιστωθεί διαρροές ή σημαντικές ανωμαλίες, σύμφωνα με το άρθρο 21 του ν. 5261/2025, οι οποίες δεν έχουν αντιμετωπισθεί επαρκώς,

β) από τις υποβαλλόμενες εκθέσεις, κατ' εφαρμογή του άρθρου 19 του ν. 5261/2025 ή τις επιθεωρήσεις που διενεργούνται κατ' εφαρμογή του άρθρου 20 του ν. 5261/2025, προκύπτει η μη συμμόρφωση προς τις προϋποθέσεις της άδειας ή η ύπαρξη κινδύνου διαρροών ή σημαντικών ανωμαλιών,

γ) ο φορέας εκμετάλλευσης αδυνατεί να τηρήσει τις προϋποθέσεις ισχύος της άδειας,

δ) κρίνεται αναγκαίο, βάσει των πρόσφατων επιστημονικών πορισμάτων και της τεχνολογικής εξέλιξης.

Σε κάθε περίπτωση, με την επιφύλαξη των περ. α) έως δ), η επικαιροποίηση της άδειας είναι δυνατή πέντε (5) έτη από τη χορήγησή της και στη συνέχεια ανά δεκαετία.

3. Η παράβαση των όρων της παρούσας αποτελεί λόγο ανάκλησης της άδειας αποθήκευσης από το αρμόδιο όργανο του Υπουργείου Περιβάλλοντος και Ενέργειας.

Άρθρο 18
Οργανωτική δομή και Αυτοαξιολόγηση

1. Το αργότερο έξι (6) μήνες πριν από την έναρξη της περιόδου έγχυσης, ο Φορέας Εκμετάλλευσης υποβάλλει στην Αρμόδια Αρχή CCS το «Οργανόγραμμα Λειτουργίας Φάσης Αποθήκευσης CO_2», το οποίο αποδεικνύει ότι η οργανωτική δομή είναι κατάλληλη για τη διαχείριση των κινδύνων του τόπου και της αποθήκευσης, καθώς και το «Έντυπο Αυτοαξιολόγησης Φορέα Εκμετάλλευσης CO_2».

2. Οι υποχρεώσεις της παραγράφου 1 εφαρμόζονται επίσης σε περίπτωση συμβάντων όπως ορίζονται στο άρθρο 17 της παρούσης, οπότε διενεργείται αυτοαξιολόγηση και η Αρμόδια Αρχή CCS ενημερώνεται άμεσα σε περίπτωση ανάγκης λήψης μέτρων από τον Φορέα Εκμετάλλευσης ή την Αρμόδια Αρχή.

Άρθρο 19
Ενσωμάτωση Σχεδίων

Κατά την επικαιροποίηση των σχεδίων διαχείρισης κινδύνου, παρακολούθησης, διορθωτικών μέτρων, προσωρινού και οριστικού σχεδίου περιόδου μετά το κλείσιμο, ο Φορέας Εκμετάλλευσης τεκμηριώνει και διασφαλίζει τη συνοχή, συμβατότητα και ευθυγράμμισή τους.

Άρθρο 20
Υποβολή Εκθέσεων

Ο Φορέας Εκμετάλλευσης φέρει τις υποχρεώσεις υποβολής εκθέσεων, όπως ορίζονται στο άρθρο 8 παρ. 4 και τις εκπληρώνει άμεσα και δίχως καθυστέρηση.

Άρθρο 21
Φάκελοι Αποκλίσεων

1. Ο Φορέας Εκμετάλλευσης τηρεί «Φάκελο Αποκλίσεων Σχεδίων», όπου καταγράφονται όλες οι αποκλίσεις από το εγκεκριμένο σχέδιο έγχυσης, το σχέδιο παρακολούθησης, το σχέδιο διαχείρισης κινδύνου και τα σχέδια συντήρησης γεωτρήσεων και εγκαταστάσεων. Σε περίπτωση απόκλισης, περιγράφεται η απόκλιση και προτείνονται τα κατάλληλα μέτρα αποκατάστασης. Ο φάκελος αυτός, ο οποίος δύναται να βεβαιώνει ότι δεν υπάρχουν αποκλίσεις, υποβάλλεται τουλάχιστον μία φορά ετησίως στην Αρμόδια Αρχή CCS.

2. Ο Φορέας Εκμετάλλευσης τηρεί «Φάκελο Αποκλίσεων Φορέα», στον οποίο καταγράφονται τυχόν μεταβολές στη νομική μορφή, χρηματοοικονομική επάρκεια ή τεχνική ικανότητά του. Σε περίπτωση τέτοιων μεταβολών, ενημερώνει άμεσα την Αρμόδια Αρχή CCS προκειμένου να διασφαλισθεί η τήρηση των προβλεπόμενων όρων. Ο φάκελος αυτός υποβάλλεται τουλάχιστον μία φορά ετησίως στην Αρμόδια Αρχή CCS.

Άρθρο 22
Έγγραφα ως μέρη της άδειας αποθήκευσης

Όλα τα έγγραφα που υποβλήθηκαν με την αίτηση αποτελούν αναπόσπαστο μέρος της παρούσας άδειας αποθήκευσης. Όλα τα έγγραφα πρέπει να φέρουν ημεροχρονολογία με σαφή αναφορά σε τυχόν επικαιροποιημένη έκδοση, ημερομηνία έκδοσης. Σε περίπτωση ύπαρξης περισσοτέρων εκδόσεων του ιδίου εγγράφου, λαμβάνεται υπόψη η πιο πρόσφατη χρονολογικά έκδοση.

Άρθρο 23
Αναστολή - Ανάκληση

1. Το αρμόδιο όργανο του Υπουργείου Περιβάλλοντος και Ενέργειας, κατόπιν εισήγησης της Αρμόδιας Αρχής CCS έχει δικαίωμα να αναστείλει την ισχύ της παρούσας για διάστημα έως έξι (6) μηνών εφόσον ο Φορέας Εκμετάλλευσης δεν υποβάλει επαρκή τεκμηρίωση σύμφωνα με τα άρθρα 8 παρ. 2, 10 παρ. 2, 11 παρ. 2, 12 παρ. 2παρέχοντάς του εύλογο χρόνο για επικαιροποίηση.

2. Σε περίπτωση που ο Φορέας Εκμετάλλευσης δεν λάβει την απαιτούμενη έγκριση ή παραβιάσει όρους της παρούσας, το αρμόδιο όργανο του Υπουργείου Περιβάλλοντος και Ενέργειας δύναται να ανακαλέσει την άδεια σύμφωνα με τα ειδικότερα προβλεπόμενα στο άρθρο 16 του ν. 5261/2025.

Άρθρο 24
Έναρξη Ισχύος

Η απόφαση αυτή ισχύει από την ημερομηνία δημοσίευσής της στην Εφημερίδα της Κυβερνήσεως.

ANNEX I

Prinos CO2 Storage Site Suitability Report

HEREMA

Prinos CO2 Storage Site Suitability Report

Confidential Report
Prepared for:

Hellenic Hydrocarbons & Energy Resources Management Company (HEREMA)

Dim. Margari 18,
115 25,
Athens,
Greece

Project no.: HEE001	**Document No:** AX-25-HEE-001-RPT-SS-608R3b	**Date:** 11 February 2026
Prepared by: Phil Sutcliffe; Karl Charvin; Hector Martingano; Iain Matthews CCUS Team	**Reviewed by:** Peter Griffiths Lynsey Harris	**Approved by:** Peter Griffiths Lynsey Harris

Confidential Report

Prepared for:

Hellenic Hydrocarbons & Energy Resources Management Company (HEREMA)
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Athens,
Greece

Document Control

Document No.	Date	Document Information
AX-25-HEE-001-RPT-SS-608	30 / 09 / 2025	Rev1 – For Client Comment
AX-25-HEE-001-RPT-SS-608R2	08 /02 /2026	Rev2 – For Client Comment
AX-25-HEE-001-RPT-SS-608R3b	11/02/2026	Rev3 – With costs removed

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1. Executive Summary

As part of the EY team, Axis was requested to provide an assessment of the suitability of the depleted Prinos oil field as a potential CO_2 subsurface store offshore Greece. If suitable in all aspects the Greek CCS Competent Authority (HEREMA) can then consider providing their first CO_2 storage permit to the incumbent operator, EnEarth. If some aspects are unsuitable or require more evaluation this assessment will highlight them for inclusion in the applicant’s forward work programme.

To provide the above assessment Axis reviewed over 100 documents submitted by the applicant EnEarth (46 from the original application in Jun24, and 27 updates from Feb25, 7 from Jul25, 15 from Sept25, 10 from Oct 2025, and 2 in Jan-2026 as shown in Appendix 1). This review consisted of a structured approach to the suitability of the Prinos oil field for CO_2 storage by evaluating the following key storage suitability factors:

- CO_2 Storage Capacity
- CO_2 Containment
- CO_2 Injectivity & Productivity
- CO_2 Storage Location & Cost

The conclusion from the assessment is summarised in Table 1-1. Based on the updated Containment Risk Assessment (CRA) and supporting studies, storage containment risk is dominated by legacy wells, which represent the principal residual risk to the store. While a subset of legacy wells does not fully meet current CCS barrier expectations, the reviewed evidence indicates that a risk-management approach based on targeted Monitoring, Measurement and Verification (MMV) and credible corrective measures can manage this risk to acceptable levels, rather than requiring mandatory pre-injection repair of all higher-risk legacy wells. On this basis, “Storage Containment” and “Overall Storage Suitability” are acceptable, provided that the MMV and corrective measures framework are implemented and maintained over the project lifecycle.

Storage Suitability Criteria	Assessment	Summary Comments
Storage Capacity Assessment	🟩	The Prinos store has been assessed positively for the majority of storage capacity factors, however, “Define Phase” studies are recommended to further de-risk the trap to the NE for an over-pressure scenario, the lateral connectivity between the proposed injectors and producers, the impact of potential asphaltene deposition and improve overall data quality & detail.
Storage Containment Assessment	🟨 Until remediated 🟩 Once remediated	The Prinos storage site remains suitable for CO_2 storage based on geological containment, pressure management and secondary sealing capacity. Axis’ review indicates that overall containment risk is dominated by legacy wells, however, aggregated leak-rate modelling shows low expected site-wide leakage for the majority of outcomes, with higher end P90 cases representing conservative scenarios. Provided that the MMV plan and corrective measures are implemented as proposed, legacy well-related risks can be managed to acceptable levels and do not preclude site suitability. Successful remediation of PA-3 would move this to a low risk.
Storage Injectivity Assessment	🟨	The Prinos store has been assessed positively for the majority of storage injectivity factors, however, more “Define Phase” studies are required to de-risk aquifer permeability, the lateral connectivity between the proposed injectors and producers, permeability degradation due to potential halite and asphaltene deposition and improve overall data quality & detail.
Storage Productivity Assessment	🟨	The Prinos store has been assessed positively for the majority of storage productivity factors, however, more “Define Phase” studies are required to de-risk aquifer permeability, store thickness, sanding risk, lateral connectivity between injectors & producers, aquifer water composition & improve overall data quality & detail
Storage Location Assessment	🟩	The Prinos store has been assessed positively for the storage location factors including adjacency to existing facilities & emitters & potential for low transportation costs
Overall Storage Suitability Assessment	🟨	The Prinos store has been assessed positively for the majority of storage suitability criteria. Based on the updated Containment Risk Assessment and supporting studies, storage containment risk is dominated by legacy wells,

	🟨	which represent the principal residual risk to the store. While a subset of legacy wells does not fully meet current CCS barrier expectations, the reviewed evidence indicates that this risk can be managed to acceptable levels through implementation of targeted Monitoring, Measurement and Verification (MMV) and a credible corrective measures framework, rather than requiring mandatory pre-injection repair of all higher-risk legacy wells. On this basis, “Storage Containment” and “Overall Storage Suitability” are assessed as acceptable, subject to the effective implementation and maintenance of the MMV and corrective measures approach over the project lifecycle. For the remaining “Storage Suitability” criteria, a range of “Define Phase” studies are required to de-risk the store prior to proceeding to FID.
LEGEND		
	🟩	Low risk or probability to the project
	🟨	Medium risk or probability to the project
	🟥	High risk or probability to the project

Table 1-1 CO_2 Storage Suitability Assessment Summary

For the remaining storage suitability criteria, the applied risk mitigations are generally satisfactory, however, there remains a recommendation for improved engineering scope and definition, supported by improved data quality and technical detail where practicable, prior to Final Investment Decision (FID).

To enable the Prinos depleted oil reservoir progress as a suitable CO_2 storage site, a number of “Define Phase” studies and actions are recommended as provided in the Recommendations section of this report all of which should be included in the Operator’s detailed forward work programme. Satisfactory completion of those recommendations would further lower the risk to low for the over all project.

2. Conclusions and Recommendations

2.1 Conclusions

This storage suitability assessment concludes the following:

- The Prinos store has been assessed positively for the majority of store suitability criteria. Based on Axis' independent review of the updated Containment Risk Assessment and supporting studies, storage containment risk is dominated by legacy wells, which represent the principal residual risk to the store.
- The reviewed evidence indicates that, while a subset of legacy wells does not fully meet current CCS barrier expectations, the associated containment risk can be managed to acceptable levels through implementation of targeted Monitoring, Measurement and Verification (MMV) and a credible corrective measures framework, rather than requiring mandatory pre-injection repair of all higher-risk legacy wells.
- Accordingly, provided that the MMV plan and corrective measures are implemented as proposed and remain effective throughout the project lifecycle, legacy well-related risks do not preclude the suitability of the Prinos store for CO_2 storage.
- For the remaining "Storage Suitability" criteria, a range of "Define Phase" studies are required to de-risk the store prior to proceeding to FID as follows:
    - Further definition of NE trapping mechanism towards N Prinos
    - Connectivity between proposed CO_2 injectors & brine producers
    - Impact of asphaltene deposition on reservoir permeability and storage capacity
    - Aquifer permeability definition
    - Impact of halite and asphaltene deposition on reservoir permeability and injectivity
    - Reduced store thickness near brine producers
    - Sanding risk at brine producers
    - Aquifer water composition definition and potential for heavy metals/other issues
    - Storage costs should be better defined using a "Define Phase" methodology
- Other risks which may require further study/actions can be found in Sections 5->8 below.

2.2 Recommendations

To enable the depleted Prinos oil field to be an acceptable CO_2 store this storage suitability assessment recommends a range of studies/actions be performed prior to final investment decision as follows:

- Continued assessment of leak-rate behaviour for wells identified as non-compliant with CCS barrier expectations
- Study clarifying NE trapping mechanism towards N Prinos
- Connectivity study between proposed CO_2 injectors & brine producers
- Asphaltene study assessing impact on reservoir permeability and storage capacity
- Aquifer permeability definition study
- Halite deposition study assessing impact on reservoir permeability and injectivity
- Store thickness study near brine producers
- Sanding risk study for brine producers
- Aquifer water composition study highlighting any heavy metals/other issues
- Storage costs study (lifecycle capex, opex & abex) using a "Define Phase" methodology
- Include all of the above studies and actions in the Operator's detailed work programme

It is also recommended that additional studies/actions be considered after a detailed review of the findings in Sections 5->8 below.

3. Introduction

Axis was requested to provide an assessment of the suitability of the depleted Prinos oil field as a potential CO_2 subsurface store offshore Greece. If suitable in all aspects the Greek CCS Competent Authority (HEREMA) can then consider providing their first CO_2 storage permit to the incumbent operator, EnEarth. If some aspects are unsuitable or require more evaluation this assessment will highlight them for inclusion in the applicant’s forward work programme.

To provide the above assessment Axis reviewed over 100 documents submitted by the applicant EnEarth (46 from the original application in Jun24, and 27 updates from Feb25, 7 from Jul25, 15 from Sept25, 10 from Oct 2025, and 2 in Jan-2026 as shown in Appendix 1). This review consisted of a structured approach to the suitability of the Prinos oil field for CO_2 storage by evaluating the following key storage suitability factors:

- CO_2 Storage Capacity
- CO_2 Containment
- CO_2 Injectivity & Productivity
- CO_2 Storage Location & Cost

The results of the above assessment are provided within the remaining sections of this report.

Note: for clarity the storage site and complex to be proposed by the competent authority (HEREMA), both vertically and areally, is summarized in Section 4.

4. Storage Site and Complex

4.1 Storage Site

1. The storage site is the depleted Prinos oil field with an associated underlying aquifer. The storage site is comprised of a volume area within the storage unit along with the associated surface facilities as described in the ESIA, whereas the storage site does not include pipelines insofar as they are part of the transport network.

2. The storage unit is the Miocene Pre-Evaporitic Sequence of turbiditic sandstones A1, A2, B and C.

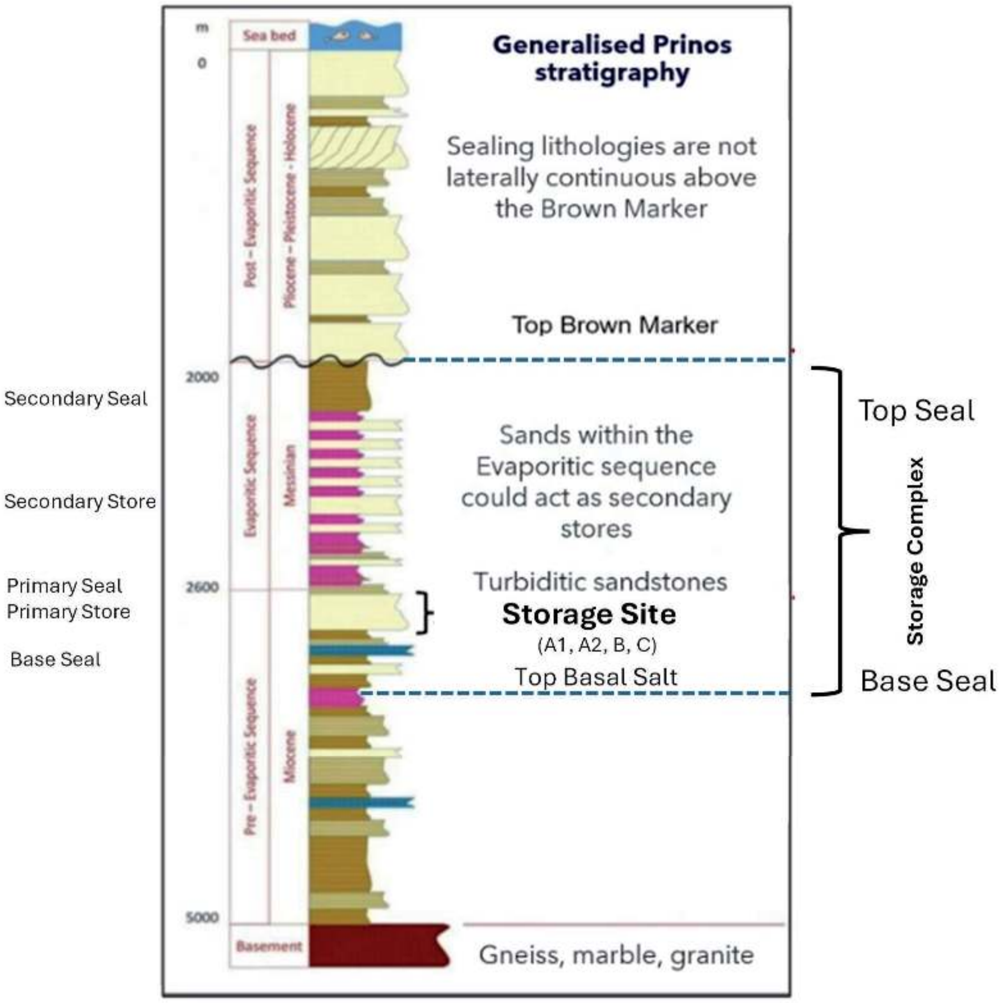


Figure 4-1: Vertical Definition of Storage Site & Complex

3. The storage site area includes the Prinos oil field and is delimited laterally upstructure by the reference case mapped structural faults and pinch-out and downstructure by the reference case

lowest closing contour (-2900m True Vertical Depth Subsea ('TVDSS')) and mapped faults. The storage Site Area is depicted in Figure 4-2 below by the white contour.

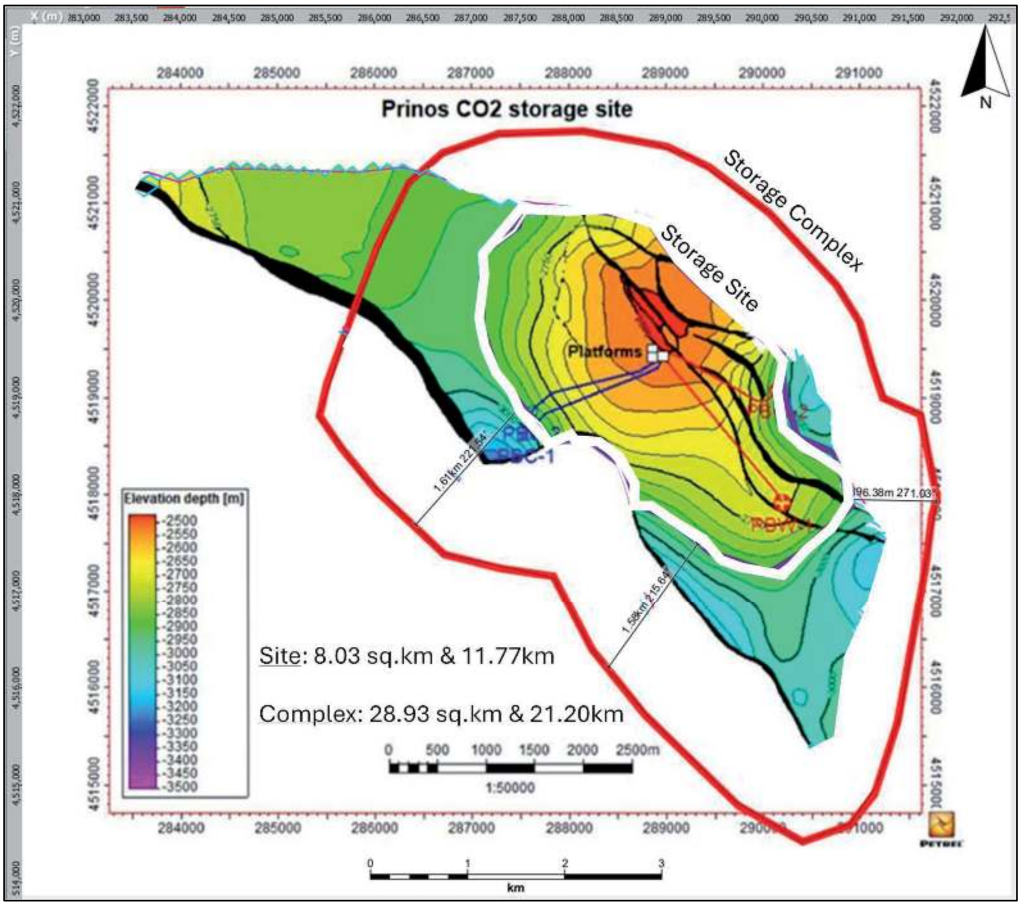


Figure 4-2: Areal Definition of Storage Site & Complex (Zoom-In)

4. The Site Area covers an area of about 8.03 km2, with a perimeter of 11.77 km.

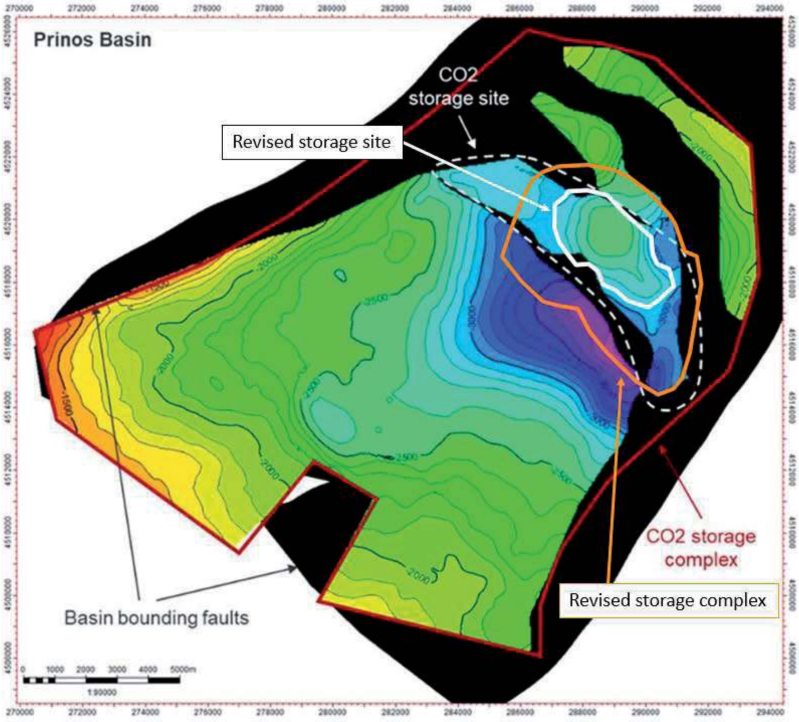
4.2 Storage Complex

1. The storage complex consists of the Storage Site and surrounding geological domain. The surrounding geological domain consists of the top of the geological complex (see Figure 4-1), which is the top of the Messinian Evaporitic Sequence as defined by the “Brown Marker”. Prinos Primary

Seal is defined by the claystone caprock at the base of the Messinian Evaporitic Sequence overlain by the Lower Main Salt (LMS) sequence. The Prinos Secondary Seal is defined by the remainder of the Messinian Evaporitic Sequence up to and including the “Brown Marker”, which includes the Upper Main Salt (UMS) overlain by six evaporite sequences interbedded with sandstones and claystones.

2. The base of the geologic complex is as defined by the base of the lowermost D zone claystone or Top Basal Salt Sequence (see Figure 4-1).

3. Areally, the storage complex includes the storage site with an extension to account for mapped subsurface uncertainty and to allow for identification of CO_2 migration from the storage site providing an early warning of potential leakage from the storage complex. The storage Complex Area is depicted by the red contour in Figure 4-2 above entitled “Storage Complex” and the orange contour in Figure 4-3 below entitled “Revised Storage Complex”.



Revised CO2 site = 8.03 sq.km.
Revised complex = 28.93 sq.km.

Site perimeter = 11.77 km
Complex perimeter = 21.20 km

Figure 4-3: Areal Definition of Storage Site & Complex (Zoom-Out)

The Complex Area covers an area of about 28.93 km2, with a perimeter of approximately 21.20 km.

5. Storage Capacity

The key factors in this store which provide a positive assessment of CO_2 storage capacity are listed below:

- Store Depth > 800m:
- Storage Temperature:
- Maximum Storage Pressure:
- CO_2 Density @ T & Max P:
- Proven Trap:
- Proven Bulk Volume:
- Estimated Storage Capacity (Phase 1):
- Storage Efficiency:
- Good Horizontal Permeability:
- Good Lateral Connectivity:
- Low Vertical Permeability:
- High Residual CO_2 Saturation:
- Pressure < Fracture Pressure:
- Negligible Reaction Between CO_2 + Formation Rock + Oil + Water:
- Good Data Quality:
- Overall Storage Capacity Assessment:

A brief review of the above is provided by sub-section below:

5.1 Store Depth > 800m:

The Prinos Field occurs at the top of the pre-evaporite sequence. The Prinos Field lies at a depth ranging from 2490m to 2710m tvdss which is significantly deeper than the desired depth of >800m which is typically required to ensure that CO_2 is stored as a liquid (maximising storage capacity). The Prinos Field is separated from the Epsilon Field by a saddle at around 2870m tvdss. Overall, the structure depth is well defined by 3D seismic dataset and is tied by many wells (E&A and Productions).

5.2 Storage Temperature:

The temperature for the three Prinos reservoirs lie in the range 132 – 141 °C. Quoted values for injection temperature are in the range 54 - 65°C. These values are well above the CO_2 critical temperature (30.9°C) and therefore it is anticipated that CO_2 will be in supercritical phase for the duration of the injection phase and the subsequent shut-in phase. Cross-sections showing the evolution of temperature at one of the injector locations through time are shown in Figure 5-1 (blue=65 degC, green=110degC, red=150degC).

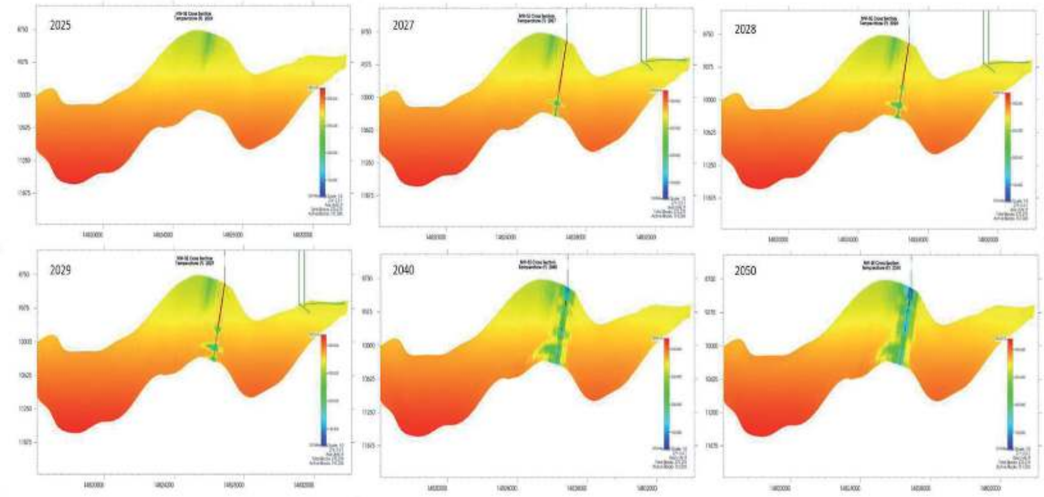


Figure 5-1: Cross-sections showing temperature evolution with time

5.3 Maximum Storage Pressure:

At the end of the proposed 20-year injection period, the average reservoir pressure is estimated to be in the range 5450 – 5725 psia for the three reservoirs. The pressure in the area of the legacy wells is estimated to be less than 6000 psia which is less than the maximum pressure constraint derived from the well integrity studies (6,200psia). However, the sensitivity of maximum pressure at legacy wells has not been fully tested in uncertainty analysis. The reservoir pressure is well in excess of the critical pressure (1070 psia), so CO_2 is expected to remain in supercritical phase for the duration of the injection and shut-in phase (hence maximising storage capacity). Cross-sections showing pressure evolution with time at one of the injector locations are shown in Figure 5.2 (blue=4500psia, green=5250psia, red=6000psia).

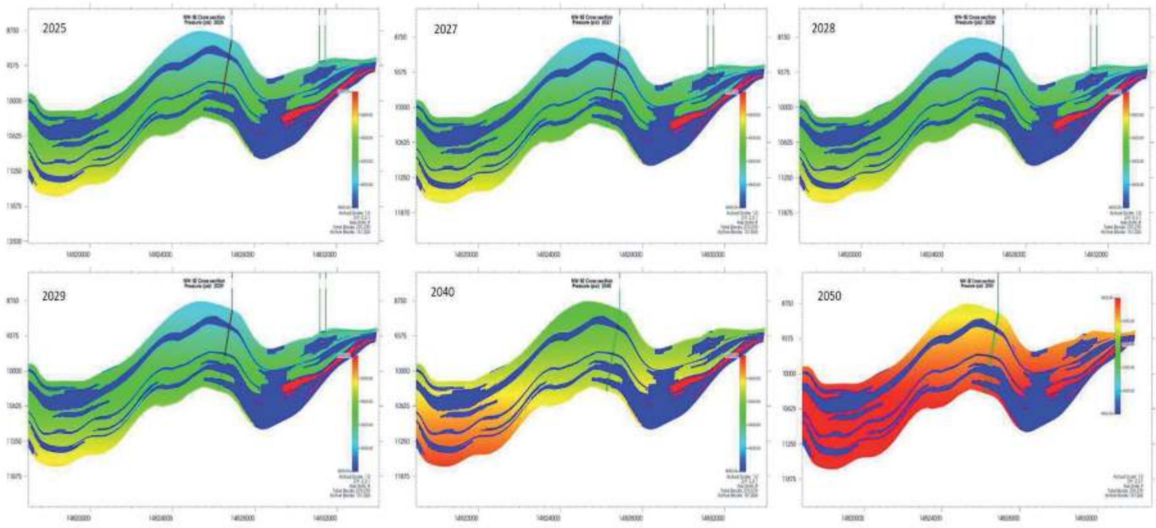


Figure 5-2: Cross-sections showing pressure evolution with time

5.4 High CO_2 Density @ T & Max P:

By the end of the 20 year injection period the CO_2 density is estimated to be in the range 629 – 638 kg/m3, which is a typical CO_2 density for projects where CO_2 is injected in the supercritical phase, representing efficient storage of the injected volumes.

5.5 Proven Trap:

The Prinos Field is a proven hydrocarbon (oil) accumulation, that was over-pressured. The Prinos Field is a low relief fault bounded anticline forming a two-way dip closure with fault closure to the Southeast and to the Northwest at Epsilon which is separated from Prinos by a saddle/spill-point @ ~-2900m tvdss. While the fault closure to the South-west is well defined with a major offset, the fault closure toward the Northeast is unclear.

The interpretation is potentially ambiguous, the static model is cropped at the upstructure turquoise fault illustrated in Figure 5-3 suggesting a reservoir to Evaporite juxtaposition. However different interpretations have been seen in the various reports: reservoir to reservoir juxtaposition in Figure 5-3, reservoir stratigraphic pinch out, reservoir roll over with potential contact with the underlying basement. All of these would, however, be appropriate trap seals. This variation affects the lateral seal, closure definition and ability to handle potential over-pressure when trying to maximise storage capacity, though it is noted the original hydrocarbon reservoir was over-pressured. If pressures are therefore maintained at or below historically seen values, it is reasonable to assume a trap is in place.

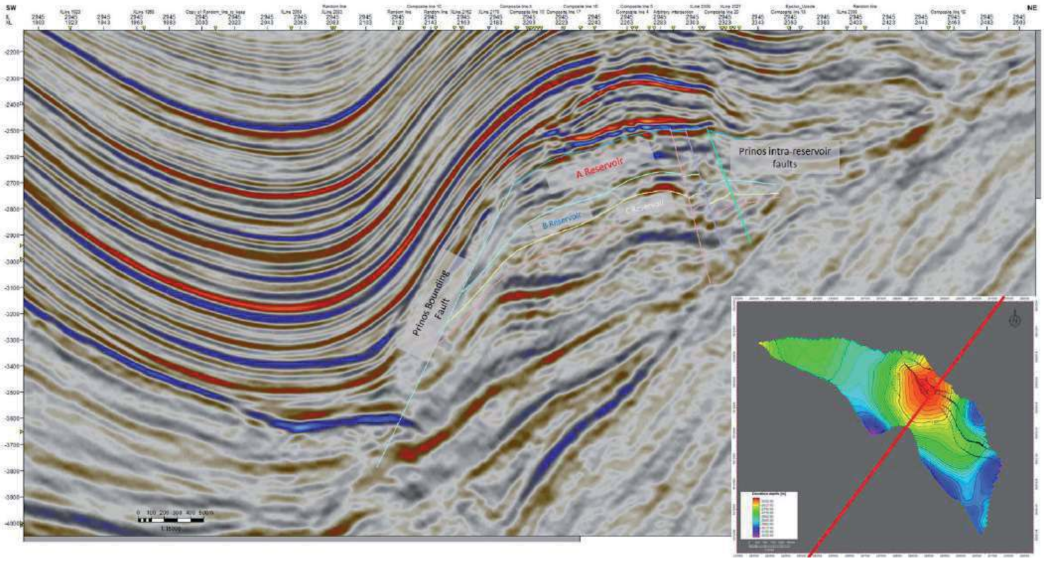


Figure 5-3: Prinos Field trap definition (the definition is unclear to the Northeast of the field (right side of the seismic cross-section).

5.6 Proven Bulk Volume:

Although the storage capacity centres around Prinos a combined Prinos-Epsilon structural model including underlying aquifer, different OWC, 3D seismic interpretation, thicknesses information, constrained by well data (number of which encountered the aquifer at both Prinos and Epsilon location) have been built and used to estimate bulk volume and maximum theoretical CO_2 capacity of the stores assuming the whole pore volume would be hypothetical filled with $C0_2$. Results are presented below in Table 5-1. The work appears to be robust, however, no physical models were provided for further quality control.

Prinos & Epsilon (inc. aquifer)	Volume Estimates	Prinos Structure	Epsilon Structure

Bulk volume	4875 *10^6 m3	550*10^6 m3 (oil) 3280*10^6 m3 (aquifer)	584*10^6 m3 (oil) 461*10^6 m3 (aquifer)
Net volume	3896 *10^6 m3	482*10^6 m3 (oil) 2600*10^6 m3 (aquifer)	437*10^6 m3 (oil) 377*10^6 m3 (aquifer)
Pore volume	551 *10^6 m3	78*10^6 m3 (oil) 366*10^6 m3 (aquifer)	58*10^6 m3 (oil) 49*10^6 m3 (aquifer)
Ultimate CO_2 storage capacity volume (reservoir cond.)	551 *10^6 rm3	78*10^6 m3 (oil) 366*10^6 m3 (aquifer)	58*10^6 m3 (oil) 49*10^6 m3 (aquifer)
Ultimate CO_2 storage capacity volume equivalent tons	**375 Mtn CO_2**	**53 Mtn CO_2 (oil)** **249 Mtn CO_2 (aquifer)**	**40 Mtn CO_2 (oil)** **33 Mtn CO_2 (aquifer)**

Table 5-1: Bulk volume (Gross rock volume), net volume, pore volume and ultimate (max theoretical) CO_2 storage capacity of the Prinos and Epsilon structures, including the aquifer. The conversion of CO_2 storage capacity volume in equivalent tons has been calculated using a density of 680kg/m3 for the CO_2 (in situ).

5.7 High Estimated Storage Capacity (Phase 1):

The planned storage volume for phase 1 is around 18 Mt, assuming a 20-year injection period. This compares with an estimated ultimate Prinos CO_2 storage capacity of 313 Mt (not accounting for pressure limits) and a capacity of 100 Mt using the Permedia CO_2 software, which utilises invasion percolation modelling. If phase 1 is successful further phases are likely. Dynamic simulations carried out by the Operator looking at notional development schemes indicate storage volumes as high as 63 Mt.

5.8 High Storage Efficiency:

Based on a 20-year injection period, the storage efficiencies are calculated to be around 5%, 5% and 14% respectively for reservoirs A, B & C respectively. The overall storage efficiency is calculated as 7%. Bearing in mind this is modelled as a closed system with a limited aquifer extent, these storage efficiencies are higher than they may otherwise be. Future phases with higher planned injection volumes (see 5.7) will result in higher storage efficiencies.

5.9 Good Horizontal Permeability:

Prinos reservoir exhibits relatively good horizontal permeability (Table 5-2). The reservoir model is constrained by well logs defined from core measurements.

Reservoir Levels	Well-Log NET-PERM Average (mD)	Upscaled NET-PERM Average (mD)	Property NET-PERM Average (mD)
Layer 1-2	313.9	312.0	311.1
Layer 3	190.4	156.7	163.2
Layer 4-5-6	185.8	158.8	189.8
Layer 7	120.5	122.2	123.0
B	90.5	74.4	89.2
C	697.4	515.8	598.4

Table 5-2: Modelled Permeability in Prinos Field

Note 1: No report demonstrates whether the aquifer presents same or different permeabilities. More study work may be required to assess this aspect since much of the development depends on the aquifer and its associated flow properties.

Note 2: The proposed locations for the two CO_2 injector wells and brine producers are in areas of the reservoir that are thought to be previously undeveloped and therefore there will be less certainty on likely permeability estimates at these locations.

Note 3: The grid vertical resolution is variable (proportional layering). In certain areas and stratigraphic zones, the resolution is too coarse to capture the permeability heterogeneities. The use of a permeability scale ranging from 0.01 to 1,000 mD is not appropriate to quality control the log upscaling to the grid resolution (Figure 5-4). Consequences are multiple: from over predicting the vertical flow within each reservoir unit to creating a more uniform CO_2 Plume front.

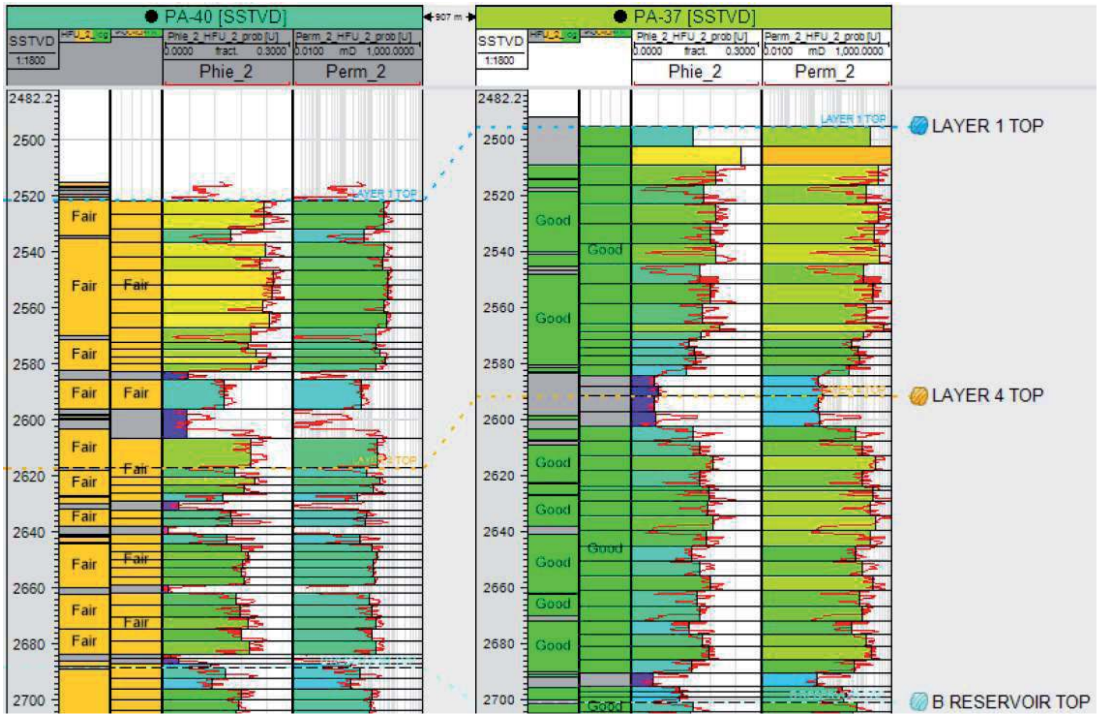


Figure 5-4: Example of well Porosity and Permeability logs upscaling into the static grid.

Note 4: The core analysis shows the presence of fractures, deformation bands in the reservoir interval. While their occurrence is generally low within the reservoir, their presence increased toward the faults (in Prinos). The fractures are considered as lower permeability features / zones due to pore space collapse. It is unclear how this has been added in the model and if their impact is significant.

Note 5: Faults within the reservoir show reservoir to reservoir juxtaposition and tend to exhibit, if any, lower permeability than the surrounding reservoir. This has been addressed in the reservoir model via fault transmissibility factors. The number of faults in the reservoir model is lower than the number of faults illustrated in some seismic cross-sections (see paragraph Good Lateral Connectivity:5.10).

5.10 Good Lateral Connectivity:

There is at least one mapped fault between the proposed CO_2 injection locations and the water producer locations (there are two mapped faults for one of the water producer locations – see Figure 5-5). If these faults are sealing or partially sealing then this could negate the effect of the water producers and result in excessive pressure rise in the region around the injection wells, which would limit the volume of CO_2 that can be stored. This is considered to be a potentially significant risk, as fault compartmentalization is observed in the north-eastern crestal area, as documented in the MMV report. There is also some concern that not all faults have been incorporated in the PEC full store model compared to the finer scale model used to model Prinos oil production.

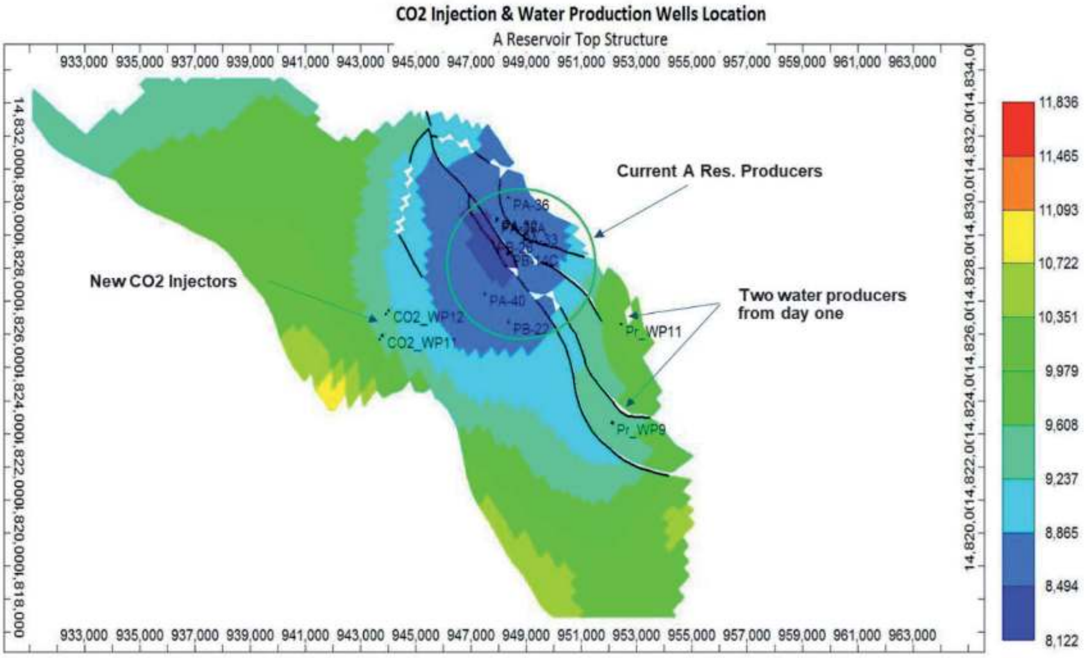


Figure 5-5: Proposed CO_2 injectors and water producers locations

There is also concern about potential lateral connectivity between the CO_2 injection wells and the Epsilon field. Future plans concerning Epsilon production are unclear. The sand in Epsilon is generally lower quality than Prinos, which could suggest high(ish) drawdowns to achieve commercial rates. If there are simultaneous operations (injection in Prinos, production in Epsilon), then Epsilon oil production could act as a pressure sink for the CO_2, risking back-production of the CO_2 via the Epsilon production well(s), which may not be designed for CO_2 operations. In the figure below (Figure 5-6) taken from the Risk Assessment Report, there is an inference from the well marker symbols that production in Epsilon ceases sometime in the period 2035 – 2040; CO_2 injection is due to commence in A sand in 2035 so it is possible there could be a period of overlapping simultaneous production and injection in A sand for one or more years. The same report argues that CO_2 will preferentially move towards the water production wells which are on the other side of the field; however this is not necessarily the case. As can be seen in Figure 5-7, taken from the MMV report, the Epsilon wells appear to be situated closer to the injection wells, compared to the water production wells. As discussed above, there is uncertainty as to what extent these water production wells will be in pressure communication with the injection wells due to the presence of nearby faults. This must considered to be a potentially significant risk, as fault compartmentalization is observed in other parts of the field (i.e. in the north-eastern section of the crest). The same report states that there may be hydraulic communication in the A sand between Prinos and Epsilon, through the aquifer. In order to de-risk this potential outcome, more detailed clarification is required from the Operator, in particular production profiles for Epsilon (oil, water and gas), bottom hole pressure profiles and pressure maps across the Prinos / Epsilon structure as a function of time from 2035 – 2040 (on an annual basis). In correspondence, the Operator has stated that in 100% of simulations, CO_2 does not migrate across the saddle to the Epsilon structure, but it is unclear if future Epsilon production was included in these simulations.

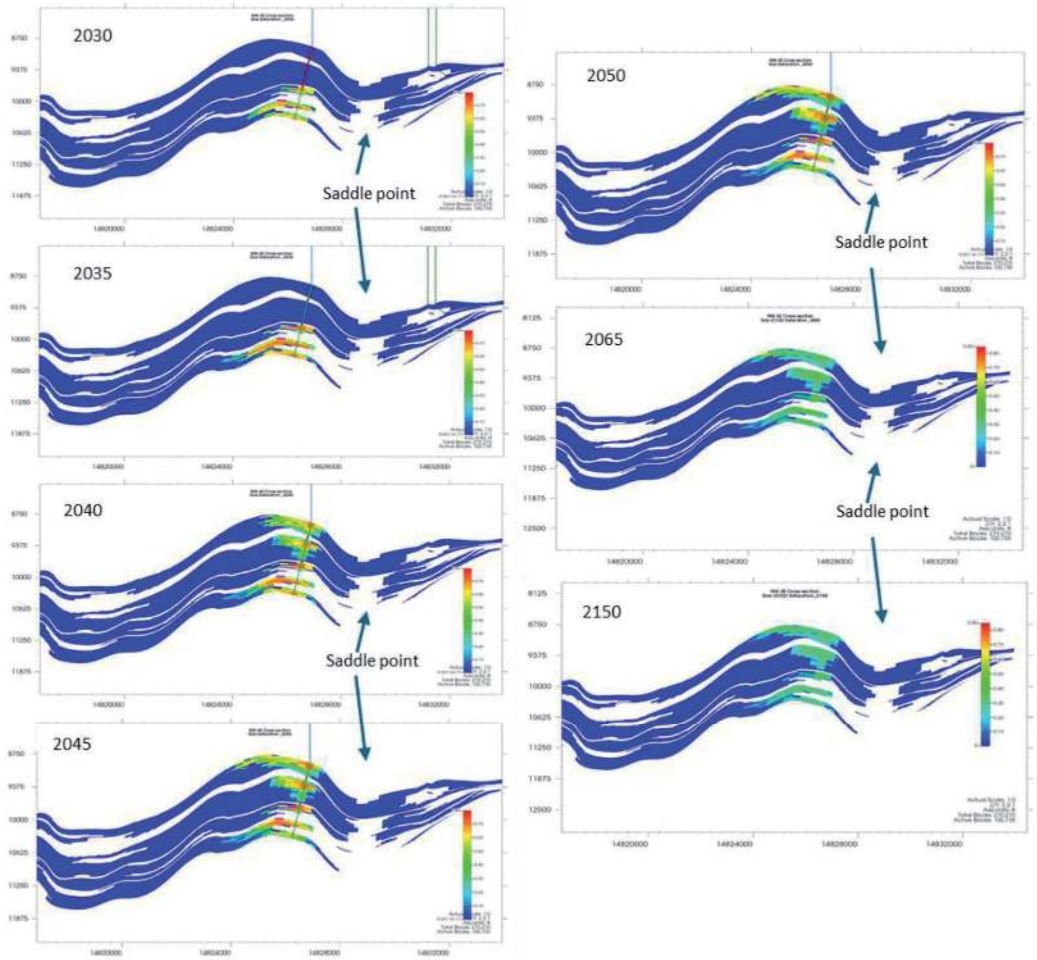


Figure 5-6: Cross-sectional plots through Prinos and Epsilon showing CO2 Movement

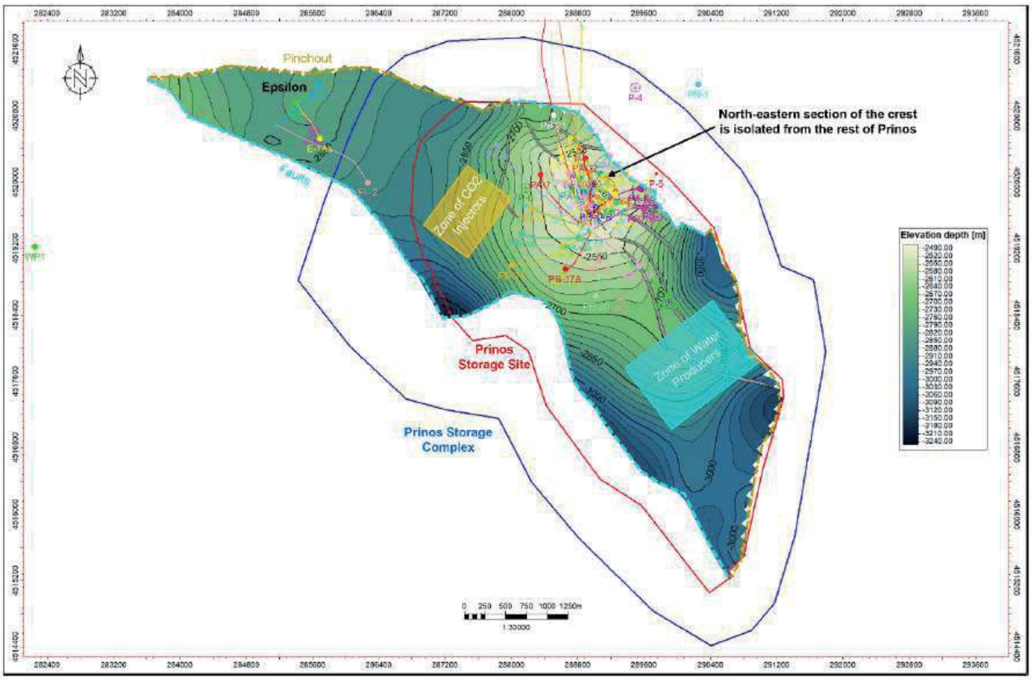


Figure 5-7: Map showing relative location of CO2 injectors, water producers and Epsilon wells

The correlation of sand intervals between Epsilon and Prinos is challenging as it has been modelled abruptly (Figure 5-8).

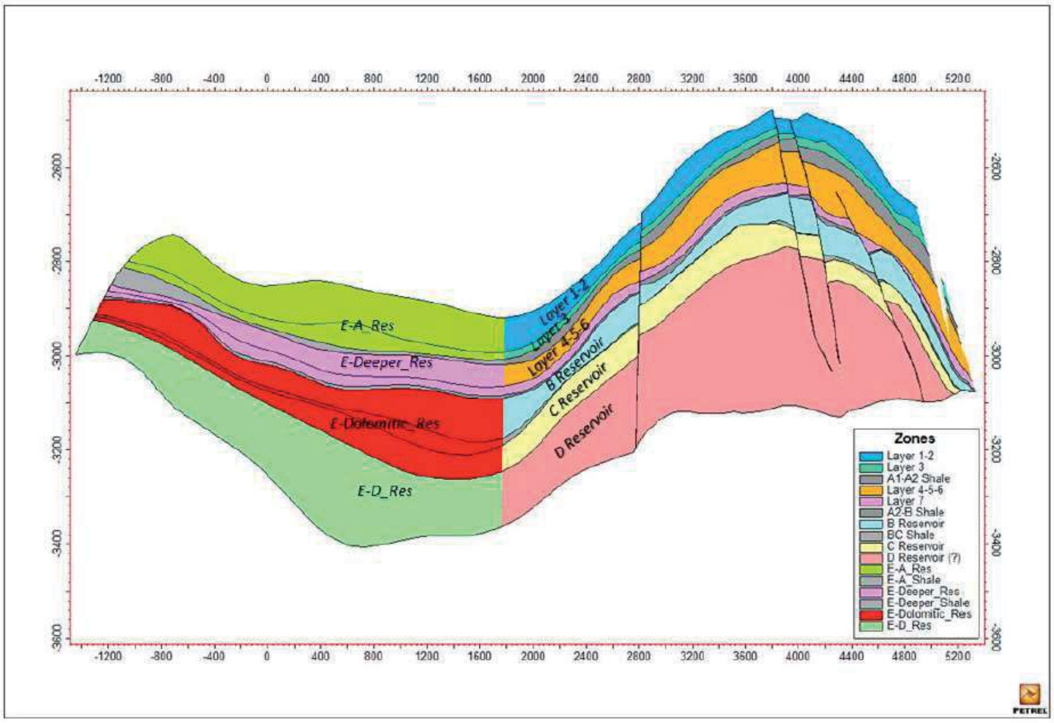


Figure 5-8: Zones / reservoir interval correlation between Epsilon (left) and Prinos (right) in the static model

5.11 Low Vertical Permeability:

No Kv/Kh properties have been shared in the static modelling report. However, the Prinos Field contained three clear sands (named A, B and C) both separated by regionally extensive shales (named AB and BC). The AB shale is 6.5m thick on average, and the BC shale is 10.5m thick. At Prinos, each reservoir has a different OWC (Table 5-3) proving the sealing capacity of the shales. Each shale layer has been implicitly built in the model. Other shales, (more local) are presents (A1-A2 for example) and have been integrated into the model too. The laterally extensive shales restrict considerably the overall vertical permeability of the Field.

Prinos		Epsilon	
Zone	OWC (Depth in TVDss)	Zone	OWC (Depth in TVDss)
A Reservoir	-2711m	A Reservoir	-2916.5m
		Deeper Reservoir	-3087m
B Reservoir	-2751m	Dolomitic Reservoir	-3120m
C Reservoir	-2791m		

Table 5-3: OWC contacts in Prinos and Epsilon Fields

5.12 High Residual CO_2 Saturation:

The amount of CO_2 trapped by residual trapping is estimated to be around 22% of the total injected by the year 2550, which in comparison with some other planned CO_2 storage projects is not particularly high. This is probably because this is a closed structure as opposed to an open aquifer system, where CO_2 may have opportunity to migrate over significant distances, resulting in residual trapping due to brine imbibition at the tail of the plume. A plot of the breakdown of different trapping mechanisms is shown in Figure 5-9.

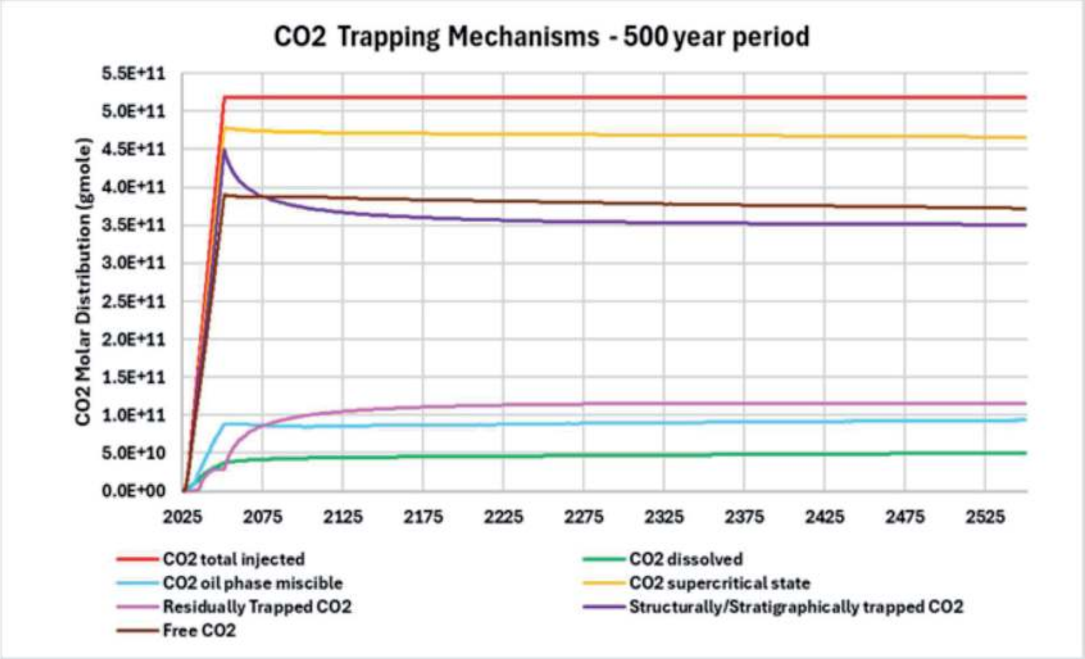


Figure 5-9: Breakdown of CO_2 trapping mechanisms

5.13 Pressure < Fracture Pressure:

The maximum FBHP constraint is set at 7000 psia, which should not exceed the maximum static reservoir pressure. An additional safety buffer of around +500 psi has been applied in arriving at this constraint. However, as the maximum injection rate per well has been set at 0.5 Mtpa, the maximum injection pressure constraint is not reached. Plots of individual well BHP versus time have not been provided for review. Due to historic oil production, the reservoirs are depleted, compared to initial pressure by around 1500 – 2000 psi. By the end of the 20-year injection period, the average reservoir pressure is approaching initial reservoir pressure.

5.14 Negligible Reaction Between CO_2 + Formation Rock + Oil + Water:

Geochemical modelling shows only minor mineralogical reactions resulting in a small predicted change in porosity over 30 – 1000 year timeframes, which presents no threat to store integrity.

In the short-term however there is an adverse reaction between the remaining reservoir oil and the CO_2 as it migrates upstructure since the CO_2 causes the asphaltene to precipitate and reduce formation permeability. Further work is required to de-risk this aspect.

5.15 Good Data Quality:

Some reports are light on detail, making it difficult to perform an in-depth technical assessment in some areas. Some report figures contain plots with either missing legends and/or illegible scale bars.

5.16 Overall Storage Capacity Assessment:

A summary of the above assessment is provided below:-

Capacity Criteria	Assessment	Summary Comment
Store Depth > 800m	🟩	Store depth ranging from 2490m to 2710m tvdss, ensuring CO_2 stored in liquid phase in subsurface, maximising storage capacity
Storage Temperature:	🟩	The temperature for the three Prinos reservoirs lie in the range 132 – 141 °C, maximising storage capacity
Maximum Storage Pressure	🟩	At the end of the proposed 20 year injection period, the average reservoir pressure is estimated to be in the range 5450 – 5725 psia for the three reservoirs < max allowable of ~6200psia
CO2 Density @ T & Max P	🟩	By the end of the 20 year injection period the CO_2 density is estimated to be in the range 629 – 638 kg/m3 maximising storage capacity
Proven Trap:	🟩	Whilst there are several interpretations encountered across various reports, and there is perhaps some lack of clarity in the NE of trap definition, it remains a fact that the trap held over-pressured hydrocarbons. Whilst storage pressure remains below max HC reservoir pressure there is little evidence to suggest potential for trap failure
Proven Bulk Volume	🟩	The proven bulk volume is well constrained by 3D seismic data and numerous well penetrations all taken into account while building the structural model
Estimated Storage Capacity (Phase 1):	🟩	The planned storage volume for phase 1 is around 18 Mt over 20 years
Storage Efficiency	🟩	Overall storage efficiency is calculated as 7% which is reasonable for this type of store.
Good Horizontal Permeability	🟩	Good horizontal permeability constrained by core measurement ranging from an average of 75mD in the poorest reservoir interval to circa 600mD in the best reservoir interval (200-300mD in the upper units)
Good Lateral Connectivity	🟨	Some concern over mapped faults between injectors and water producers, which could cause issues with pressure management, if sealing or partially sealing. Some concern around potential connection with Epsilon, which in worse case scenario could lead to breakthrough of CO_2 at Epsilon producers.
Low Vertical Permeability	🟩	Vertical permeability impacted by laterally extensive sealing shale units over the entire Prinos- Epsilon area
High Residual CO2 Saturation	🟩	CO_2 trapped by residual trapping is estimated to be around 22% of the total injected by the year 2550.
Pressure < Fracture Pressure	🟩	The maximum FBHP of 7000psia is not predicted to exceed the fracture pressure.
Negligible Reaction Between CO2 + Formation Rock + Oil + Water	🟨	Geochemical modelling shows mineralogical reactions present no threat to store integrity.However, in the short-trm asphaltene deposition may reduce permeability.
Good Data Quality	🟩	Some reports light on detail and report figures have missing legends / illegible scale bars – later rectified
Overall Storage Capacity Assessment	🟩	The Prinos store has been assessed positively for the majority of storage capacity factors, however, “Define Phase” studies are recommended to further de-risk the trap to the NE for an over-pressure scenario, the lateral connectivity between the proposed injectors and producers, the impact of potential asphaltene deposition and improve overall data quality & detail.

Table 5-4 CO_2 Storage Capacity Assessment Summary

6. Storage Containment

The key factors in this store which provide a positive assessment of containment of the CO_2 are listed below:

- Proven Primary Storage Seal
- Proven Secondary Storage Seal
- Reservoir Pressure < Fracture Pressure
- No Reactivation of Faults or Fractures
- Negligible Reaction Between Caprock + CO_2
- Legacy Wells Have Good Integrity
- Good Data Quality

A brief review of the above is provided by sub-section below:

6.1 Proven Primary Storage Seal

Given the nature of the trap, the Prinos traps contains two seal mechanisms:
- A top seal
- Two fault juxtapositions seals.

The primary proven top seal is the shale interval overlying the upper most reservoir interval A. The shale is laterally extensive across Prinos and is overlaid by the Messinian evaporitic sequence (see paragraph 6.2). The shale thickness averages 14m and is shown in Figure 6-1.

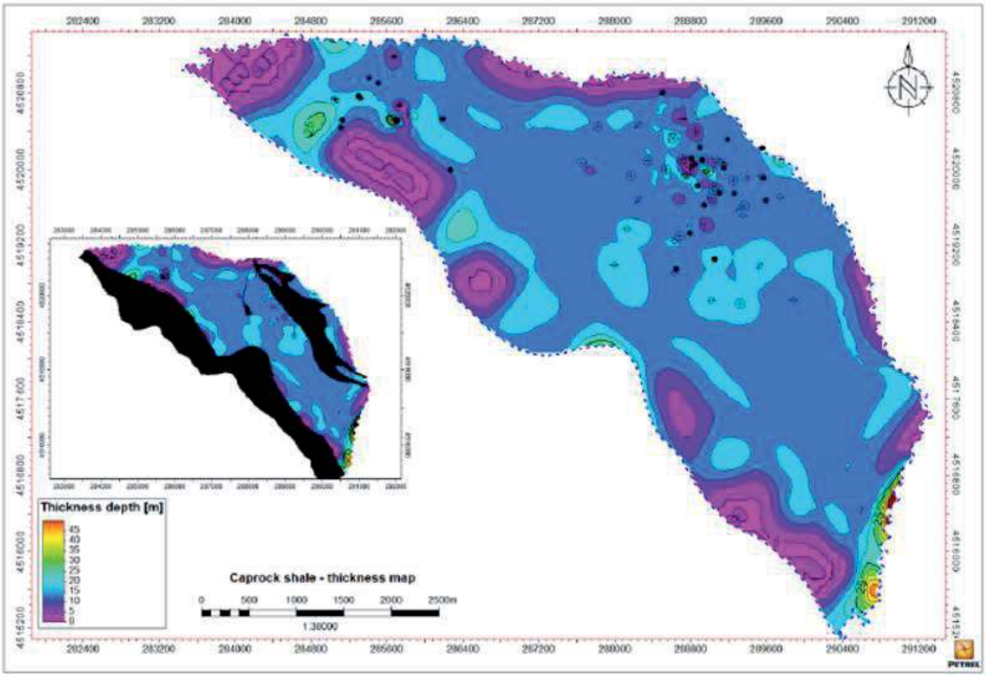


Figure 6-1: Caprock shale overlaying Upper Most reservoir interval in Prinos and Epsilon. The map is derived from well data only and its certainty is defined by the variation in well density.

The figure highlights the uncertainty on shale thickness predictions due to the variation in well data density and notably thinner intervals nearby well control. Nevertheless, the shale is proven to hold a 221m hydrocarbon column at Prinos (reservoir unit A). The anticipated average sealing capacity of the cap-rock in the Prinos field has been quantified using capillary sealing estimation techniques to be approximately 800m of $C0_2$ column height.

The Southwest fault is a major fault bounding both the Prinos and Epsilon structures. The throw is such that the reservoirs are juxtaposed to the thick and younger Messinian evaporitic sequence (salt) defining a juxtaposition seal (reservoir vs non-resevoir). The capillary fault seal capacity has been estimated to be able to hold a CO_2 column height of 350m which is judged to be sufficient for the anticipated amount of CO_2.

The northeast definition of the trap mechanism is unclear (see paragraph 5.5). Although hydrocarbon (oil) are proven to be trapped, the seal mechanism relies either on:

- Minor offset faults with reservoir to reservoir juxtaposition proven to have some baffling effects but no sealing capacity (illustrated by shale gouge ratio studies)
- Minor offset faults with the last fault presenting a juxtaposition seal against the Messinian evaporitic sequence.
- Stratigraphic pinchout
- Roll over structure with stratigraphic base truncation on basement.

The reservoir model is truncated in this area implicitly modelling a fault with juxtaposition seal but this is contradictory with some seismic interpretation cross-sections shared in various reports. With the lack of clarity presented in the reports, the degree of over-pressure this fault may be able to withstand is uncertain and remains a project risk requiring further study.

A number of potential subsurface related leak paths have been identified named V1-V5, L1-L3. These have been evaluated by EnEarth to be low risk and providing the MMV plan and corrective measures are implemented as proposed and remain effective throughout the project lifecycle these risks do no preclude the suitability of the Prinos store for CO_2 storage. With the exception of the observations in Section 5.10 regarding the potential communication with the Epsilon field, the risks and mitigations for the remaining seven potential leak paths are well explained although there is some clarity required regarding the effectiveness of the seal across the NE bounding fault into Prinos North.

6.2 Proven Secondary Storage Seal

The store exhibits two proven secondary seals:

- The overarching Messinian thick (600 to 800m) evaporitic sequence characterised by several salt layers alternating with clastic. This acts as top seal and both fault juxtaposition seal
- Intra reservoir and laterally continuous shales splitting the reservoir into different flow units presenting different oil water contacts.

6.3 Reservoir Pressure < Fracture Pressure

At the end of the proposed 20-year injection period, the average reservoir pressure is estimated to be in the range 5450 – 5725 psia for the three reservoirs. The pressure in the area of the legacy wells is estimated to be less than 6000 psia which is less than the maximum pressure constraint derived from the well integrity studies (6,200psia). Further work is required to clarify this assessment.

6.4 No Reactivation of Faults or Fractures

Geomechanical studies have shown that the stress to strength ratio (SSR) is at its peak in Prinos during depletion following production when some fault movement and potential well damage may have occurred. However, this stress situation alleviates during re-pressurisation with CO_2 and as such is not considered a key project risk. It is worth revisiting this assessment to confirm the SSR assessment (consider less conservative and more typical fault friction angle) and ensure that no well damage exists within the current wellstock.

6.5 Negligible Reaction Between Caprock + CO_2

Geochemical modelling (Desk based study without experimental measurement) was conducted over two different time intervals: 30 years to simulate an engineering timescale and 1000 years to simulate the long-term security of the injection site. Although the main objective of this study was to determine the types and extent of interaction between the reservoir rocks and the pore waters in the Prinos field with the injected CO_2, a secondary objective was to also determine the types and extent of interaction between the upper mudstone caprock (a component of the caprock) and its pore waters with the injected CO_2.

No quantitative data was available to help define the upper mudstone caprock mineralogy of Prinos. Its mineralogy has been constructed by analogy using a more clay-rich, quartz-poor version of the Epsilon reservoir sandstones. Although the caprock minerology includes much greater quantity of chlorite (and other clay minerals), the changes in its porosity by approximately 0.5% (increase) over 30 years, are very similar to separate Epsilon modelling results.

Note: the geochemical models do not account for the effect of capillary pressure which may totally inhibit reaction between CO_2 and the upper mudstone caprock, especially if the contact between the mudstone and CO_2 is limited to the interface between the CO_2-bearing reservoir and the upper mudstone caprock.

6.6 Legacy Wells and Well Integrity

A detailed Containment Risk Assessment (CRA) has been prepared by EnEarth to assess the contribution of legacy wells to the overall storage containment risk at the Prinos site. The CRA confirms that, while geological containment risks associated with the storage complex are low and that legacy wells represent the dominant containment pathway requiring explicit lifecycle risk management.

The CRA identifies approximately 76 legacy wells within the wider assessment area, comprising active wells, exploration and appraisal wells and plugged and abandoned wells. Of these, 12 wells are classified as non-compliant with current CCS barrier expectations, based on available abandonment records and integrity information. Within this group, four wells (PA-3, PA-8, PA-10 and PB-13A) are classified as irregularities due to uncertainty in barrier condition, accessibility constraints and potential exposure to the plume migration over the project life. Modelling shows that plume and pressure effects evolve over time, with some legacy wells (e.g. PA-8) potentially contacted by CO_2 later in the project life. These wells therefore remain relevant containment pathways over the full lifecycle.

To characterise the potential magnitude of leakage should containment be compromised, the CRA includes detailed leak-rate modelling for a representative worst-case legacy well (PA-3). In addition to single well sensitivity cases, the CRA evaluates the aggregated leakage potential from all legacy wells at the site. The results indicate that aggregated leakage is dominated by a small number of higher risk wells, mainly PA-3. At the site level, the aggregated leak rate estimates are low for the majority of outcomes, with P10 and P50 scenarios corresponding to very small surface fluxes, while higher P90 outcomes represent conservative cases. For the assessed scenarios, aggregated surface leakage rates are on the order of less than ~0.1 t/day at P10, approximately ~1 t/day at P50, and ~23 t/day at P90 under worst-case assumptions. The results demonstrate that predicted leakage rates are highly sensitive to assumed well restriction and barrier performance. For several higher-risk wells, effective leak potential may be reduced by restricted through bore conditions (e.g. scale) and/or existing barriers, which may result in relatively low leak rates. However, these restrictions are uncertain and should not be treated as permanent or reliable containment barriers.

Latterly, subsequent work has also been carried out for the modelling of leak rates on the other three irregular classified wells. This reaffirmed that the total leak volume is related to the connected CO2 volume, and not the restrictions modelled within the well. For PA-8 probabilistic assessment showed a P50 leak volume of 4.6MT, for PA-10 it was 1.9MT and for PB-13A it was 2.6MT. Each well had seen 50MT of injection.

Based on this analysis, the CRA concludes that pre-emptive re-entry of legacy wells prior to CO_2 injection is not demonstrably ALARP, given the inability to confirm the existence of an active leakage pathway in advance of injection and the technical challenges associated with installing fully CCS-compliant barriers in legacy wells. Instead, the preferred containment risk management strategy relies on targeted Monitoring, Measurement and Verification (MMV) as an early-warning system, combined with a credible corrective measures framework, enabling timely intervention should leakage be detected.

Leakage via legacy wells is considered inherently more detectable and manageable than geological leakage pathways, as well locations are known and monitoring can be focused. Corrective measures, including the drilling of relief wells where required, are considered technically feasible and effective in mitigating leakage impacts.

Accordingly, while legacy wells constitute the principal containment risk for the Prinos storage site, the updated assessment indicates that this risk could be managed to acceptable levels through implementation of the MMV plan and corrective measures and does not significantly alter the site’s suitability for permanent CO_2 storage.

6.7 Good Data Quality

Some reports are light on detail, making it difficult to perform an in-depth technical assessment in some areas. Some report figures contain plots with either missing legends and/or illegible scale bars.

6.8 Overall Storage Containment Assessment

A summary of the above assessment is provided below:-

Containment Criteria	Assessment	Summary Comment
Proven Primary Storage Seal	🟩	Proven reservoir accumulations with hydrocarbon: Top seal and Southwest fault juxtaposition seal estimated to have capillary sealing of 800m and 350m respectively (average). Trap definion to the North East and seal capacity definition may create issues for significant over-pressure events. Further studies would explore this.
Proven Secondary Storage Seal	🟩	Trap overlaid by thick (600-800m) Messinian evaporitic sequence containing numerous salt layers. Intra-reservoir shale layers provide additional secondary seals for the deeper interval.
Reservoir Pressure < Fracture Pressure	🟩	At the end of the proposed 20-year injection period, the average reservoir pressure is estimated to be in the range 5450 – 5725 psia for the three reservoirs which is <fracture pressure & represents minimal risk for the store.
No Reactivation of Faults or Fractures	🟩	Geomechanical model shows stress strength ratio (SSR) reduces during CO_2 injection so faults/fracture reactivation is not considered to be a significant risk for Prinos
Negligible Reaction Between Caprock + CO_2	🟩	Desktop study and modelling shows negligible impact of $C0_2$ on the top reservoir shale (increase of 0.5% of porosity over 30years) using Epsilon analogue results.
Legacy Wells Have Good Integrity	🟨 Until remediated 🟩 Once remediated	Based on the CRA, a subset of legacy wells does not fully meet current CCS barrier expectations and represents the dominant containment risk. Four wells (PA-3, PA-8, PA-10 and PB-13A) are identified as irregularities. For this permit, only PA-3 is of note, and that shall be recommended to be remediated before injection begins. Modelling indicates that some legacy wells may be contacted by the CO_2 plume later in the project life, although effective leak rates may be reduced by restricted throughbore conditions and existing barriers, which are uncertain and should not be relied upon as permanent containment. The assessed risk is considered manageable through targeted MMV and a credible corrective measures framework rather than requiring mandatory pre-injection remediation. PA-3 successfully remediated would move this to low.
Data Quality	🟩	Some reports light on detail and report figures have missing legends / illegible scale bars. This was remedied
Overall Storage Containment Assessment:	🟨 Until remediated 🟩 Once remediated	The Prinos storage site remains suitable for CO_2 storage based on geological containment, pressure management and secondary sealing capacity. Axis’ review indicates that overall containment risk is dominated by legacy wells, however, aggregated leak-rate modelling shows low expected site-wide leakage for the majority of outcomes, with higher end P90 cases representing conservative scenarios. Provided that the MMV plan and corrective measures are implemented as proposed, legacy well-related risks can be managed to acceptable levels and do not preclude site suitability. Successful remediation of PA-3 would move this to low risk.

Table 6-1 CO_2 Storage Containment Assessment Summary

7. Storage Injectivity and Productivity

7.1 Injectivity

The key factors in this store which provide a positive assessment of injectivity of the CO_2 are listed below:

- Good Horizontal Permeability:
- Good Store Thickness:
- Low Wellbore Skin:
- Low CO_2 Viscosity:
- FBHP Pressure < Fracture Pressure:
- Good Lateral Connectivity:
- Negligible Reaction Between CO_2 + Formation Rock + Oil + Water:
- Sustainable Injection Rate > 0.5 MTPA through project life:
- Good Data Quality:

A brief review of the above is provided by sub-section below:

7.2 Good Horizontal Permeability

Prinos reservoir exhibits relatively good horizontal permeability (Table 5-2). The reservoir model is constrained by well logs defined from core measurements.

Note 1: No report demonstrates whether the aquifer presents similar or different permeabilities. More study work may be required to assess this aspect since much of the development depends on the aquifer's flow properties.
Note 2: The proposed locations for the two CO2 injector wells are in an area of the reservoir that is thought to be previously undeveloped and therefore there will be less certainty on likely permeability estimates at these locations.
Note 3: The grid vertical resolution is variable (proportional layering). In certain areas and stratigraphic zones, the resolution is too coarse to capture the permeability heterogeneities. The use of a permeability scale ranging from 0.01 to 1,000 mD is not appropriate to quality control the log upscaling to the grid resolution (Figure 5-4). Consequences are multiple: from over predicting the vertical flow within each reservoir unit to creating a more uniform CO_2 Plume front.

7.3 Good Store Thickness

The stratified nature of the reservoir means each individual reservoir (A1, A2, B and C reservoirs) needs to be considered separately. In general, based on limited cross-sections provided, it would appear that the reservoir is thinner in the aquifer, on the flanks of the structure, compared to the oil producing zones on the crest. Based on a cross-section through one of the injection wells, the reservoir thicknesses at this location are approximately as follows: A1 is 280 ft, A2 is 415 ft, B is 162 ft and C is 185 ft at the injector location (see Figure 7-1). Proposed injection rates into B reservoir are relatively low, whereas into C reservoir they are up to 0.5 Mtpa for a short period, which is where any "bottleneck" in injectivity would likely occur, if at all. Overall, however, it is anticipated that reservoir thickness should be sufficient for required injectivity, but proposed well injection and production rates, by reservoir, should be checked with historical production and water injection well performance to ensure that they are attainable.

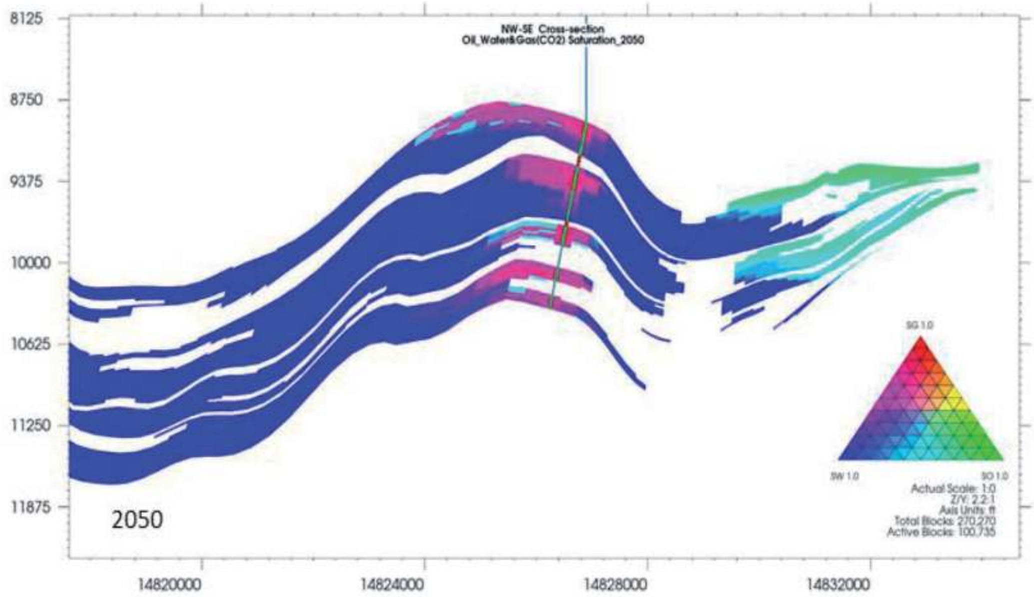


Figure 7-1: Cross-section through CO2 injector

7.4 Low Wellbore Skin

No reference to wellbore skin has been seen in the documentation, though it is assumed that well planning will target minimal skin. Possible thermal fracturing (see section **Error! Reference source not found.**) could result in a negative skin and help mitigate any near wellbore formation damage.

7.5 Low CO_2 Viscosity

Assuming an injection temperature of 54°C, the CO_2 viscosity is in the range 0.08 – 0.09 cP which is over an order of magnitude less than the viscosity of seawater at an injection temperature of (say) 20°C. This will positively promote injectivity of CO_2.

7.6 FBH Pressure < Fracture Pressure

The maximum injection pressure constraint is set at 7000 psia, which should not exceed the maximum static reservoir pressure. An additional safety buffer of around +500 psi has been applied in arriving at this constraint. However, as the maximum injection rate per well has been set at 0.5 Mtpa, the maximum injection pressure constraint is not reached. Plots of individual well BHP versus time have not been provided for review. Due to historic oil production, the reservoirs are depleted, compared to initial pressure by around 1500 – 2000 psi. By the end of the 20-year injection period, the average reservoir pressure is approaching initial reservoir pressure.

Geomechanical modelling indicates that there is a risk of thermal fracturing in A1 and C reservoirs, due to the lowering of near wellbore rock strength from low injection temperature when compared to the original reservoir temperature. This aspect needs further study to assess whether this is likely to be a limited near wellbore effect (ie no out of zone fracturing of the caprock) with the benefit of promoting well injectivity and not needing the CO_2 to be heated prior to injection.

7.7 Good Lateral Connectivity

There is at least one mapped fault between the proposed CO_2 injection locations and the water producer locations (there are two mapped faults for one of the water producer locations – see Figure 5-5). If these faults are sealing or partially sealing then this could negate the effect of the water producers and result in excessive pressure rise in the region around the injection wells, which would limit the volume of CO_2 that can be stored. This is considered to be a potential significant risk, as fault compartmentalization is observed in the north-eastern crestal area, as documented in the MMV report. There is also some concern that not all faults have been incorporated in the PEC full store model compared to the finer scale model used to model Prinos oil production.

There is also concern about potential lateral connectivity between the CO_2 injection wells and the Epsilon field. Future plans concerning Epsilon production are unclear. The sand in Epsilon is generally lower quality than Prinos, which could suggest high(ish) drawdowns to achieve commercial rates. If there are simultaneous operations (injection in Prinos, production in Epsilon), then Epsilon oil production could act as a pressure sink for the CO_2, risking back-production of the CO_2 via the Epsilon production well(s), which may not be designed for CO_2 operations. In Figure 5-6 taken from the Risk Assessment Report, there is an inference from the well marker symbols that production in Epsilon ceases sometime in the period 2035 – 2040; CO_2 injection is due to commence in A sand in 2035 so it is possible there could be a period of overlapping simultaneous production and injection in A sand for one or more years. The same report argues that CO_2 will preferentially move towards the water production wells which are on the other side of the field; however this is not necessarily the case. As can be seen in Figure 5-7, taken from the MMV report, the Epsilon wells appear to be situated closer to the injection wells, compared to the water production wells. Also, as discussed above, there is uncertainty as to what extent these water production wells will be in pressure communication with the injection wells due to the presence of nearby faults. This must considered to be a potential significant risk, as fault compartmentalization is observed in other parts of the field (i.e. in the north-eastern section of the crest). The same report states that there may be hydraulic communication in the A sand between Prinos and Epsilon, through the aquifer. In order to de-risk this potential outcome, more detailed clarification is required from the Operator, in particular production profiles for Epsilon (oil, water and gas), bottom hole pressure profiles and pressure maps across the Prinos / Epsilon structure as a function of time from 2035 – 2040 (on an annual basis). In correspondence, the Operator has stated that in 100% of simulations, CO_2 does not migrate across the saddle to the Epsilon structure, but it is unclear if future Epsilon production was included in these simulations.

7.8 Negligible Reaction Between CO_2 + Formation Rock + Oil + Water

A high risk of halite precipitation in the wellbore has been identified. This is estimated to reduce the permeability in the near wellbore area by ~30% representing a risk to well injectivity. An effective mitigation programme is required to reduce this risk. Away from the injectors, located in the water leg, asphaltene deposition from CO_2 migration upstructure will occur and likely reduce permeability and storage in the oil leg.

7.9 Sustainable Injection Rate > 0.5 MTPA Through Project Life

Proposed well injection rates, by reservoir, should be checked with historical water injection well performance to ensure that they are attainable. The main risks are perceived to be possible poor communication with supporting water producers, leading to pressure management issues and the potential for halite precipitation to reduce injectivity. In a worst-case scenario, these risks could lead to a reduction in total storage volume.

7.10 Good Data Quality

Some reports are light on detail, making it difficult to perform an in-depth technical assessment in some areas. Some report figures contain plots with either missing legends and/or illegible scale bars.

7.11 Overall Storage Injectivity Assessment

A summary of the above assessment is provided below:-

Injectivity Criteria	Assessment	Summary Comment
Good Horizontal Permeability	🟨	Good horizontal permeability is observed in oil leg, however, more studies may be required to ensure good permeability exists below the OWC
Good Store Thickness	🟩	Reservoir thickness is anticipated to be sufficient for the required injectivity & productivity but should be checked against historical well performance.
Low Wellbore Skin	🟩	Low wellbore skin is assumed; possible thermal fracturing may result in negative skin mitigating formation damage.
Low CO2 Viscosity	🟩	CO2 viscosity is low which should promote good CO2 injectivity.
FBHP Pressure < Fracture Pressure	🟩	The maximum injection FBHP of 7,000psi is not predicted to exceed the fracture pressure. More definition of this required during next study phase.
Good Lateral Connectivity	🟨	Some concern over mapped faults between injectors and water producers, which could cause issues with pressure management, if sealing or partially sealing. Some concern around potential connection with Epsilon, which in worse case scenario could lead to breakthrough of CO_2 at Epsilon producers.
Negligible Reaction Between CO2 + Formation Rock + Oil + Water	🟥	A high risk of halite precipitation in the near wellbore is predicted resulting in ~30% permeability.reduction. Away from injectors asphaltene deposition from CO2 contact will likely reduce permeability and storage in the oil leg.
Sustainable Injection Rate > 0.5 MTPA through project life	🟩	Proposed well injection rates, by reservoir, should be checked with historical production & water injection well performance to ensure that they are attainable.
Good Data Quality	🟩	Some reports light on detail and report figures have missing legends / illegible scale bars. This was remedied
Overall Storage Injectivity Assessment	🟨	The Prinos store has been assessed positively for the majority of storage injectivity factors, however, more “Define Phase” studies are required to de-risk aquifer permeability, the lateral connectivity between the proposed injectors and producers, permeability degradation due to potential halite and asphaltene deposition and improve overall data quality & detail.

Table 7-1 CO_2 Storage Injectivity Assessment Summary

7.12 Productivity

The key factors in this store which provide a positive assessment of productivity of the water producers are listed below:

- Good Horizontal Permeability:
- Good Store Thickness:
- Low Wellbore Skin:
- Low Water Viscosity:
- Well Drawdown < Sand Production Drawdown:
- Good Lateral Connectivity:
- Negligible Produced Water Issues Overboard:
- Sustainable Production Rate > 9 mbwpd through project life:
- Good Data Quality:
- Overall Storage Productivity Assessment:

A brief review of the above is provided by sub-section below:

7.13 Good Horizontal Permeability

Prinos reservoir exhibits relatively good horizontal permeability (Table 5-2). The reservoir model is constrained by well logs defined from core measurements.

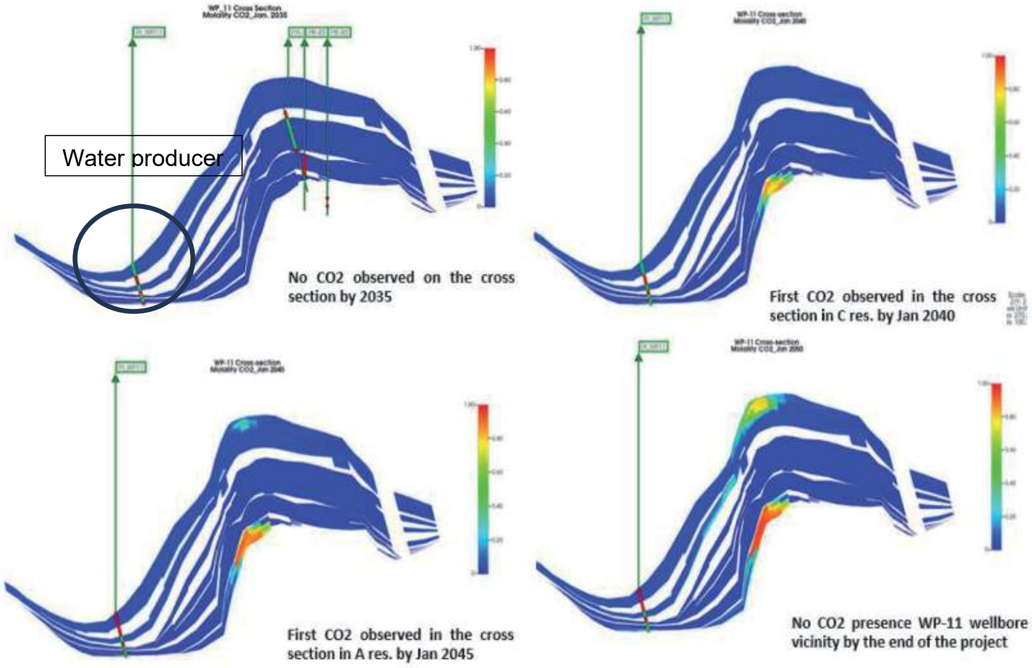
Note 1: No report demonstrates whether the aquifer presents same or different permeabilities. More study work may be required to assess this aspect since much of the development depends on the aquifer

Note 2: The proposed locations for the two water production wells are in an area of the reservoir that is thought to be previously undeveloped and therefore there will be less certainty on likely permeability estimates at these locations.

Note 3: The grid vertical resolution is variable (proportional layering). In certain areas and stratigraphic zones, the resolution is too coarse to capture the permeability heterogeneities. The use of a permeability scale ranging from 0.01 to 1,000 mD is not appropriate to quality control the log upscaling to the grid resolution (Figure 5-4). Consequences are multiple: from over predicting the vertical flow within each reservoir unit to creating a more uniform CO_2 Plume front.

7.14 Good Store Thickness

The stratified nature of the reservoir means each individual reservoir (A1, A2, B and C reservoirs) needs to be considered separately. Cross-sections through the water producers have been made available, but depth scale bars are missing, making it difficult to assess reservoir thickness. For one of the proposed water producer locations (WP-11), the reservoir thickness in the B & C reservoir looks thin, based on a visual qualitative inspection (see Figure 7-2). Whilst production rates from the B reservoir are relatively low, the proposed production from the C reservoir is higher (over 15000 bwpd from two producers for over two years). This is where any “bottleneck” in productivity could occur, if at all. Thin reservoirs imply a high drawdown could be required in order to realise the target production rate, which in turn could act as a pressure sink for the CO_2. Proposed well production rates, by reservoir, should be checked with historical well production and/or water injector performance, to ensure the rates are attainable.



No CO2 observed on the cross section by 2035

First CO2 observed in the cross section in C res. by Jan 2040

First CO2 observed in the cross section in A res. by Jan 2045

No CO2 presence WP-11 wellbore vicinity by the end of the project

Figure 7-2: Cross-section through water producer

7.15 Low Wellbore Skin

No reference to wellbore skin has been seen in the documentation, though it is assumed that well planning will target minimal skin.

7.16 Low Water Viscosity

Formation water is expected to have a viscosity around 0.9 - 1 cP over the range of pressures anticipated over the injection phase. Therefore, there should be no adverse productivity impact due to viscosity for the water producers.

7.17 Well Drawdown < Sand Production Drawdown

No information has been presented on sanding risk. The rock strength model shows a rather competent / consolidated sandstone, which suggests probably a low sanding risk. Sanding risk should definitely be evaluated in future phases of the work.

7.18 Good Lateral Connectivity

There is at least one mapped fault between the proposed CO_2 injection locations and the water producer locations (there are two mapped faults for one of the water producer locations – see Figure 5-5). If these faults are sealing or partially sealing then this could negate the effect of the water producers and result in excessive pressure rise in the region around the injection wells, which would limit the volume of CO_2

that can be stored. This is considered to be a potential significant risk, as fault compartmentalization is observed in the north-eastern crestal area, as documented in the MMV report. There is also some concern that not all faults have been incorporated in the PEC full store model compared to the finer scale model used to model Prinos oil production.

7.19 Negligible Produced Water Issues Overboard

Based on the documents reviewed, there is ambiguity as to whether the CO_2 project is to be developed via a completely new platform or using the existing facilities. Some concerns include:- (1) the capability of the existing system to handle increased flowrates. The modelled water production rates appear to exceed the nominal capacity of the water treatment system and there is no given explanation as to how the system will cope. (2) How will the system operate after cessation of oil production? Where will the sweet gas for H_2S stripping be sourced and how will the flare be fuelled to dispose of the H_2S? (3) How will any breakthrough CO_2 in the produced water be measured? (4) Water composition in the aquifer is not known. Presence of heavy metals or other issues could mean that it can’t be discharged to sea and it has to be treated onshore or injected into another location.

7.20 Sustainable Production Rate > 9 mbwpd Through Project Life

Proposed well production rates, by reservoir, should be checked with historical well production performance (and/or water injector performance, as they are located in the aquifer) to ensure the rates are attainable. The main risk is perceived to be possible poor communication with the CO_2 injectors, leading to pressure management issues as well as uncertainty as to whether there is capacity to handle the additional volumes of produced water.

7.21 Good Data Quality

Some reports are light on detail, making it difficult to perform an in-depth technical assessment in some areas. Some report figures contain plots with either missing legends and/or illegible scale bars.

7.22 Overall Storage Productivity Assessment

A summary of the above assessment is provided below:-

Productivity Criteria	Assessment	Summary Comment
Good Horizontal Permeability	🟨	Good horizontal permeability is observed in oil leg, however, more studies may be required to ensure good permeability exists below the OWC
Good Store Thickness	🟨	Possible thin B & C reservoir for one of the water producers. To be further assessed.
Low Wellbore Skin	🟩	Expected to be minimal.
Low Water Viscosity	🟩	No adverse productivity impact expected due to viscosity for the water producers.
Well Drawdown < Sand Production Drawdown	🟨	Not evaluated. Well sanding risk evaluation to be performed in next phase of studies..
Good Lateral Connectivity	🟨	Some concern over mapped faults between injectors and water producers, which may cause pressure management issues and storage reduction, if sealing/partially sealing. Some concern around potential connection with Epsilon, which in worse case scenario could lead to breakthrough of CO_2 at Epsilon producers.

Negligible Produced Water Issues Overboard	🟨	Concerns that forecast water production rates are in excess of water treatment plant design capacity. Also, uncertainty on water composition – presence of heavy metals could mean that water can’t be discharged to sea.
Sustainable Production Rate > 9 mbwpd through project life	🟨	Proposed well injection rates, by reservoir, should be checked with historical production & water injection well performance to ensure that they are attainable.
Good Data Quality	🟩	Some reports light on detail and report figures have missing legends / illegible scale bars. This was remedied.
Overall Storage Productivity Assessment	🟨	The Prinos store has been assessed positively for the majority of storage productivity factors, however, more “Define Phase” studies are required to de-risk aquifer permeability, store thickness, sanding risk, lateral connectivity between injectors & producers, aquifer water composition & improve overall data quality & detail

Table 7-2 CO_2 Storage Productivity Assessment Summary

8. Storage Location

The key factors in this store which provide a positive assessment of store location are listed below:

8.1 Location

- Adjacent to existing Prinos O&G facilities
- Good access to emitter markets
- Low transportation costs
- Overall Store Location Assessment

A brief review of the above is provided by sub-section below:

8.2 Adjacent To Existing Prinos O&G Facilities

The planned site for the onshore CO_2 handling and injection facilities is positioned close to the existing oil processing facilities, remote from population centres. The existing pipeline corridor will be used to install a new CO_2 injection line to the offshore facilities. This will reduce the risk of third-party damage by, for example, trawler damage and limit the areal disturbance to the environment. The new offshore facilities will also be remote from population centres.

Energean’s Sigma onshore facility and the Prinos offshore complex have safely handled produced fluids containing high levels of toxic H_2S for many years. The risks of handling harmful substances are well understood by the parent company. Risk assessments undertaken for the CO_2 facilities have followed international standards and leveraged Energean’s regional experience to identify mitigations to ensure that risks remain As Low As Reasonably Practicable (ALARP).

8.3 Good Access To Emitter Markets

Prinos CO_2, as a Project of Common Interest for the EU and a key element of infrastructure for the Mediterranean CCS Plan, is well placed to provide open access CO_2 storage to emitters in the Mediterranean region and, potentially, beyond. Prinos’s onshore facility is being designed to be capable of receiving CO_2 via ship, pipeline and road tanker. The potential Greek industrial emitters within 600 km of Prinos could provide more than 12 MTPA of CO_2. The combined industry emissions for countries along the shoreline of the northern Mediterranean would account for a further 100 MTPA of CO_2. Enearth have already signed 12 MOUs or partnerships with potential customers and are actively engaging with other emitters. Their current non-binding interests amount to more than 5.0 MTPA of CO_2 emissions.

8.4 Low Transportation Costs

The base concept for Prinos CO_2 is that it offers a storage service only. Transportation of CO_2 falls outside of this service, although Enearth are investigating the potential for a combined transportation and storage offer if this is requested by the market. Engineering definition during FEED (“Define Phase”) will develop optimised reception facilities and CO_2 specifications to maximise the number and type of emitters which are able to access the Prinos storage service whilst favouring as much as possible standardised designs which are expected to evolve as the market develops. EU-wide standardisation of transport conditions is expected to focus market competition and bring down costs. EnEarth are taking a holistic evaluation approach which considers the combined capture, transportation and storage costs; these will likely vary by emitter and the amount of government funding and support that they secure.

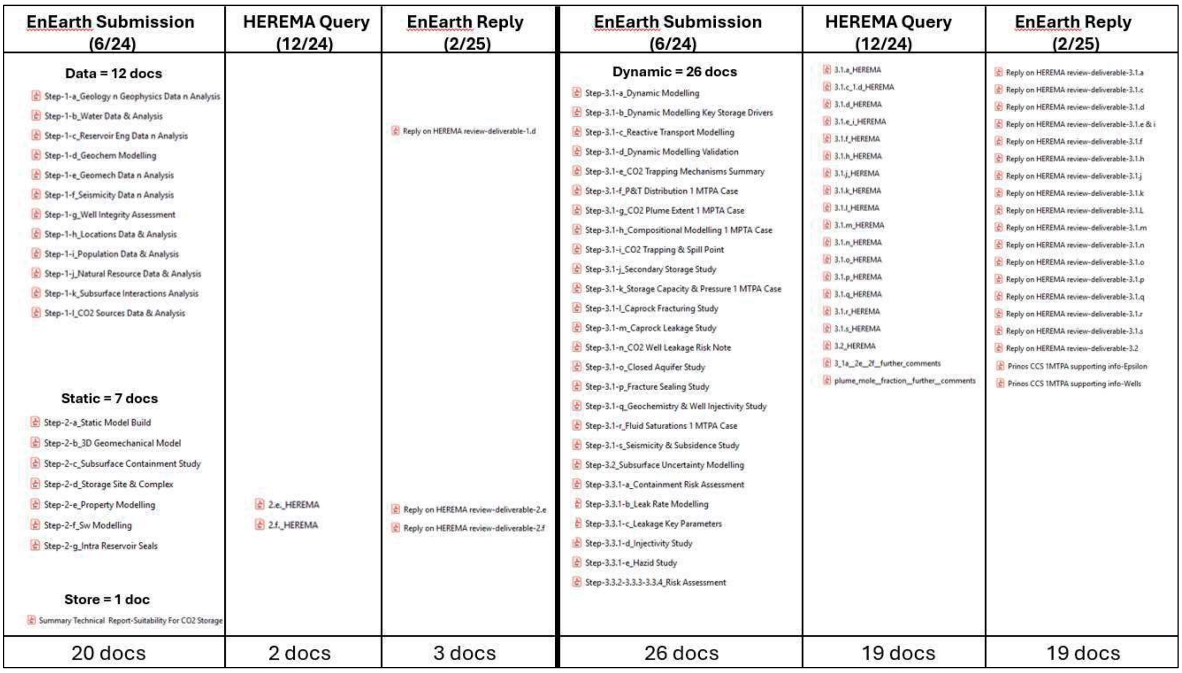
8.5 Overall Store Location Assessment

A summary of the above assessment is provided below:

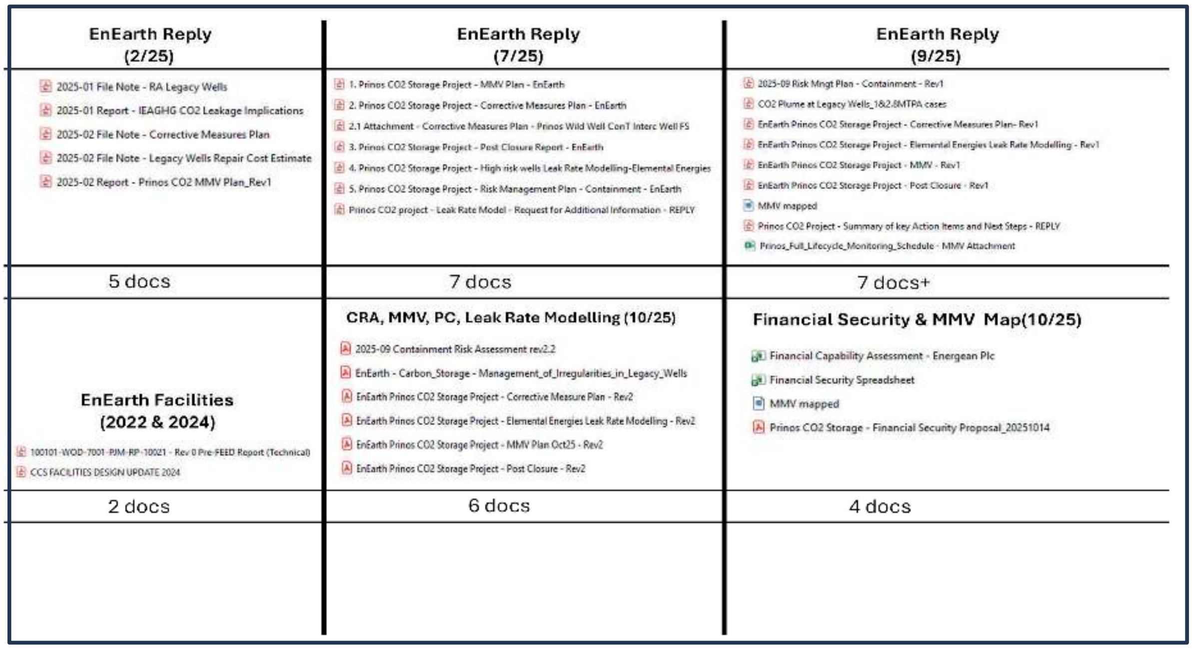
Location Criteria	**Assessment**	**Summary Comment**
Adjacent to existing Prinos O&G facilities	🟩	Onshore & offshore facilities are well operated & located away from population centres & considered ALARP.
Good access to emitter markets	🟩	Well-placed to service Mediterranean emitters via tanker, pipeline and ship.100MTPA potential.
Low transportation costs	🟨	A range of transport options being considered at present, providing potential for low transportation costs, including potential for government funding.
Overall Store Location Assessment	🟩	The Prinos store has been assessed positively for the storage location factors including adjacency to existing facilities & emitters & potential for low transportation costs

Table 8-1 CO2 Store Location Assessment Summary

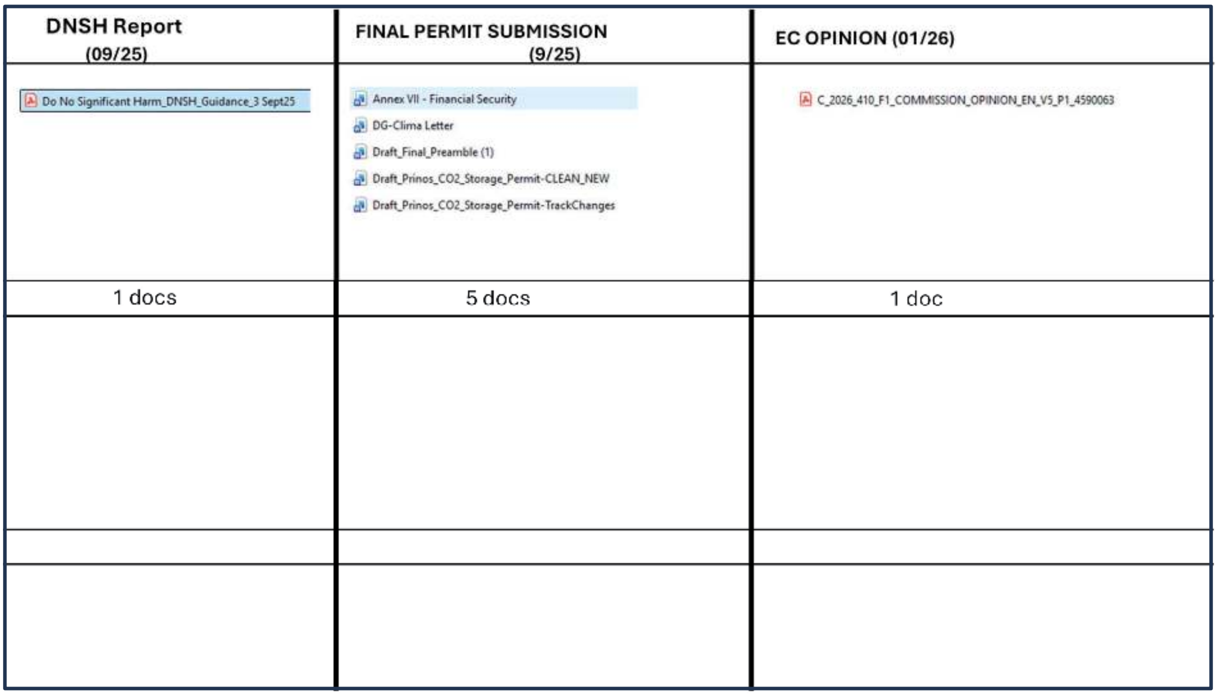
9. Appendix 1 – Master Document Register



EnEarth Submission (6/24)	HEREMA Query (12/24)	EnEarth Reply (2/25)	EnEarth Submission (6/24)	HEREMA Query (12/24)	EnEarth Reply (2/25)
Data = 12 docs Step-1-a_Geology n Geophysics Data n Analysis Step-1-b_Water Data & Analysis Step-1-c_Reservoir Eng Data n Analysis Step-1-d_Geochem Modelling Step-1-e_Geomech Data n Analysis Step-1-f_Seismicity Data n Analysis Step-1-g_Well Integrity Assessment Step-1-h_Locations Data & Analysis Step-1-i_Population Data & Analysis Step-1-j_Natural Resource Data & Analysis Step-1-k_Subsurface Interactions Analysis Step-1-l_CO2 Sources Data & Analysis **Static = 7 docs** Step-2-a_Static Model Build Step-2-b_3D Geomechanical Model Step-2-c_Subsurface Containment Study Step-2-d_Storage Site & Complex Step-2-e_Property Modelling Step-2-f_Sw Modelling Step-2-g_Intra Reservoir Seals **Store = 1 doc** Summary Technical Report-Suitability For CO2 Storage	2.e._HEREMA 2.f._HEREMA	Reply on HEREMA review-deliverable-1.d Reply on HEREMA review-deliverable-2.e Reply on HEREMA review-deliverable-2.f	**Dynamic = 26 docs** Step-3.1-a_Dynamic Modelling Step-3.1-b_Dynamic Modelling Key Storage Drivers Step-3.1-c_Reactive Transport Modelling Step-3.1-d_Dynamic Modelling Validation Step-3.1-e_CO2 Trapping Mechanisms Summary Step-3.1-f_P&T Distribution 1 MTPA Case Step-3.1-g_CO2 Plume Extent 1 MPTA Case Step-3.1-h_Compositional Modelling 1 MPTA Case Step-3.1-i_CO2 Trapping & Spill Point Step-3.1-j_Secondary Storage Study Step-3.1-k_Storage Capacity & Pressure 1 MTPA Case Step-3.1-l_Caprock Fracturing Study Step-3.1-m_Caprock Leakage Study Step-3.1-n_CO2 Well Leakage Risk Note Step-3.1-o_Closed Aquifer Study Step-3.1-p_Fracture Sealing Study Step-3.1-q_Geochemistry & Well Injectivity Study Step-3.1-r_Fluid Saturations 1 MTPA Case Step-3.1-s_Seismicity & Subsidence Study Step-3.2_Subsurface Uncertainty Modelling Step-3.3.1-a_Containment Risk Assessment Step-3.3.1-b_Leak Rate Modelling Step-3.3.1-c_Leakage Key Parameters Step-3.3.1-d_Injectivity Study Step-3.3.1-e_Hazid Study Step-3.3.2-3.3.3-3.3.4_Risk Assessment	3.1.a_HEREMA 3.1.c_1.d_HEREMA 3.1.d_HEREMA 3.1.e_i_HEREMA 3.1.f_HEREMA 3.1.h_HEREMA 3.1.j_HEREMA 3.1.k_HEREMA 3.1.l_HEREMA 3.1.m_HEREMA 3.1.n_HEREMA 3.1.o_HEREMA 3.1.p_HEREMA 3.1.q_HEREMA 3.1.r_HEREMA 3.1.s_HEREMA 3.2_HEREMA 3_1a__2e__2f__further_comments plume_mole__fraction__further__comments	Reply on HEREMA review-deliverable-3.1.a Reply on HEREMA review-deliverable-3.1.c Reply on HEREMA review-deliverable-3.1.d Reply on HEREMA review-deliverable-3.1.e & i Reply on HEREMA review-deliverable-3.1.f Reply on HEREMA review-deliverable-3.1.h Reply on HEREMA review-deliverable-3.1.j Reply on HEREMA review-deliverable-3.1.k Reply on HEREMA review-deliverable-3.1.L Reply on HEREMA review-deliverable-3.1.m Reply on HEREMA review-deliverable-3.1.n Reply on HEREMA review-deliverable-3.1.o Reply on HEREMA review-deliverable-3.1.p Reply on HEREMA review-deliverable-3.1.q Reply on HEREMA review-deliverable-3.1.r Reply on HEREMA review-deliverable-3.1.s Reply on HEREMA review-deliverable-3.2 Prinos CCS 1MTPA supporting info-Epsilon Prinos CCS 1MTPA supporting info-Wells
20 docs	2 docs	3 docs	26 docs	19 docs	19 docs



EnEarth Reply (2/25)	EnEarth Reply (7/25)	EnEarth Reply (9/25)
2025-01 File Note - RA Legacy Wells 2025-01 Report - IEAGHG CO2 Leakage Implications 2025-02 File Note - Corrective Measures Plan 2025-02 File Note - Legacy Wells Repair Cost Estimate 2025-02 Report - Prinos CO2 MMV Plan_Rev1	1. Prinos CO2 Storage Project - MMV Plan - EnEarth 2. Prinos CO2 Storage Project - Corrective Measures Plan - EnEarth 2.1 Attachment - Corrective Measures Plan - Prinos Wild Well ConT Interc Well FS 3. Prinos CO2 Storage Project - Post Closure Report - EnEarth 4. Prinos CO2 Storage Project - High risk wells Leak Rate Modelling-Elemental Energies 5. Prinos CO2 Storage Project - Risk Management Plan - Containment - EnEarth Prinos CO2 project - Leak Rate Model - Request for Additional Information - REPLY	2025-09 Risk Mngt Plan - Containment - Rev1 CO2 Plume at Legacy Wells_1&2.8MTPA cases EnEarth Prinos CO2 Storage Project - Corrective Measures Plan- Rev1 EnEarth Prinos CO2 Storage Project - Elemental Energies Leak Rate Modelling - Rev1 EnEarth Prinos CO2 Storage Project - MMV - Rev1 EnEarth Prinos CO2 Storage Project - Post Closure - Rev1 MMV mapped Prinos CO2 Project - Summary of key Action Items and Next Steps - REPLY Prinos_Full_Lifecycle_Monitoring_Schedule - MMV Attachment
5 docs	7 docs	7 docs+
EnEarth Facilities (2022 & 2024) 100101-WOD-7001-PJM-RP-10021 - Rev 0 Pre-FEED Report (Technical) CCS FACILITIES DESIGN UPDATE 2024	**CRA, MMV, PC, Leak Rate Modelling (10/25)** 2025-09 Containment Risk Assessment rev2.2 EnEarth - Carbon_Storage - Management_of_Irregularities_in_Legacy_Wells EnEarth Prinos CO2 Storage Project - Corrective Measure Plan - Rev2 EnEarth Prinos CO2 Storage Project - Elemental Energies Leak Rate Modelling - Rev2 EnEarth Prinos CO2 Storage Project - MMV Plan Oct25 - Rev2 EnEarth Prinos CO2 Storage Project - Post Closure - Rev2	**Financial Security & MMV Map(10/25)** Financial Capability Assessment - Energean Plc Financial Security Spreadsheet MMV mapped Prinos CO2 Storage - Financial Security Proposal_20251014
2 docs	6 docs	4 docs



DNSH Report (09/25)	FINAL PERMIT SUBMISSION (9/25)	EC OPINION (01/26)
Do No Significant Harm_DNSH_Guidance_3 Sept25	Annex VII - Financial Security DG-Clima Letter Draft_Final_Preamble (1) Draft_Prinos_CO2_Storage_Permit-CLEAN_NEW Draft_Prinos_CO2_Storage_Permit-TrackChanges	C_2026_410_F1_COMMISSION_OPINION_EN_V5_P1_4590063
1 docs	5 docs	1 doc

10.Appendix 2 – Recommended Carbon Storage Permit Documentation

A list of the consolidated documents required to meet HEREMA’s needs and allow FID to proceed is provided below:

1. Carbon Storage Project Overview
   (to include clear cross-reference table showing where each clause of directive is covered in the documentation)

2. Storage Site & Complex Characterisation
   (to include “Define Phase” data analysis, static modelling and dynamic modelling)

3. Carbon Storage Development Plan
   (to include “Define Phase” integrated subsurface, wells and facilities plan & associated life cycle cost estimates)

4. Containment Risk Assessment
   (to include “Define Phase” assessment of reservoir, well and facilities containment of CO_2)

5. Monitoring Plan
   (to include “Define Phase” monitoring plan & associated life cycle cost estimate)

6. Corrective Measures Plan
   (to include “Define Phase” corrective measures plan & associated life cycle cost estimate)

7. Provision Post-Closure Plan
   (to include “Define Phase” provisional post-closure plan & associated life cycle cost estimate)

8. Proposed Financial Security
   (to include “Define Phase” financial security proposal supported by integrated life cycle cost estimates)

This list is based on the UK’s regulatory requirements (NSTA) and details expected to be included in each document are provided in the following links:-

- Guidance on the content of an offshore carbon storage permit applications

- The “Define Phase” requirements contained within the following document Guidance on Applications for a Carbon Storage Permit Operations Guidance on Applications for a Carbon Storage Permit

ANNEX II

PRINOS CO_2 STORAGE

Monitoring, Measurement, and Verification (MMV) Plan

In line with the ESIA
Prepared as a standalone document to support
communication with DG CLIMA

EnEarth

October 14th, 2025

Prinos CO_2 Monitoring, Measurement and Verification (MMV) Plan

Contents

1. Introduction

This report documents EnEarth’s Monitoring, Measurement, and Verification (MMV) plan for the Prinos CO_2 Storage project. MMV is the systematic process of tracking, quantifying, and ensuring the secure storage of carbon dioxide (CO_2) and meet safety, environmental and regulatory requirements. MMV plans are central for maintaining safe, effective, and permanent storage of CO_2 by monitoring for leaks and verifying compliance.

The EU Directive 2009/31 and its guideline documents state the need for a structured approach to risk assessment for carbon capture and storage projects. The core of this is the requirement for a rigorous and methodical risk assessment, concentrating on the safety and integrity of CO_2 storage to prevent leakage and harm to human health, fauna, the environment, and other resources.

A risk assessment has been carried out by EnEarth (Risk Management Plan – Containment, ref. PRC-CCS-REP-DRI-0002) which has fed into the design of the Prinos MMV plan. Additionally, EnEarth have built up an extensive body of technical work to characterise the Monitoring Area. Together, the risk assessment and characterisation have resulted in site specific monitoring requirements. They also ensure that efforts and resources are directed towards mitigating the most significant risks.

The focus for the Prinos MMV plan is on designing solutions that are necessary, site-specific, well-executed, and cost-effective. The Prinos MMV plan addresses the unique characteristics and risks related to this project. Doing what is essential and doing it well is preferable to implementing every conceivable solution, thereby optimizing the balance between safety, effectiveness, and financial investment.

The Prinos CO_2 Storage MMV plan is a live document and will be updated at least every 5 years or before to account for changes to assessed risk of leakage, changes to the assessed risks to the environment and human health, new scientific knowledge, and improvements in technology.

This MMV has been constructed with the help of specialised contractors, including Elemental Energies, Halliburton, Silixa and SpotLight.

2. Legislative Context

MMV plans are central for maintaining safe, effective, and permanent storage of CO_2. The Prinos MMV is designed to monitor plume conformance, detect leaks and verify compliance with regulations. It is tailored to regulations and risks specific to the Prinos CO_2 project. The key objective of the Prinos MMV plan is to:

Demonstrate a plan and timeframe that work to verify storage performance and the absence of significant leaks. This plan will confirm containment of CO_2 and raise alerts if there is a potential for leakage. If remedial action is required, the Prinos Corrective Measures Plan (2025) will be implemented. The MMV plan is designed to identify significant irregularities and verify the behaviour of the injected CO_2. It is designed to ensure:

- **Containment:** demonstrate the absence of significant leaks
- **Conformance:** determine the injection and long-term behaviour of the CO_2 plume and reservoir pressure
- **Confidence:** emissions accounting, manage induced seismicity and maintain social acceptance
- **Contingency:** establish plans to respond to irregularities

This MMV plan is designed to meet the regulatory requirements set out by the CCS (Carbon, Capture and Storage) Directive 2009/31/EC of the European Parliament and of the Council, Article 13 (1):

- “The operator should carry out monitoring of the injection facilities, the Storage Complex (including where possible the CO_2 plume), and where appropriate the surrounding environment for the purpose of:
    - Comparison between the actual and modelled behaviour of CO_2 and formation water, in the Storage Site
    - Detecting significant irregularities
    - Detecting migration of CO_2
    - Detecting leakage of CO_2
    - Detecting significant adverse effects for the surrounding environment, including in particular on drinking water, for human populations, or for users of the surrounding biosphere
    - Assessing the effectiveness of any corrective measures
    - Updating the assessment of the safety and integrity of the Storage Complex in the short- and long-term, including the assessment of whether the stored CO_2 will be completely and permanently contained.
- The monitoring shall be based on a monitoring plan designed by the operator pursuant to the requirements laid down in Annex II, including details on the monitoring in accordance with the guidelines established pursuant to Article 14 and Article 23(2) of Directive 2003/87/EC.
- The plan shall be updated pursuant to the requirements laid down in Annex II and in any case every five years to take account of changes to the assessed risk of leakage, changes to the assessed risks to the environment and human health, new scientific knowledge, and improvements in best available technology. Updated plans shall be re-submitted for approval to the competent authority.”

The CCS Directive does not specify the measurement methods or technologies that should be considered or used for monitoring. However, it does specify that monitoring must include continuous or intermittent monitoring of:

- Fugitive emissions of CO_2 at the injection facility
- CO_2 volumetric flow at injection wellheads
- CO_2 pressure and temperature at injection wellheads (to determine mass flow)
- Chemical analysis of the injected material
- Reservoir temperature and pressure (to determine CO_2 phase behaviour and state)

In addition to the above list, continuous or intermittent monitoring of the pressure in injection and water production wellbore annuli is recommended to verify well integrity.

3. Characterisation

3.1 Prinos CO_2 Storage Development Summary

The Prinos CO_2 Storage project will use the partially depleted Prinos oilfield for CO_2 storage (*Figure 1*). The project is located within the Prinos-Kavala basin, in the northern Aegean Sea (in water depths of ~30m), between the Greek mainland (18km to the north) and the island of Thasos (8km to the east).

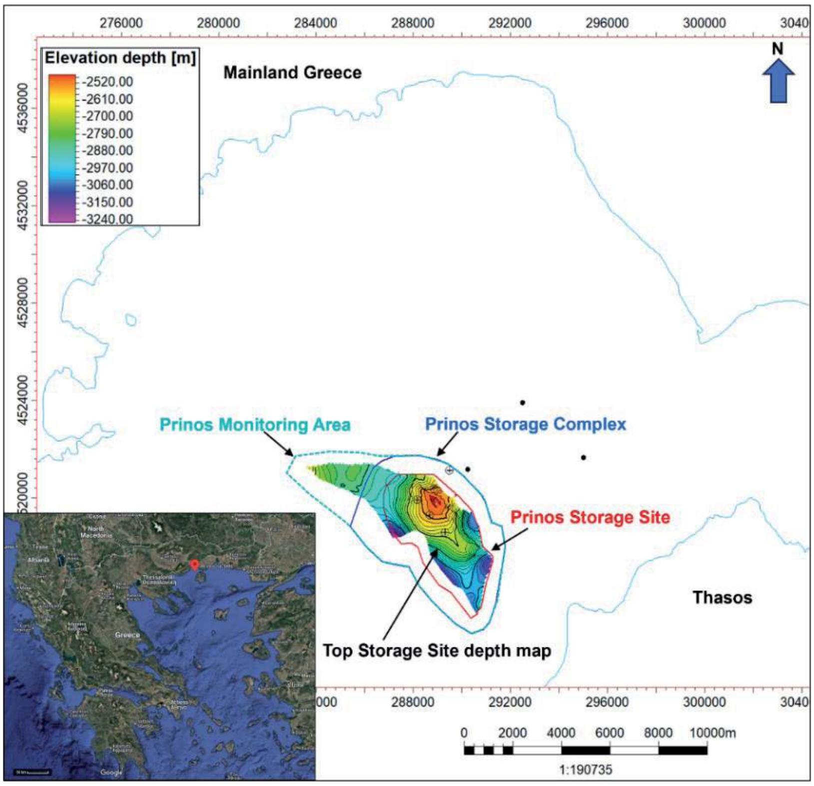


Figure 1: Prinos CO2 Storage project location map, with top Storage Site depth map (m) overlay

The Prinos oil field was discovered by the Prinos-1 well in 1973 and was appraised by 5 further wells between 1974 and 1977. Oil production started in 1981 and continues to 2025. Over 70 wells (including sidetracks) have been drilled into the Monitoring Area, all of which penetrate the formations to be used for storage. Several smaller hydrocarbon accumulations located within 2 to 4 km of the main Prinos field have also been discovered (Prinos North, Epsilon, Zeta, and Delta). Prinos North has been partially developed, and Epsilon produced oil via extended reach wells drilled from the Prinos Alpha platform infrastructure. The smaller Zeta and Delta discoveries have not been appraised following initial exploration well tests. The mapped Alpha prospect has yet to be drilled. The South Kavala depleted gas field lies ~12 km southwest of the Prinos oilfield.

Given the new injectors and water producing wells are currently planned in locations downdip of the Prinos oil field, data will be collected from these in-order to refine reservoir property estimates away from existing geological control points. Early CO_2 storage development wells should also acquire geological information in the Storage Site overburden to complete the existing dataset and improve monitoring.

EnEarth’s current development plans (see Figure 2 and Figure 3) are to:

- **Development Scheme 1 (Phase 1):**
    - 4 wells: 2 injectors + 2 water producers, all potential sidetracks from the Prinos Beta platform, using existing water processing infrastructure
    - First years inject into B and C reservoirs, while the A reservoir continues to produce oil
    - 10 years later the A reservoir oil shuts down and the CO_2 is injected everywhere, including the A, B, and C reservoirs. These assumptions also apply to water production
    - Up to 1 MPTA capacity, averaging 0.5 MPTA per well, with a maximum of 0.7 MPTA per well
    - New pipeline + receiving terminal onshore
- **Development Scheme 2 (Full Scale Capacity Phase):**
    - 15 wells: 6 injectors and 9 water producers
    - All new wells to be drilled from a new platform
    - Oil production ceases before any CO_2 injection activity
    - First years inject into B&C reservoirs, then addition of the A reservoir. Same for water production.
    - Up to 3MPTA, averaging at 0.5 MPTA per well, with a maximum of 0.7 MPTA per well
    - New additional platform for the new water processing infrastructure + new pipeline + receiving terminal onshore.

A phased approach will allow for geological data gathered in the new wells and to be integrated into the store development plan to optimise or adjust it, as required. The total CO_2 storage capacity for the Prinos CO_2 project is 18 MT. The targeted flow rates have an average injection rate of 0.55 MTPA and a maximum of 0.7 MTPA per well. Given the reservoir pressure and temperature conditions during injection, CO_2 will be in a supercritical state in the store.

During Phase 1 the existing Prinos oilfield infrastructure will be used as the host facility for CO_2 related wells. An offshore normally unmanned installation dedicated to hosting CO_2 offshore infrastructure is to be installed above the Prinos Storage Site for Phase 2.

CO_2 will be injected in locations downdip of the existing Prinos oilfield wells. Additionally, water will be produced from the reservoir to help manage pore pressure in the Storage Site and ensure operation within safe limits.

Formation water will be produced via new producers drilled into the water leg downdip of the field's crest to relieve pressure build up and ensure operation within safe limits to prevent geomechanical problems - with ca. 9000 bpd of water production per well. Timing of the cessation of Prinos oil production will be decided by the operator of the oil development in synergy with the conversion to CO_2 Storage and enhanced oil recovery effects will be avoided.

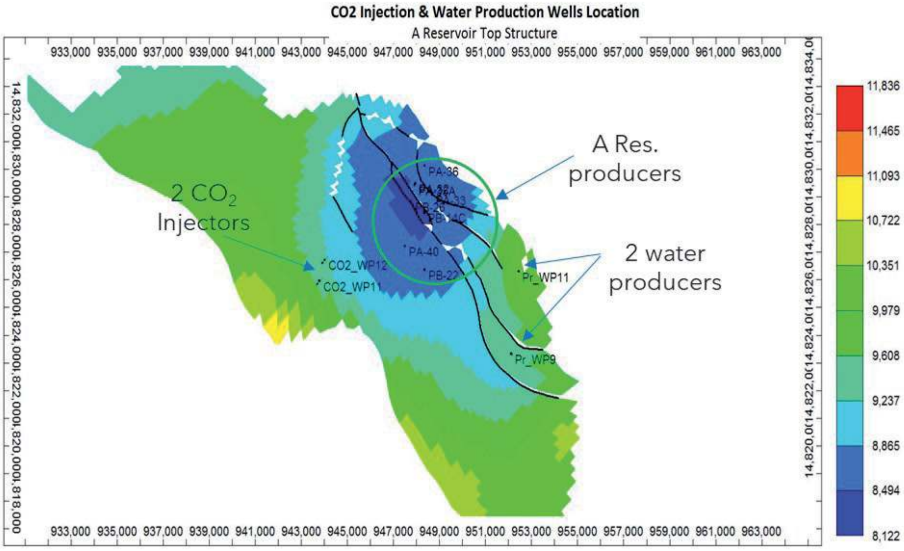


Figure 2: Top A reservoir depth map with 1MPTA case (permit application) Prinos CO2 storage project wells

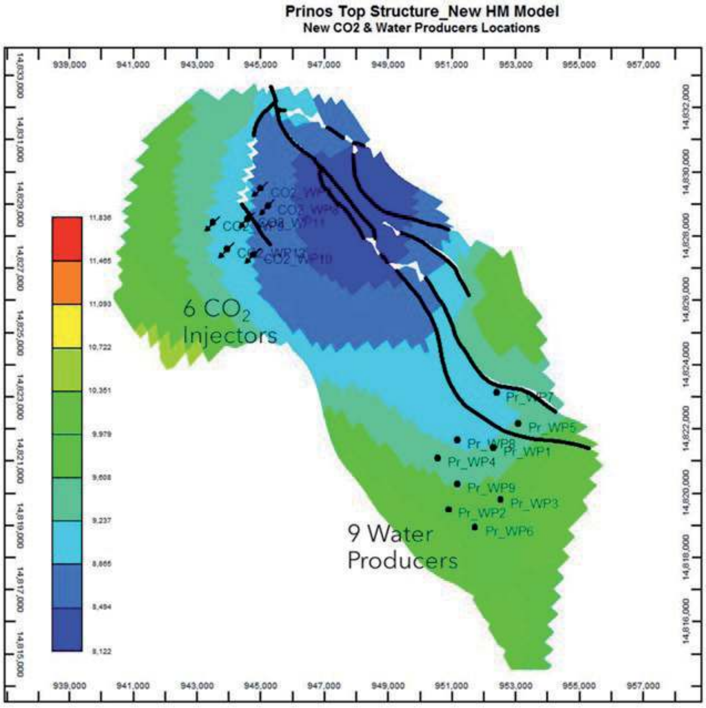


Figure 3: Top A reservoir depth map with proposed injector and water producing wells for the full-scale capacity case

3.2 Prinos CO_2 Storage Site, Storage Complex and Monitoring Area Definitions

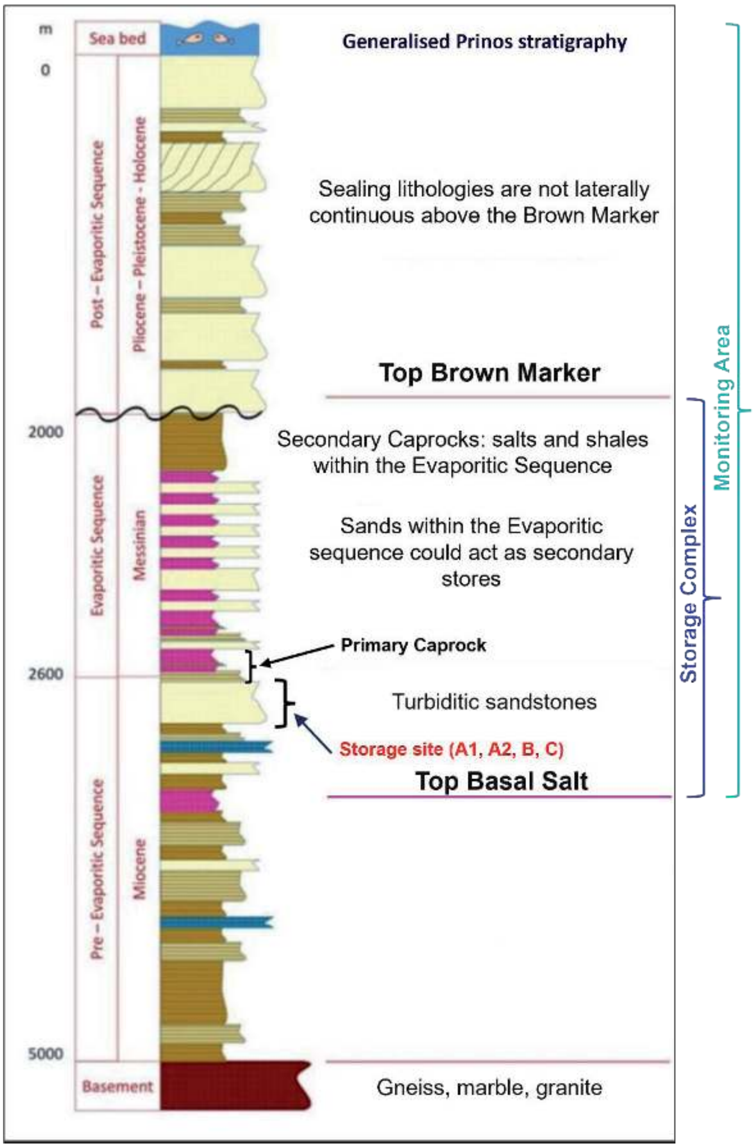


Figure 4: Generalized Prinos CO_2 Storage project stratigraphy, and the vertical extents of the Prinos Storage Site, Complex and Monitoring Area

Prinos Storage Reservoirs: CO_2 will be injected and stored within the Miocene Pre-Evaporitic sequence, specifically the turbiditic reservoirs known as A1, A2, B and C (Figure 4).

Storage Site: The Storage Site is a defined volume within a geological formation used for the geological storage of CO_2, and a defined area covering the associated surface and injection facilities (European Commission Guidance Document 1, 2024). The Prinos Storage Site consists of the Storage Reservoirs (Pre-Evaporitic Sequence A1, A2, B & C Miocene sands) and includes all wells and surface infrastructure within the red polygon shown in (

Figure *1*). The Storage Site boundaries have been agreed between HEREMA (Hellenic Hydrocarbons and Energy Resources Management Company) and EnEarth based on the maximum extent of the injected CO_2 plume in the reservoir throughout the project lifecycle, trap geometry, spill points, lithology changes and bounding faults.

Primary Caprock: A caprock is a geological formation overlying the Storage Site or Complex that effectively restricts upward migration of CO_2 or charged CO_2 formation fluids. At Prinos this is defined as the lowermost section of the Messinian Evaporitic Sequence, consisting of a ~20 m thick claystone overlain by the Lower Main Salt (LMS, ~100 m thick).

Secondary Caprocks: Overlying the Primary Caprock a sequence of salts interbedded with clastics, and capped by mudstone, belonging to the Evaporitic Sequence is present. Some of these salts and claystones could work as Secondary Caprocks, providing additional safeguards, in the event of migration from the Storage Site.

Storage Complex: This is the Storage Site and surrounding geological domain which can influence overall storage integrity and security; that is secondary storage, caprock and containment formations. EnEarth have agreed the vertical and lateral extend of the Storage Complex with HEREMA. Stratigraphically the Storage Complex extends from the top of the Storage Site to the top of the “Brown Marker” (Figure 4). The Storage Complex area was defined based on geological features (such as faults and facies changes) that may impact the containment of CO2 and risk assessments. Any permeable reservoirs within the Storage Complex could be additional secondary storage reservoirs, although they are not injection targets. The extent of the Prinos Storage Complex is highlighted by the blue polygon shown in (

Figure *1*).

Surrounding Area: This is the surface and subsurface area surrounding the Storage Complex where leakage or negative effects on the environment or human health are realistically possible. A risk assessment (EnEarth Prinos Risk Assessment, 2025) has been carried out to assess the significance of risks and inform on the extent of the Storage Complex and surrounding area.

Monitoring Area: The Storage Complex and Surrounding Area encompass the Monitoring Area. The extent of the Prinos Monitoring Area is highlighted by the dashed cyan polygon shown in (

Figure *1*), which includes the Epsilon field accumulation. The extent of the Monitoring Area has yet to be finalised with HEREMA.

3.3 Geological Characterisation and Expected Plume Behaviour

3.3.1 Reservoirs

Storage Site

The Storage Site consists of four stacked Miocene sandstone packages; A1, A2, B and C (Figure 4). Core descriptions suggest that the reservoir sandstones consist of a series of stacked/amalgamated high to very high-energy turbidite flows, separated by low to very low-energy mud-dominated flows. The storage reservoirs consist of a mix of channel and distal fan turbidites, deposited during basin subsidence.

Petrographic interpretations show that reservoir A1 contains moderately well sorted, mostly medium grained sandstones. Reservoir A2 contains alternations of structureless, fine laminated sandstones with medium grained and moderately well sorted sandstones. Reservoir B is characterized by structureless sandstones with grain size typically being medium to coarse sand. As with A2, the B reservoir has several thin sandy claystones layers. The sandstones of the C reservoir are mainly poorly sorted, very coarse-grained with some conglomeratic intervals. Vertical connectivity is low between stratigraphic reservoirs with correlated horizontal barriers interpreted between A, B and C reservoirs.

The combined average thickness of the Storage Site reservoir is 285 m TVT. Depth to Storage Site crest is 2450 m TVDSS, with the deepest section of the Storage Site located at 3566 m TVDSS. Net to gross ranges from 69 to 76%, while net porosity ranges from 7-20% (average 14%). Permeability averages at 250mD but can be up to 6000 mD (Table 1).

The Prinos field produces an undersaturated, sour crude (27-29° API gravity) with high sulphur content (from 30% of the gas phase in the B and C reservoirs to 60% of the gas phase in the A reservoirs), wax, and asphaltene content. CO_2 is also present within the crude (2.02% at well PB-13). The B and C reservoirs are lower Net to Gross and more heterogenous than the A reservoirs. ~80% of the produced oil originated from the A reservoirs. Well P-1 on drill stem test (DST) flowed at 2950 bopd, under restricted conditions.

The A, B and C reservoirs are separate and have three different OWCs (2711, 2751 and 2791 m TVDSS respectively), with sealing claystones between each of the reservoirs. There is no evidence for the three reservoir zones exhibiting vertical communication with several pieces of evidence supporting this: different depletion levels, varying oil qualities, different pressure gradients and three distinct oil-water contacts. Laterally there is also evidence of fault compartmentalization; the north-eastern section of the crest is isolated from the rest of the field (Figure 5). The Prinos reservoirs do not exhibit a well-developed and connected natural fracture system. However, there is some evidence of deformation bands which could work as baffles to flow.

The Prinos Field is partially depleted by production, indicating a lack of pressure support from the aquifer, and necessitating the use of water injection to remain above bubble point pressure and support oil production. A similar pressure response is shown at the Epsilon field, again indicating a closed system. This and seismic interpretation suggest that the oil field and aquifer system is closed.

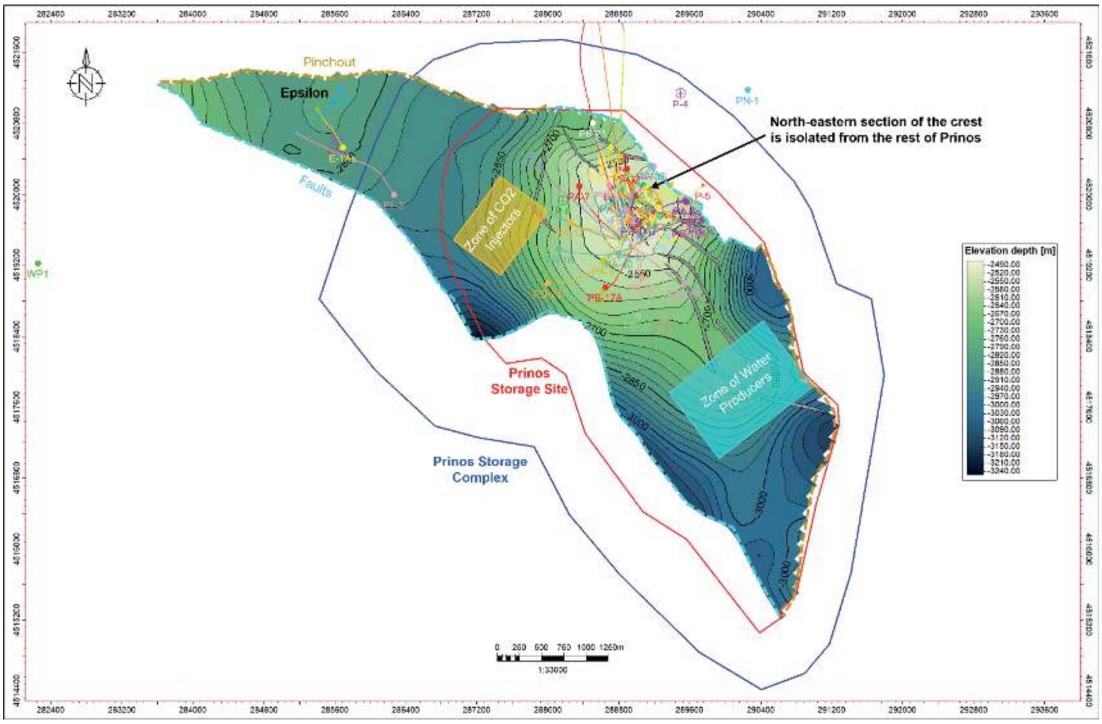


Figure 5: Top Reservoir A depth (m) map showing the extent of the Prinos aquifer and al. Boxes denote areas where CO2 Injector and water producer wells are likely to be located

Reservoir	Area	Average Gross Thickness (m TVT)	Depth Range (m TVDSS)	Average Porosity (PU)	Average Perm (mD)	Pressure at Injection Start, Crestal (psia)	Temperature at Injection Start, Crestal (˚C)
A1	Storage Site	62	2482-3186	0.166	291	4083	110
A2	Storage Site	81	2553-3382	0.141	196	4269	115
B	Storage Site	42	2652-3457	0.13	106	5024	125
C	Storage Site	55	2714-3566	0.134	561	4867	130

Table 1: Average Storage Site properties

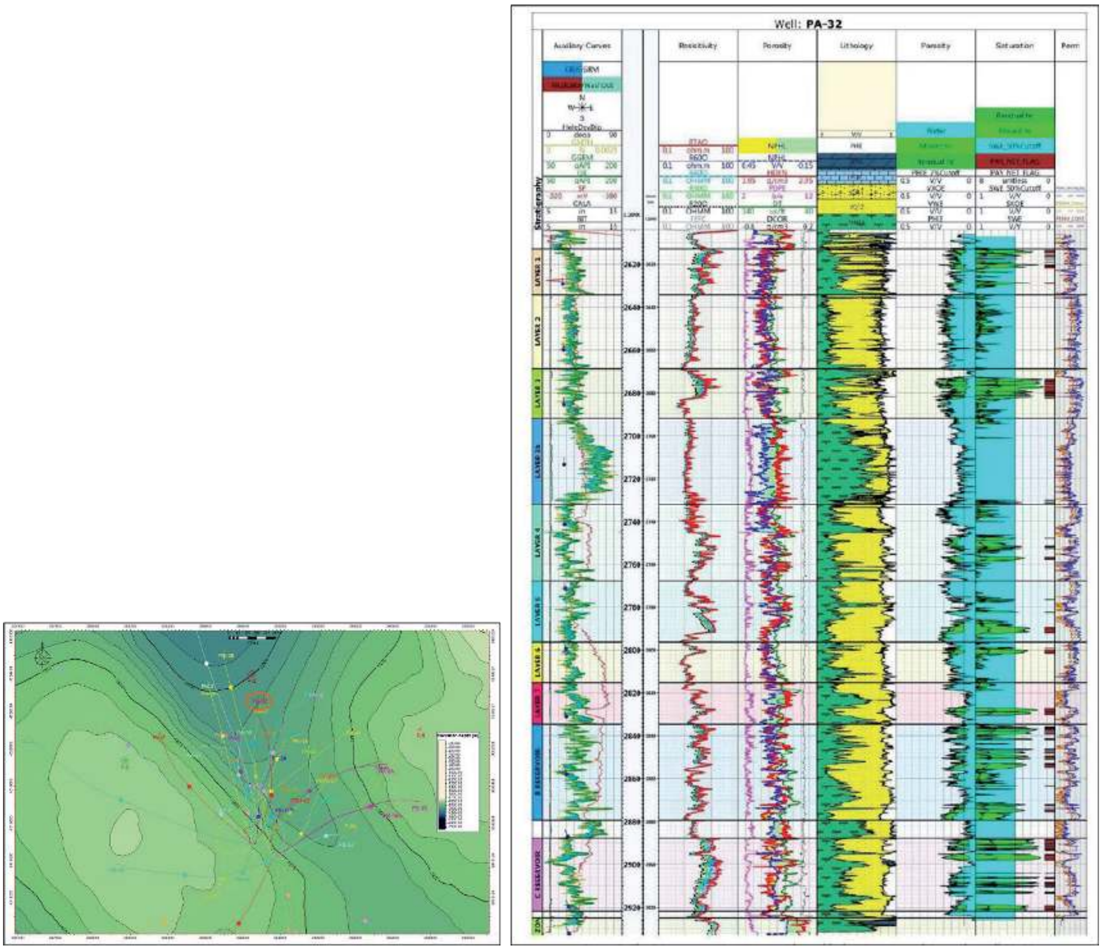


Figure 6: Example computer processed interpretation (CPI) from well PA-3. Well location shown inset on a map of Top Brown Marker depth.

Expected Plume Behaviour

CO_2 will be injected in the super-critical phase and remain in this phase while contained in the Storage Site. CO_2 will be in contact with oil, water, and rock. CO_2 will be stored, principally, under four trapping mechanisms:

- Structural and stratigraphic trapping
- Residual trapping due to relative permeability and capillary pressure imbibition-drainage hysteresis
- Solubility trapping – CO_2 will be trapped dissolved in reservoir fluids.
- Mineral trapping.

Injectors are currently planned to be located west of the Prinos field, while water producers will be to the south-east of the field (Figure 5). During CO_2 injection some oil production from Prinos could be on-going:

- **Phase 1:** Simultaneous Oil Production and CO_2 Injection: To minimise the risk of CO_2 leaks, oil production should be restricted to the A Reservoir while CO_2 injection and storage will be limited to Reservoirs B and C. Potential crossflow through legacy wells should be monitored.
- **Full Scale Capacity Phase:** Oil Production Cessation: CO_2 will be injected and stored within all Prinos A, B and C reservoirs.

Injection will commence in the water legs of reservoirs B and C. Simulations show that CO_2 will migrate up dip towards the field's crest following the roof of reservoirs B and C. These are stratigraphically isolated from each other. Once the CO_2 reaches the Prinos oilfield, the CO_2 front is likely to sweep oil and act as a solvent, stripping volatile hydrocarbon fractions and leaving behind low saturations of heavy residual oil.

At a later stage in Phase 1, CO_2 will be injected into the A1 and A2 reservoirs. Simulations show that CO_2 will accumulate within the structural highs of each of the Prinos reservoirs, while some will dissolve slowly within the water leg as injection continuous.

Water production wells will extract water to the south-east to prevent excess reservoir pressure build-up and protect Storage Site seal integrity. The water offtake is likely to act as a pressure sink and spread towards the water production wells. CO_2 in the form of carbonic acid may eventually reach these water producers. This will be accounted for in the well design, monitoring, and management.

A narrow and depleted fault block located north of the field's crest (Figure 5) is shielded from the CO_2 plume due to a fault acting as a barrier. Wells in this part of the Prinos field are unlikely to see the CO_2 plume.

The Epsilon oilfield wells will not be exposed to the CO_2 plume. The B and C reservoir units are not in communication between the two oil fields, while the A reservoir may have some hydraulic communication through the aquifer (uncertain), thus potentially an increase in pressure in the A zone of Epsilon field may be observed, as the Prinos structure is pressured up.

Epsilon currently produces oil through a single extended reach well (from the Prinos Alpha Platform). The Epsilon oil field reservoirs are within the upper Pre-Evaporitic Sequence, in the same interval as those of Prinos. The field has three oil reservoirs separated by claystones and each with individual OWCs. The total STOIIP is estimated to be 82MMbbls, with low recovery (<1%) to date. Epsilon produces lighter, compared to Prinos, undersaturated sour oil with 2-3% CO_2 and H_2S of 8-14% mole in gas. The Prinos North oilfield is currently still producing but is located updip of Prinos, in an isolated compartment and will not be affected by CO_2 storage activities.

Storage Complex

Emergence and shallowing, in association with the Messinian salinity crisis, occurred after the deposition of the Prinos Turbidites. The Storage Site is unconformably overlain by a thick succession of over-pressured salts (halites and anhydrites) and interbeds of claystone, siltstone, and sandstone clastic rocks, known as the Evaporitic Sequence. These clastics could form secondary storage intervals in the event of migration from the Storage Site.

The uppermost reservoir of the Evaporitic Sequence is known as the “Brown Marker.” This is a thick succession of tan-coloured, marls, sands, anhydrites, and claystones which represent a deepening and/or a renewed connection to the open Mediterranean at the end of the salinity crisis event. The top of the Brown-Marker is the upper limit of the Storage Complex and considered as the MSAD (Minimum Safe Abandonment Depth) at its shallowest depth.

The Storage Complex extends below the Storage Site down to the top of the Basal Salt. This under-burden section consists of interbeds of claystone, siltstone, limestone, and sandstone which will require monitoring for containment assurance.

Overburden

The Post-Evaporitic sequence (Figure 4) is of Pliocene to Pleistocene in age. This section contains permeable sands, with occasional silt and clay layers (which are difficult to correlate regionally). The lower Post-Evaporitic sequence is marine dominated while towards the top of the Post-Evaporitic interval sediments were deposited by a prograding delta that was fed by the palaeo Nestos River. A transgression led to the deposition of marine clastics above this sequence. There are no continuous seals or caprocks within this interval.

3.3.2 Trap

The Prinos CO_2 storage project makes use of the same trapping mechanism as the oilfield; three-way dip closure onto an updip fault. Depth to Storage Site crest is 2450 m TVDSS, while the deepest section of the Storage Site is located at 3566 m TVDSS. Within the tectonic setting of the Prinos basin, the Prinos and Epsilon fields are structural traps located in the hanging wall of an intra-sedimentary low angle listric fault, with flat-ramp-flat geometry, and were formed as submarine extensional wedges due to unstable sliding. The Storage Site is situated on the southerly, down-thrown side of a NNW-SSE listric fault. NW-SE trending normal faults crosscut the Storage Site (Figure 5). It is possible that sands within the Evaporitic Sequence could form secondary CO_2 stores in the event of migration from the Primary Store from the primary Prinos storage site.

3.3.3 Caprocks

The Primary Caprock consists of a claystone (approx. 20 m thick) overlain by a sequence of evaporites known as the Lower Main Salt (approx. 100 m thick), which is crosscut by relatively few faults. The Storage Site updip lateral seal (Figure 5) is provided by fault juxtaposition, reservoir against the lower Pre-Evaporitic sequence. This sequence consists of siltstones, claystones, thin limestones, and conglomerates. To the east the Storage Site is defined by stratigraphic pinchout, while to the south-west faults seal the Storage Site. The north-western boundary of the Storage Site is defined by the spill-point towards the Epsilon oilfield. Seismic mapping, drilling, and reservoir development data all suggest the Prinos aquifer is a closed pressure cell system, and not open-ended.

Oil production, pressure history and calibrated dynamic simulation suggest that the claystones between each of the four reservoirs can also be considered as sealing.

The Primary Caprock is overlain by claystones and impermeable, creeping salts within the Evaporitic

Sequence (700-1000 m TVT) which could provide additional storage complex containment integrity. Above the Storage Complex limit, regional seals have not been identified.

The Prinos Evaporitic Sequence Sealing Potential study indicates that active creep in the Evaporitic Sequence, in particular across the Lower Main Salt is taking place, which is in line with field experience. The Lower Main Salt likely to be an excellent caprock because of its layer thickness, homogeneity and depth – which drives the closure stress at the cement interfaces. Halite has a closure stress approaching the overburden gradient, of the order of 2.1 SG.

4. Prinos MMV Approach

MMV programs are central for maintaining safe, effective, and permanent storage of CO_2 by monitoring for leaks, and verifying compliance with regulations. This MMV plan is tailored to regulations and risks specifically associated with the Prinos CO_2 storage project. The key objectives of the Prinos MMV plan are to:

- Design a plan that works to verify storage performance and absence of significant leaks
- Set a timeframe for the MMV plan

Monitoring should confirm containment of CO_2, be alert to any increased leakage risk, identify and locate leakage if it occurs and significant irregularities, and verify the behaviour of the injected CO_2. If remedial actions are required, the Prinos CO2 Corrective Measures Plan (2025) can be implemented.

This MMV plan is guided by EU Commission Guidance Document 2 (2024) and recommendations made by the International Association of Oil and Gas Producers (IOGP, 2022). EU Commission Guidance Document 2 (2024) states that mandatory monitoring of the below is required:

- Fugitive emissions of CO_2 at the injection facility
- CO_2 volumetric flow at injection wellheads
- CO_2 pressure and temperature at injection wellheads (to determine mass flow)
- Chemical analysis of the injected material
- Reservoir temperature and pressure (to determine CO_2 phase behaviour and state)

Prinos carbon storage will be first CO_2 geological storage site developed in Greece. This MMV was developed using learnings from other CO_2 storage projects, located worldwide. The Prinos MMV philosophy is risk based, site specific and designed to be cost effective. A risk assessment (including bow-tie analysis) feeds into the MMV. There is a focus on accurate measurements at the wells, with heavy reliance on mature technology. Equally away from the wells the MMV is focused on providing robust characterisation of the Storage Site, Complex and overburden (for example using seismic solutions including SpotLight).

Some of the unique characteristics of the Prinos CO_2 project include:

- Numerous legacy hydrocarbon related wells penetrate the Storage Complex
- High salinity brine (200 000 ppm%w) within the storage reservoirs

Hence the Prinos MMV plan is focused on obtaining comprehensive baselines, a wide selection of monitoring techniques providing a mix of continuous and periodic measurements. In addition, if deviations from expected behaviours are observed a series of contingency (triggered) monitoring measures are in place. Further to this the MMV outlines specific solutions for monitoring the legacy wells.

4.1.1 Evolution of Offshore MMV Programs: Industry MMV Experience and Approach

Numerous CCS projects have been launched in the last 30 years, mostly onshore with a few offshore projects. 30 years of safe geological storage of CO_2 suggests that effective means of monitoring have been developed. In addition, these projects demonstrate the ability to conduct comprehensive MMV programs which are with regulations and exhibit an ability to describe CO_2 migration patterns within the reservoir.

MMVs which are relevant to the Prinos CO_2 project in terms of providing analogue experience were written in support of the following European projects: Acorn (UK), Endurance (UK), Greensand (Denmark), HyNet (UK), Northern Lights (Norway), Poseidon (UK), Sleipner (Norway), and Snohvit (Norway). In addition, valuable technical and methodology learnings were taken from onshore projects such as the Moomba CCS (Australia) project as well as the Canadian Quest and Aquistore projects.

5. Risk Assessment Approach and Key Findings

5.1 Risk Assessment Approach

EnEarth have carried out a Semi Quantitative Risk Assessment (SQRA) (Prinos CO_2 Risk Assessment, 2025) using the risk matrix shown in Table 2 to analyse potential risks to containment within the Prinos Storage Site and Complex. The risk assessment was completed by a multi-disciplinary team and is a life document which will be updated throughout the project life cycle. It builds on the earlier risk assessment and studies work completed by EnEarth as part of the Storage Permit Application (2024) which incorporates the results of the earlier bow tie analysis (Qualitative Risk Assessment).

Directive 2009/31/EC of the European Parliament and of the Council states:

> “A site should therefore only be selected as a Storage Site, if there is no significant risk of leakage, and if in any case no significant environmental or health impacts are likely to occur. This should be determined through a characterisation and assessment of a potential Storage Complex pursuant to specific requirements.”

EU Commission Guidance Document 1 (2024) states:

> “A key principle of risk management is that the level of risk is reduced as low as reasonably practicable (ALARP). This implies that some risks may be assessed as contingent acceptable or tolerable if the cost or effort associated with reducing the risk is disproportionate to the level of risk, and the risk can be maintained at an insignificant level.”

One important consideration for ALARP demonstration and the determination of risk significance is the principle that the risk of negative impacts should not outweigh the positive effects (Prinos CO_2 Risk Assessment, 2025). For CO_2 geological storage activities, this implies that the risk of negative impacts of a project to human health or the environment should not outweigh the expected benefits to the social good, including from the emission reductions obtained.

5.2 Risk Assessment Key Findings

Below is a summary of the risks associated with the Prinos CO_2 Storage project:

- Leaks from legacy Prinos oilfield wells, exploration, and appraisal wells
- Leaks from Prinos CO_2 Storage project wells
- Lateral geological leak out of Storage Complex
- Vertical migration/leak through faults out of primary Storage Site
- Vertical migration through Primary Caprock out of primary Storage Site
- Geological leak out of secondary Storage Site and Complex

Article 3 of Directive 2009/31/EC defines a leak as “any release of CO_2 from the Storage Complex”. This includes releases into the marine and atmospheric environments as well as leaks outside the subsurface Storage Complex boundaries.

The largest overall risk to containment is wells, as there is a large variety of ways the CO_2 can leak from wells penetrating the overburden and reservoir out of the store or complex. All geological risks are in the low-risk category.

CONSEQUENCE							PROBABILITY				
							P1	P2	P3	P4	P5
CATEGORY	PEOPLE	PROCESS SAFETY	ENVIRONMENT	DAMAGE / LOSS		REPUTATION	Very rare - once per 1,000-10,000 wells (once or less in the company, a few times or less in the industry)	Very unlikely (Not likely to occur) - once per 100-1,000 wells (isolated event across the company or occurred several times in the industry)	Unlikely (Possibility of occurring sometime) - once per 10-100 wells (not happened at the site but occurred a few times in the company)	Somewhat Likely (Possibility of isolated incidents) - once per 1-10 wells (once at the site or several times across the company)	Very Likely (Possibility of repeated incidents) - several times during a well (several times at the site or many times across the Company)
							Annual Frequency				
				Wells Time / Asset Loss	**Well Control (ref. IOGP Report 660)**		$< 10^{-4}$ < 1 / 10,000	10^{-4} to 10^{-3} > 1 / 10,000	10^{-3} to 10^{-2} > 1 / 1,000	10^{-2} to 10^{-1} > 1 / 100	10^{-1} > 1/10
1 Slight	FAC	Demand/Activation of safety systems, safe operating limit excursions, impaired or bypassed safety systems, safety systems failing on demand or in test, primary containment inspection or testing results outside acceptable limits	Inconsequential or No Adverse Effects	< 24 hours NPT or Unplan time < $1 million		Technical or administrative non-conformance but promptly addressed - No public knowledge.	L	L	L	L	L
2 Minor	MTC, RWDC	Per BEIS report/IOGP 456, *CO2 leak ≤ 5.0 tonnes/day*	Potential Short Term, Minor Adverse Effects < 1 month LOCAL	> 24 hours NPT or Unplan time > $1 million	WCI Level 4 - Near miss or potential well control incident	Public Complaints With No Media Coverage. Temporary Closure of Side Road/Site. Minor Inconvenience	L	L	L	M	M
3 Moderate	Serious Injury, LTI / LWDC	Per BEIS report/IOGP 456, *CO2 leak up > 5.0 tonnes/day up to 50 tonnes/day*	Potential Short Term Impact < 1 year, Minor Advserse Effects REGIONAL	> 72 hours NPT or unplan time > $6 million	WCI Level 3 - Routine Well Control	Local Media Coverage, Small Community Impact, Secondary Road/Site Closure < 24 Hours	L	L	M	M	H
4 Severe	Long term Disabity. Serious Injury Requiring Medical Treatment to Members of Public	Per BEIS report/IOGP 456, *CO2 leak > 50 tonnes/day up to 1,000 tonnes/day - SIGNIFICANT risk per EU Directive 2009/31EC*	Long Term Impact (1-3 years)	> 10 days NPT or unplan time > $12.5 million	WCI Level 2 - Complicated Well Control	Some Public Disruption, Extended National Media Coverage. Medium Community Impact. Small Scale Evacuation or shelter-in-place. Major Road/Site Closure > 24 Hours	L	M	M	H	H
5 Major	Fatality(ies)	Per BEIS report, for *CO2 in the CCS context > 1,000 tonnes/day - SIGNIFICANT risk per EU Directive 2009/31EC*	Potential widespread, long term, significant adverse effects >3 years	> 25 days NPT or unplan time > $100 million	WCI Level 1 - Loss of Well Control. Blow out	Significant Public Disruption; Major International Media Coverage; Large Community Impact, Large Scale Evacuation, Major Road Closure > 10 days	M	M	H	H	H

Table 2: EnEarth risk assessment matrix

As stated in the Containment Risk Assessment (ref. PRC-CCS-REP-DRI-0002), EnEarth proposes a dynamic significant risk threshold over the project lifecycle. During the injection period, this limit will be up to 50 tonnes per day. During the post-closure period, it will be up to 5 tonnes per day. Before and upon handover, the significant limit will be up to 2% of the total stored volume over a period of 1,000 years. These thresholds do not mean that EnEarth will not act upon identifying a leak that is below or that approaches this value. Instead, the limit informs whether additional safety precautions are required within the area of operation. It also triggers the MMV Plan to focus on identifying the source and quantifying the risk while the project team prepares to execute the Corrective Measures Plan, if applicable.

The summary of the significant risk limits over the project lifecycle is summarised in Table 3. EnEarth considers that this proposed approach is realistic, practical, and fulfils the purposes of Directive 2009/31/EC.

Table 3. Significant Risk Threshold

Project Phase	Threshold for a leak
Injection	Up to 50 tonnes per day
Post-Closure	Up to 5 tonnes per day
Before handover and after	Up to 2% of the total store volume

The Prinos site-specific conditions indicate that there will be subsurface and legacy well containment as outlined in this document. The geological-containment risks are deemed low. In the unlikely event of a leak on any inaccessible well, the path of least resistance is sideways into the deep or shallow strata. The flow path analysis indicates that it is unlikely for CO_2 to leak unrestricted through an internal pathway, such as an open-ended casing. There are restrictions in each well that prevent or restrict the seepage of CO_2.

6. Prinos CO_2 Storage Risks

EnEarth have carried out an analysis of loss of containment and conformance threats and consequences, which is summarised in Figure 7.

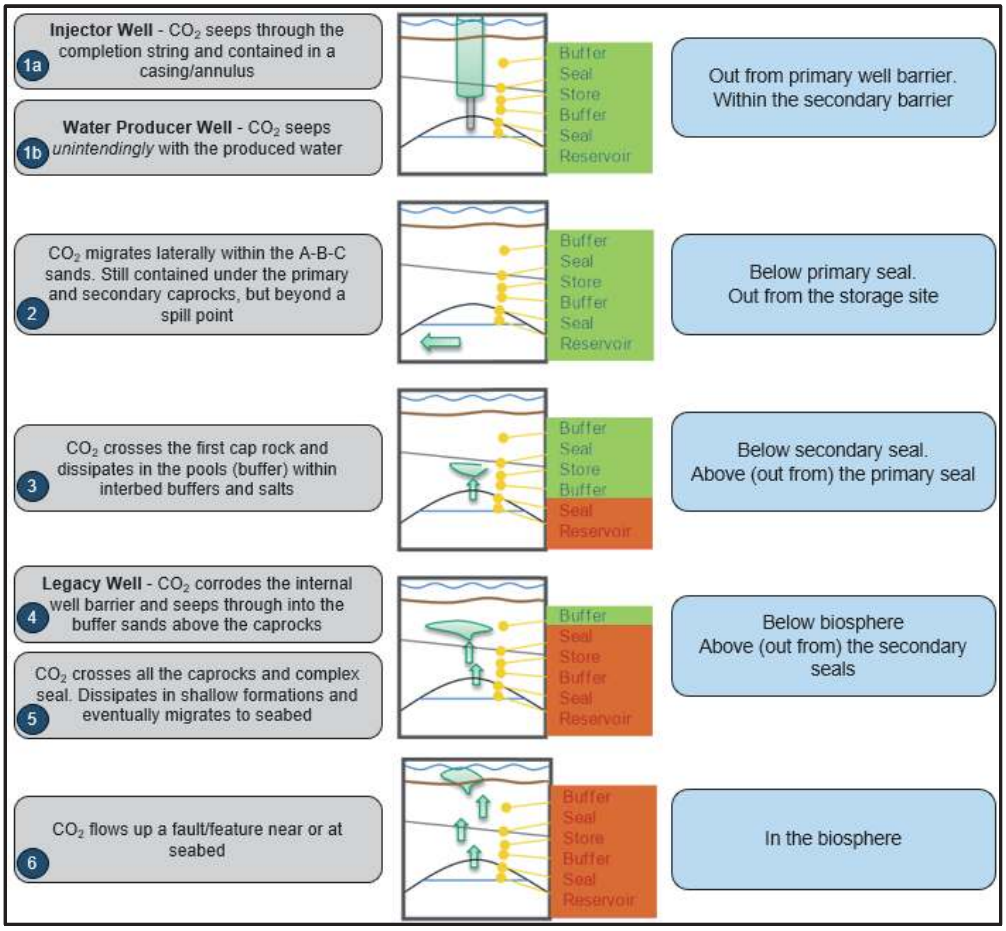


Figure 7: Summary of Prinos loss of containment and conformance threats and consequences

6.1 Well Related Risks

EnEarth (2024) have undertaken a hazard identification study on legacy wells, and future CO_2 injection wells, as documented in the Storage Application Step 1g document. This evaluated the integrity status of each well penetration within the Prinos field that could be exposed to CO_2 and pressure build-up. The evaluation involved systematic analysis of historical records to identify well barriers, placement, and verification practices. It is supplemented by a third-party report produced by Stag Geological Services, which indicates that the annulus pathways for most wells could be sealed by the creeping movement of the overlying salt.

6.1.1 Risks in Legacy Wells

Prinos has been a producing oil field since the early 1980s, and it has multiple penetrations through the caprocks. There are 76 man-made wells in the surrounding area, some of which can potentially create a leak pathway for stored CO_2 to migrate to shallower zones and/or the seabed. The legacy wells are distributed as follows:

a. 35 have or will have suitable barriers for CO_2, including the 23 currently active wells;
b. 29 have at least one verified barrier and are acceptable;
c. 12 are non-compliant and inaccessible, as each of these lacks a cement plug where it is needed to meet current CCS's plug and abandonment practices.

However, 8 of these 12 non-compliant wellbores have been recategorized as low risk, as follows: i) even in the 2.8 Mtpa scenario, which is the highest possible connected volume in Prinos, the CO_2 plume will not arrive to wells PA-28, PA-35, PA-29, PB-14, PB-14A, and P-5A, ii) well PA-31 will have a low connected mass of CO_2 at the end of injection and the shallowest potential leak point is at 1,900 m, with a zero leak flux resulting at the seabed per the leak rate models, and iii) for well PB-13, the shallowest potential leak point is below the caprocks, thus any CO_2 flux will be contained within the storage site.

Only the non-compliant wells PA-3, PA-8, PA-10, and PB-13A are considered irregularities in Prinos. However, the historical well records and 40-years of field experience confirm that these wells are fully plugged by scales and asphaltenes. Thus, EnEarth does not consider that these four non-compliant wellbores are ‘significant’ irregularities.

A detailed analysis of the legacy wells and its associated risks are described in the Containment Risk Assessment (ref. PRC-CCS-REP-DRI-0002).

6.1.2 Risks in New Wells

When any new well is drilled into a Storage Complex it disturbs the cap rock(s) and potentially creates a new leak path. Therefore, it is important to design, build, operate and abandon the CO_2 injection wells in such a way that leakage risk is minimized. Despite this the potential for a leak to occur in the event of a well failure does remain.

While it is possible that during the life of the store a small proportion of the injected CO_2 will be produced back at the water production wells, this does not in itself represent a leakage risk provided the produced fluids are contained in the processing facilities and managed in the appropriate manner. However, as with the CO_2 injection wells a well integrity failure could result in a leak.

6.2 Legacy Well Leak Rate Modelling

The leak models prepared by Elemental Energies for a sideways leak indicate that the flux rate depends on many factors, particularly the net-to-gross distribution, dips in relation to the well, connected CO_2 volume in place, leaking depth, and in-situ restrictions (e.g., tubing, fluids, scale, asphaltenes, etc.). The results summarise flux rates estimations over 1 month, 1 year, 10 years, 100 years, and 1,000 years.

A summary of the work is described in the Leak Rate Model report.

EnEarth developed an in-house probabilistic code for estimating the containment risk aggregation of all 76 legacy wells in the Prinos surrounding area. The model is limited because it can only show a snapshot at a specific point in time, as risk is dynamic and changes as more CO_2 is injected into the subsurface. The selected scenario is the end of injection, where the risk is the highest. The results show an aggregated P50 flux rate risk of 1.0 tonnes of CO_2 per day, where well PA-3 contributes the most to the containment risk. If PA-3 does not leak, the aggregated P50 flux is reduced to 0.04 tonne per day. If PA-3 and another well deemed as irregularity in Prinos do not leak, the aggregated P50 flux from Prinos is zero.

6.3 Geological Risks

The critical risk for this project at present is leakage from legacy wells, however several geology related leak pathways also require monitoring (Figure 8). The Prinos CO_2 Storage Project Risk Assessment (2025) provides more detail with regards to each of these risks.

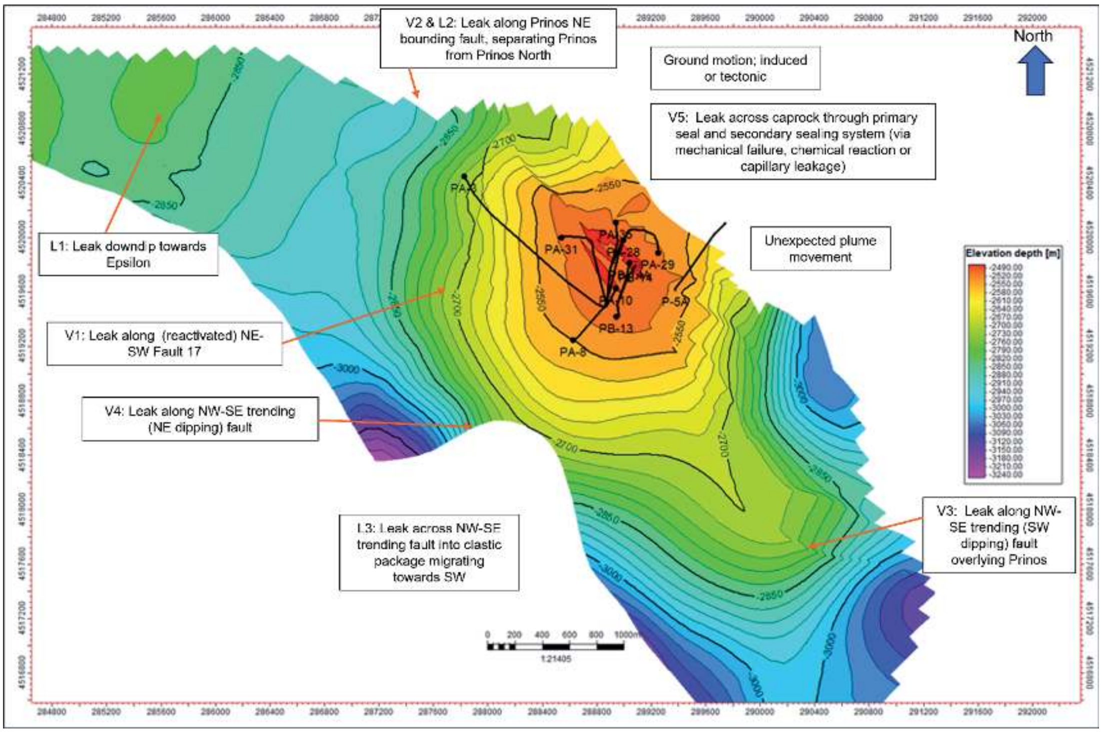


Figure 8: Top Prinos Reservoir A depth map with high risk well bores shown and key geological risks

6.4 CO_2 Pipeline and Offshore Facilities Risks

Prinos CO_2 pipelines and offshore facilities could be potential leak paths allowing release of CO_2 into the environment. High pressures, and CO_2 contamination by impurities together with potential accidental damage from external activities and operational incidents are a few of the leakage mechanisms EnEarth have analysed. These must be carefully managed and mitigated to ensure safe CO_2 transportation.

Additional risks include human error, equipment failure, and natural disasters which can cause accidents during construction, operation, and maintenance. The release of CO_2 or other hazardous materials during an accident can pose immediate health risks through inhalation or contact.

Possible CO_2 leakage pathways can be identified along the pipeline via various exposure mechanisms. The high arrival pressure of CO_2 sources namely, combined with the risk of over-pressurization due to equipment failure, pipeline blockage due to impurities accumulation, or operational errors, is a concern, which can lead to pipeline rupture or burst, resulting in CO_2 leakage into the environment. Additionally, pipeline corrosion, can deteriorate the pipeline structure over time, increasing the probability of leaks while mechanical failures, such as material fatigue or weld defects can also contribute to this event by forming weak points in the pipeline that can fail under high pressure conditions.

6.5 Environmental Considerations

The Prinos CO_2 Storage project is located in mild and stable marine conditions. Water depths over the Monitoring Area averaging at 30 m, with shallow dips. Environmental monitoring is especially important at Prinos given the project is located within a European protected area (NATURA 2000 GR1150014, Figure 9), which seeks to protect four species:

- Shag (Mediterranean subspecies) - Phalacrocorax Aristotelis Desmarestii
- Shad - Alosa Fallax
- Common Porpoise - Phocoena Phocoena
- Bottle-nosed Dolphin - Tursiops Truncatus

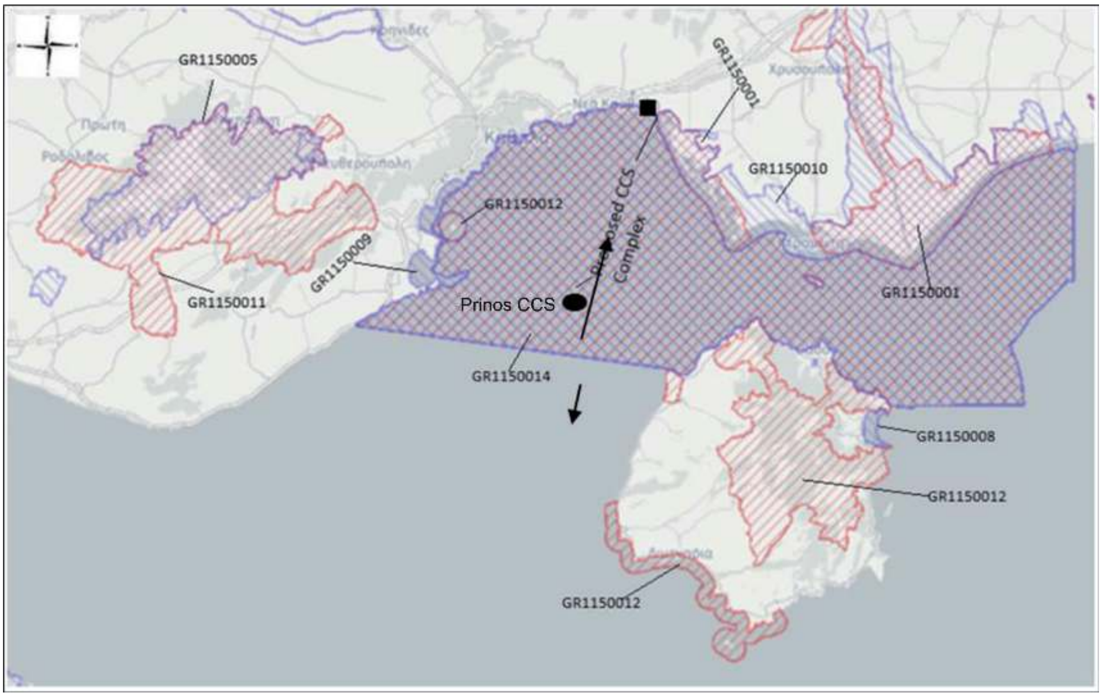


Figure 9: Northern Greece NATURA 2000 areas

The Prinos CO_2 Storage project is located 8km west of the tourist destination Thasos. Other domains, pertinent to this MMV, which could be affected by the storage of CO_2 at Prinos include:

- Marine vessels
- CO_2 pipelines
- Offshore facilities:
- Prinos oilfield facilities
- Prinos CO_2 offshore facilities
- Seabed and seawater above potential leak paths

In addition to potential CO_2, and other fluid, leaks care and attention should be taken to ensure saline produced water is handled in an environmentally sensitive manner.

7. Prinos CO_2 Storage Safeguards

7.1 Evaluation of Geological Safeguards

7.1.1 Structural Trap and Seals

The Prinos CO_2 Storage project will involve use of a structural closure which is proven to work as a trapping mechanism for hydrocarbons. The Storage Site is not part of an open-ended reservoir. Top structure depth control is high given a high density of wells available as control points. However, there is more depth and topographic uncertainty in the water leg away from the field’s crest where new injectors and producers are planned.

The Storage Site primary cap rock consists of claystone overlain by impermeable salt with few cross-cutting faults. Claystones and salts within the Evaporitic sequence could work as secondary caprocks. It is possible that sandstones within this interval could also work as secondary stores in the event of loss of containment from the Storage Site. Above the Brown marker regional seals are not present.

CO_2 could enter the Primary Caprock through mechanical failure, chemical reactions, or capillary leakage. Mechanical failure (shear and tensile) was analysed by a geomechanical study, with the results suggesting that the likelihood of this occurring is low. Considerable stress increase would be needed to trigger shear failure. Similarly, the tensile failure risk was found to be low in all modelled scenarios.

Dynamic geomechanical modelling for CO_2 injection showed that there is no risk of tensile fracturing in the Storage Site top shale and Lower Main Salt Primary Caprocks because of the planned CO_2 injection. The caprock above the top shale is composed of salt, which is ductile and has the potential to seal induced fractures.

Chemical reaction processes of the injected CO_2 with the Primary Caprock rock in-situ minerals may result in an increase in porosity of ~0.5% over 30 years. This is not expected to significantly affect the integrity of the caprock. The capillary integrity of the Primary Caprock has been simulated with the results showing practically no flow of CO_2 through the caprock.

An independent geological consultancy was commissioned to complete a review of the sealing potential of formations within the over-pressured Evaporitic Sequence. This is important for poorly cemented casing or liner strings, which may be void of cement in their annuli. The study confirmed the Prinos halite's sealing potential through active creep. This confirms the Evaporitic Sequence halites as external barriers.

7.1.2 Faults

A dynamic simulation model was built to assess the flowrates associated with CO_2 leaking across the bounding fault which separates Prinos from Prinos North. The magnitude of fault displacement between Prinos North and Prinos gives confidence that a leak following this leak pathway is highly unlikely. The model was allowed to run until CO_2 reached and invaded Prinos North or reached the Brown Marker. This was simulated to take 1450 years, with a flow velocity of 60 cm/year.

7.1.3 Induced Seismicity

The risk of induced seismicity is low given:

- Lack of faults with a tendency to slip
- Historical recorded seismicity is low over the Prinos CO_2 Monitoring Area (Figure 10 and Figure 11)
- Water will be produced at stable rates to manage the reservoir pressure and ensure it stays within a safe operating window
- Injection pressure (with temperature and flow rate) will be measured in CO_2 injectors to manage

induced local overpressure and resulting micro seismicity. Rates can be adjusted in case of increased risk based on data gathered

7.1.4 Tectonic Movement

EnEarth have completed a review of historical and instrumental seismicity (Storage Application Report 1f). There is evidence of historical earthquake activity in the region surrounding the Prinos basin (Figure 10). However, within the actual basin, historical records suggest only minor historical earthquake activity (Figure 11).

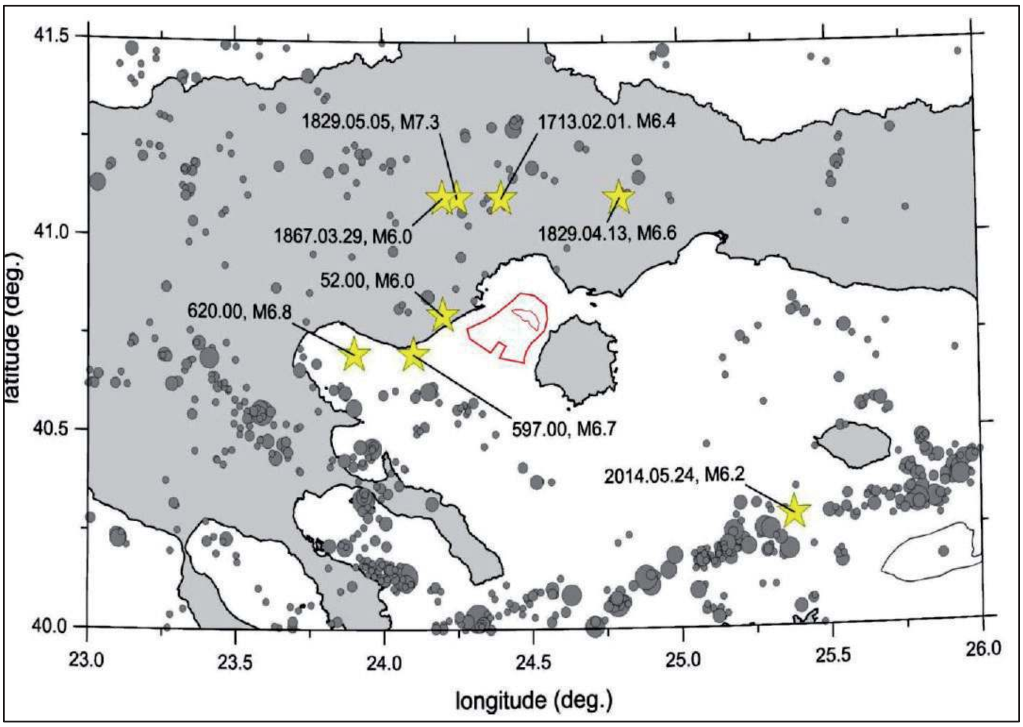


Figure 10: Epicentre map of historical seismicity. Recent seismicity, from 2010 onwards, is plotted with grey dots in the background.

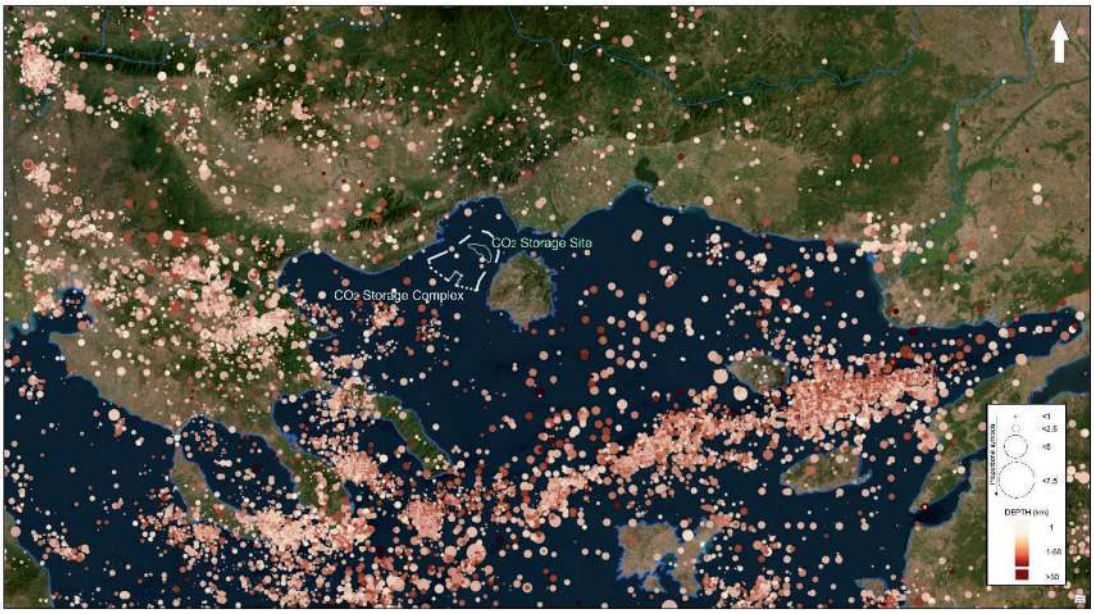


Figure 11: Distribution of earthquakes in northern Greece by plotting instrumental earthquake epicenters after combining seismic catalogues from the Geodynamic Institute of the National Observatory of Athens, the Seismological Laboratory of the National and Kapodistrian University of Athens and the Aristotle University of Thessaloniki

7.1.5 CO_2 Plume and Reservoir Pressure Response

3D dynamic simulations have been undertaken to address Storage Site risks, optimize injectivity and well placement. There is a risk that CO_2 migrates from Prinos to the Epsilon field. However, dynamic simulations, for injection rates of up to 3MTPA, suggest that 100% of the injected CO_2 will remain in the Prinos field. Safe operating limits and monitoring will be employed to ensure a suitable stand-off margin between the CO_2 plume and the structural spill point.

Based on simulation, reservoir pressure is expected to build up over time as CO_2 is injected into the Storage Site. However, water production wells will be employed to manage this. Reservoir pressure and temperature monitoring in monitoring wells and development wells will ensure that well injectivity and productivity is assessed and that safe pressure limits are not exceeded to avoid fracturing the reservoir and seals. If productivity of these wells reduces appropriate well interventions will be planned to restore productivity if unsuccessful injection rates may need to be reduced in order to maintain safe pressure limits in the store.

7.2 Engineered Safeguards – New Wells

Engineered safeguards for the injection (CO_2) wells and production (water) wells are defined by the well construction and the materials used in conjunction with the lithological surroundings along the well path. All wells will be designed with a minimum of two barriers between the store and the environment. Additionally, ensuring the injected CO_2 is within specification for the injection well design will prevent unwanted well integrity issues due to corrosion.

7.2.1 Materials

Materials suitable for CO_2 will be used in the injection wells to ensure corrosion rates are maintained below acceptable limits. This will include selecting the correct metallurgy, elastomers, and cement for the wells including casing materials, tubulars, and downhole completion equipment (TRSSSV, packers etc.). The materials of all components that are likely to encounter the injected fluids will be selected to accommodate the anticipated CO_2 composition at the range of pressures and temperatures expected over the life of the injection and beyond. This may include the potential for formation brine to enter the lowermost parts of the wells between periods of injection, potentially resulting in a highly corrosive environment.

The material selection criteria for the water production wells will ensure that corrosion rates are acceptable, not just with the current formation brine composition, but also considering the potential for changes in composition over time. Potential changes in composition may include the breakthrough of CO_2 and Prinos residual hydrocarbons (both with impurities). In addition, the presence of high H_2S concentrations in the formation fluids may result in a risk of sulphide stress cracking (SSC), therefore adherence to NACE MR0175/ISO 15156 is recommended.

Note: Where materials are not likely to come into contact with the store fluids, lower specification materials may be used provided they do not result in a higher risk of well barrier failure.

7.2.2 Completion Equipment

Completion equipment will be selected to ensure that wells can be operated in a safe and efficient manner. This will include, but not be limited to:

- Downhole safety valves – with appropriate rating for CO_2 service
- Isolation of the annulus by use of a packer
- Monitoring and measurement equipment to both assess well performance, CO_2 phase behaviour and detect potential leaks
- Equipment related to artificial lifting of the water production wells

7.2.3 Interaction with Lithology

The large sections of evaporitics above the Storage Site will play an additional role in ensuring annular leakage along the well paths is limited and that cement bond integrity is maximized. While not necessarily an engineered safeguard, this will work in conjunction with the well construction to minimize the potential for leakage along the wellbore path.

7.2.4 Well Operation

Each well will be operated based on a clearly documented operating strategy, to maintain it within a defined operating envelop (including limits of temperature, pressure, flowrate, etc.). Regular reviews of the limits will be conducted to capture any changes in the well status.

A Well Integrity Management System (WIMS), based on that already proven to be effective in the Prinos oil production development, will be implemented to track and report the integrity status of all wells.

7.2.5 Well Abandonment

All new wells will be designed with ease of abandonment as part of the design process. Final well abandonments will be carried out in accordance with recognized industry best practice and applicable regulations at the time of abandonment (Prinos Post Closure Report, 2025).

7.3 Engineered Safeguards - Existing Wells

As described in Section 6.1, 12 of the existing wells have been abandoned in a manner which was initially deemed “non-compliant”. The monitoring plan specifically targets these wells, for example with deployment of MMV technologies in nearby wellbores. 11 of the 12 of these “non-compliant” wells originate at the platforms and have been sidetracked (often on multiple occasions), with the top-hole section of child wells still being accessible. This gives an opportunity to place monitoring equipment or make measurements significantly closer to the potential source of any leak than at surface, so allowing the earlier detection of smaller leaks associated with the abandoned bore.

The existing wells which have not been abandoned will be plugged in a manner that minimizes leak risk from these wells (and where possible any sidetracks, e.g. kick-off depths will be considered during abandonment planning). EnEarth plan to abandon legacy wells prior to the CO_2 plume reaching them. Regardless of use for monitoring of the store or other wells, the integrity of these wells their will continue to be monitored until their abandonment.

7.4 Facilities and Pipeline

In designing a CO_2 pipeline and a normally unmanned installation (for Phase 2 of the CO_2 Storage project), EnEarth are focused on ensuring safety, environmental protection, and system integrity. Final facilities and pipeline designs will be carried out in accordance with recognized industry best practice and applicable regulations.

Robust leak detection and control mechanisms will be an integral part of the pipeline and facilities. Automated emergency shutdown mechanisms will be specified as part of the designs so as anomalies can be responded to quickly.

Materials used in the pipeline and installation will be corrosion-resistant and suited to CO_2-rich environments. Redundancy in critical systems, regular maintenance schedules, and pressure management protocols will help prevent failures. For unmanned installations, additional safeguards such as fail-safe valves, fire and gas detection systems, and secure communication links are essential to ensure continuous, reliable operation and to minimize risks to personnel and the environment.

8. Monitoring Requirements

Monitoring requirements define how the performance of the geological and engineering safeguards will be verified. These then inform the selection of suitable MMV technologies (table 7).

An initial set of baseline surveys should be run to define pre-injection conditions. Baseline establishment involves defining benchmark characteristics to compare future changes to. This requires an assessment of:

- Formation gas and fluid characteristics in the storage reservoir, surrounding Complex and formations that might be affected by potential leakage, including aquifers
- Background CO_2 emissions at surface or sea floor
- Surface and near surface environmental surveys
- Seabed, surface or near surface baseline surveys to define any pre-existing leakage indicators

During CO_2 injection the key monitoring requirements are:

- Detection of well leakage
- Geological seal integrity
- Fluid movement within the primary, secondary stores and above the Brown Marker
- Checking for impact on hydrocarbon resources in proximity to the Storage Complex
- Detecting environmental impacts
- Measurement of induced seismicity
- Tracking of well performance
- Quantification of CO_2 injected volume and mass

Upon closure (i.e., CO_2 injection has stopped and the site is sealed), post-closure monitoring is required to ensure long-term containment, environmental safety, and compliance with regulations. EU Commission Guidance Document 2 (2024) indicates that monitoring is required for up to 20 years after closure or until proof of CO_2 containment is demonstrated. Prinos CO_2 injectors and water producers will be abandoned within 1.5 years after injection stops and after this monitoring will consist of environmental surveys and SpotLight.

Monitoring requirements post closure should be directed towards proving that CO_2 remains contained. It is likely, although dependent on the store operational history, that during the post closure period monitoring will be reduced compared to the injection section of the project. Post closure monitoring includes:

- Verification of the location of the stored CO_2
- Determining whether the CO_2 mass is seeping into the environment
- Providing evidence that the system will behave as predicted in the future

	Lateral flow of CO2 from the Storage Site	Vertical flow of CO2 from the Storage Site	CO2 flow from an inaccessible legacy well	CO2 flow from an accessible legacy well	Primary development well barrier failure	Secondary development well barrier failure	Development well: both barriers compromised	Development well: downhole safety valve failure	Development well: other downhole equipment failure	Development well: loss of well control	CO2 pipeline leak	Surface facilities irregularity
Injection well: Wellhead and downhole temperature & pressure gauges, flow meters	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩		🟩
Water production well technology: Wellhead and downhole temperature & pressure gauges, flow meters	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩		🟩
Monitoring well: Wellhead temperature and pressure. Downhole pressure	🟩	🟩	🟩	🟩		🟩	🟩					🟩
Produced water sampling		🟩										🟩
Injection and production wells: baseline of formation fluid samples, openhole & cased logs	🟩	🟩			🟩	🟩	🟩					
Static and dynamic modelling	🟩	🟩	🟩	🟩								
Seismic: Spotlight, 4D baseline, DAS VSP at monitoring wells	🟩	🟩	🟩	🟩		🟩	🟩					
DAS and DTS at monitoring wells	🟩	🟩	🟩	🟩		🟩	🟩					
Multi-beam echo sounding, side scan sonar, satellite imaging and ROV		🟩	🟩	🟩		🟩	🟩					
Fugitive emission detectors			🟩	🟩		🟩	🟩			🟩		🟩
WellSentinel			🟩									
Corrosion coupons					🟩	🟩	🟩				🟩	
ESP monitoring equipment									🟩			
Pipeline flow rates, pressures and temperatures											🟩	
Pipeline chemical sensors											🟩	
Facilities gas samples											🟩	🟩

Table 4: Prinos CO_2 Storage Project risks and associated firm monitoring techniques

9. Monitoring Technology Selection

EnEarth have carried out a review of monitoring technologies (Halliburton, 2024), having considered: leak-path scenarios, potential induced seismicity, near-by infrastructure, regulations, technology development status (proven vs developing), cost, potential benefits, and the confidence that each method will provide stakeholders (Figure 12).

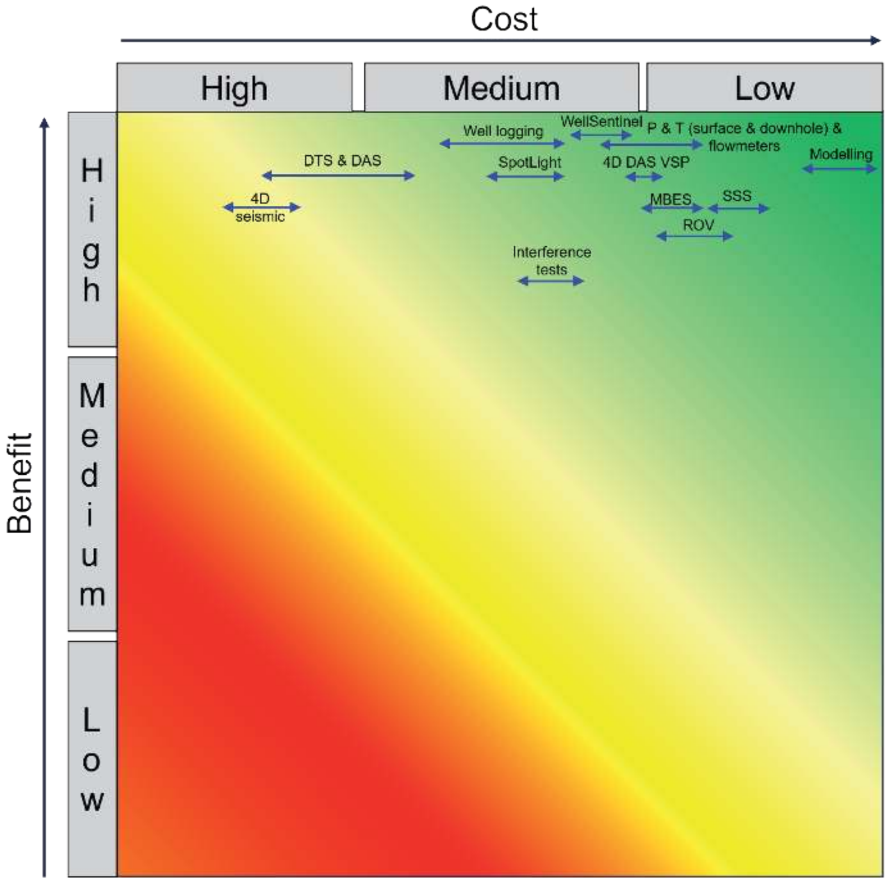


Figure 12: Qualitative technology cost versus benefit estimates, for monitoring techniques used in the Prinos MMV

Cost Estimates

MMV-1: Spotlight

Spotlight has conducted a feasibility study that confirms that the technology is fully applicable to the Prinos field. Based on their commercial proposal, the estimated cost for these services is 0.5 million euros per acquisition per year, inclusive of all associated expenses. Accordingly, one survey is planned for the baseline period, followed by ten surveys during the injection period, conducted every two years, and two additional surveys during the post closure period, scheduled for years 2, 5 10, 15 and 20.

MMV-2: Silixa DAS/DTS (4 wells)

Similar to Spotlight, Silixa conducted a feasibility study confirming that the DAS/DTS technology is suitable for the Prinos wells and the associated lithological formation. Based on their commercial offer, the installation cost for 4 monitoring wells is estimated at 1.62 million euros. In addition, Silixa charges 0.68 million euros per year for project management and monitoring package lease. Considering these parameters, the baseline OPEX includes one year of data acquisition, while during the injection phase, 20 years of DAS/DTS monitoring are anticipated. For the post closure phase, two years of additional data acquisition are assumed.

MMV-3: Well Sentinel (9 gathering systems)

The cost of each WellSentinel gathering system is €350,000 according to budgetary offers received from initial market assessments. This technology is well established for monitoring abandoned wells from the seabed and has proven to be highly reliable over the years. The above-mentioned value includes the installation fees. In addition, each gathering system carries an annual fee of €6,000 to cover satellite monitoring expenses. The systems will be installed during the baseline and will remain operational during the injection phases of the CO_2 project.

MMV-4: Silixa 4D DAS VSP

Silixa's feasibility study for the Prinos project also included the application of DAS VSP technology in the monitoring wells to track the integrity of legacy wells. Based on Silixa's commercial offer, the cost per DAS VSP acquisition is estimated at 0.06 million euros, assuming four monitoring wells. One acquisition is planned during the baseline phase, while 20 additional acquisitions are scheduled throughout the injection period (approximately two per two years), resulting in a total estimated cost of 1.2 million euros.

MMV-5: P/T gauges (facilities and downhole), slickline scope

The purchasing costs are estimated at approximately 0.2 million euros to be allocated prior to the injection phase. Operational costs during the injection period are projected to range between 0.02 and 0.06 million euros per year, consistent with current market benchmarks. Additionally, operational expenses of around 0.06 million euros per year are anticipated for two years following the injection phase. These estimates reflect a thorough assessment aligned with prevailing industry standards, providing a reliable basis for budgeting without committing to fixed figures at this stage.

MMV-6: Update of Subsurface Modelling

This refers to software / hardware and 3rd party expertise to perform updates on dynamic models and reliable forecasts, incorporating all available data. 4.25M€ are assumed to be the costs incorporating all baseline survey data, as well as well data acquired during drilling operations. Additional 1M€ is assumed per year during the injection period to update the models and prove predictability. During the post closure period we assume the dynamic models would be at a maturity level that updates would be sparsely required, thus 4M€ is assumed over the 20 years. The following gives a substantion to the subsurface costs in line with other industry scale projects and guidelines.

Baseline Model Update – Estimated Cost: EUR 4.25 million

Scope:

- Integration of baseline seismic survey and well data into a 3D static model.
- Full reservoir simulation calibration to pre-injection conditions.
- Uncertainty quantification and risk assessment reporting.

The cost basis is taken from benchmarking data from comparable CCS projects which show modelling update costs typically range from $3-5 million for large scale >1MTPA storage projects. Those would include software / hardware and specialized labour to perform updates on dynamic models and reliable forecasts, incorporating all available data. Those upfront costs will reflect and ensure high quality data integration and calibration costs before injection commences.

Operational Period (20 years) – Estimated Cost: EUR 18 million

Scope:

- Annual or biennial model updates incorporating new monitoring data (pressure, microseismic, plume migration, etc.).
- Continuous risk assessment, model recalibration, and regulatory reporting.
- Predictive simulations for plume migration and caprock integrity.

The cost basis for this phase is substantiated from industry benchmarks for monitoring and modelling. The IEAGHG / CLIMIT (2020) – Monitoring and Modelling of CO_2 Storage: The Potential for Cost Reductions is a review of global CCS projects (including Sleipner, Snøhvit, and Quest) and reports that annual monitoring and modelling costs for commercial-scale (~1 Mtpa) projects are typically in the range of USD 1–4 million per year, depending on monitoring intensity and technology mix.

Post-Closure Model Update – Estimated Cost: EUR 4 million

Scope:

- Integration of final post-injection monitoring data into the static and dynamic models.
- Long-term stabilization simulation and plume containment verification.
- Final reporting to support regulatory closure and transfer of liability.

In line with IEAGHG (2020) best-practice guidance, post-closure activities include at least one comprehensive model update, integration of final monitoring data, and preparation of closure documentation required for regulatory hand-over.

Benchmark analyses indicate that post-closure modelling and reporting typically account for 10–20 % of total MMV expenditures, corresponding to approximately USD 2–5 million for a commercial-scale storage site. The adopted estimate of EUR 4 million for post-closure model updates and documentation is therefore consistent with international CCS cost benchmarks and regulatory expectations under the EU CCS Directive.

MMV –7: Environmental Surveys

Environmental costs estimates were provided by an offer from Inosys. EnEarth plans a dense survey sampling over a 1km2 area, over the structural crest of the Prinos Storage Site with an estimated cost of ~ €600.000. These costs include vessel mobilization and demobilization, field operations (4 days approximately), and data interpretation and analysis. Away from this area, where the risk associated with legacy wells leaks is lower, a less dense sample interval is required. The total cost per environmental survey is estimated to be €1.200.000. One baseline survey is planned before the injection starts, additional surveys will be run on years 5, 10, 15 and 19 during the injection. During the post closure period 2 additional surveys will be done on years 5 and 15.

All the above costs include both the purchase or leasing of the required equipment and the external labour necessary to perform the corresponding services.

MMV No	**Technology**	**Baseline** *[MM Euros]*		**Injection** *[MM Euros]*		**Post Closure** *[MM Euros]*	
		Opex	**Capex**	**Opex**	**Capex**	**Opex**	**Capex**
MMV-1	Spotlight	0.50		5.00		2.50	
MMV-2	Silixa DAS/DTS (4 wells)	0.68	1.62	13.56		1.36	
MMV-3	Well Sentinel (9 gathering systems)	0.05	3.16	1.05			
MMV-4	Silixa 4D DAS VSP	0.06		1.20			
MMV-5	P/T gauges (facilities and downhole), slickline scope	0.2		0.76		0.12	
MMV-6	Update of Subsurface Modelling	4.25		18.00		4	
MMV -7	Environmental Surveys	1.20		4.8		2.4	
MMV		6.94	4.78	44.37[1]	0	10.38[2]	
Total MMV cost including 30% contingency		**9.02**	**6.21**	**53.24**		**13.49**	

Table 5: Estimated costings, in millions of Euros, for key Prinos MMV technologies, assuming 20 years of injection. Costs provided by SpotLight, Silixa (DAS/DTS & DAS VSP), Elemental Energies (4D seismic), WellSentinel, and Inosys

9.1 Pipeline Leaks

A comprehensive approach to detect and monitor potential leaks in pipelines is achieved through a combination of methods, as part of pipeline integrity management. Monitoring to prevent leaks is crucial to ensure safe operating conditions for both personnel and equipment, as well as to avoid operational delays and increased costs.

The most common way to detect leaks is by monitoring flow rates, pressures, and temperatures at various points along the pipeline. In the event of compressed gas escaping, the sensor will record a sudden drop in pressure at the point of the leak, which will be accompanied by a change in temperature. To prevent and monitor this during normal operations, pressure sensors must be installed at both the inlet and outlet of the pipeline. Additionally, thermometers for continuous temperature monitoring can be installed at the inlet and outlet points. Chemical sensors (CO_2 sensors) can be placed at both onshore and offshore facilities to detect elevated CO_2 concentrations in the air, indicating a leak at some point along the pipeline.

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[1] This cost refers to the full duration of the storage permit (20 years).

[2] This cost refers to the full duration of the post-closure period (20 years).

9.2 Surface Measurement – Offshore Facilities

The range and availability of surface measurement technologies that can be applied to the Prinos CO_2 store is considerable. Their function is primarily operational to ensure that each well is managed within their operational targets and envelopes. Definition of the instrumentation and metrology is part of the surface facilities specifications, and will include devices for monitoring potential fugitive emissions of CO_2 at the injection facility, CO_2 volumetric flow at injection wellheads, CO_2 pressure and temperature at injection wellheads (to determine mass flow), and CO_2 chemical analysis of the injected material.

9.2.1 Detection of Fugitive Emissions

Provision should be made for the detection of fugitive emissions of CO_2 and H_2S at the injection site. Should operations be required that would necessitate the provision of personnel working on the offshore facilities, it is likely that these operations will increase the risk of a fugitive CO_2 emissions, increasing the necessity to have some form of monitoring equipment.

9.2.2 Pressure and Temperature

It is envisaged that the monitoring equipment on each wellhead / tree will be similar to that used in an offshore oil and gas application. While the exact configuration is likely to be governed by the Christmas tree design, as a minimum it will include continuous (automated) recording and monitoring of:

- Pressure and temperature upstream of choke
- Pressure and temperature downstream of choke
- Pressure in tree downstream of production wing valve (in tree body)
- Pressure in A-annulus at wellhead

In addition, it is prudent to monitor the pressure in any outer annuli at surface with pressure gauges. The same recording and monitoring system should be used to track the status of the tree valves and the choke opening.

9.2.3 Injection Rate

Like pressure and temperature, injection rate measurement is critical to the well management and for allocation purposes. Injection rate in each well should be independently measured to allow allocation of injected fluids in the static and dynamic reservoir models. This measurement may be either a volumetric flow measurement (e.g. orifice or venturi meter), with the associated pressure and temperature gauges being used to determine the mass flow rate; or a direct mass flow measurement (e.g. Coriolis meter). If necessary, temporarily installed (e.g. clamp on) meters may be used; however, these are unlikely to be as accurate.

Measurement accuracy for the instrumentation should be in accordance with the requirements of CO_2 sequestration accounting and, if applicable, storage permitting and should have sufficient accuracy to provide input for Storage Site modelling and subsequent updates (well and dynamic reservoir models).

9.2.4 Fluid Composition

The most reliable technique for the monitoring of injected fluid is likely to involve the physical sampling of fluids for laboratory analysis. A clear specification for the fluids to be injected will be put in place and used to guide the selection of appropriate analysis methods.

Fluid samples can be collected in numerous many ways at various locations, with the choices of both sampling technique and analysis methods being critical to ensuring objectives are met. In the case of CO2 storage, the composition of the injected fluids can be a key factor in ensuring that injectivity and storage integrity are retained. Material selection and injection rates have been designed in accordance with specific water and solid contents, and changes in the injected fluid composition may require corrective actions, depending on the extent of the deviation from the specified baseline composition.

EU CCS Directive 2009/31/EC requires that:

“The operator must characterise the composition of the CO_2 stream, including incidental substances, to ensure the stream will not adversely affect the storage site or transportation infrastructure.”

It is not envisaged for the purposes of this document that fluid composition measurements will be undertaken at the offshore facilities. However, these measurements will be made at the CO_2 emitter prior to entry into the transportation system. Some targeted sampling immediately prior to injection may still be required.

The water produced for pressure management will be sampled on a regular basis to confirm that any treatment applied is appropriate and that it meets the required specification for disposal. Online measurements of both oil in water and pH (to detect changes in CO_2 content) will be considered as part of the facility design; they do not form part of this MMV.

9.2.5 Corrosion Coupons

The placement of corrosion coupons in the flow stream allows physical measurement of the corrosion rate. The coupons should be manufactured from materials with properties as close in as possible to those used for the flow wetted components of the system being monitored. To maximise the benefit, coupons should be inspected on a regular basis, with consideration given to using different exposure times to determine whether corrosion rates are stable over time. Systems are available to allow coupons to be removed from the flow for inspection and/or replacement without the need to stop flow or depressurise the system.

Use should be made of corrosion coupons to aid understanding of the corrosion rates in the flowing (CO_2 injection and water production) wells. However, it should be noted that the conditions (in particular temperature and pressure) at the coupon locations will be different to those within the wells.

9.3 Permanent Downhole Technology – In Well Monitoring

A variety of downhole measurement technologies are available for pressure, temperature, and rate determination. Different methods (gauge types) are available for determining these properties and these are discussed in the following sections.

9.3.1 Pressure and Temperature

Downhole pressure and temperature measurements are key as they are applicable to several different monitoring program elements. Typically located near the reservoir, their primary function is to provide feedback on well operation with respect to its operating envelop (maximum pressure and flow rate) and integrity (loss of integrity in wellbore architecture).

Downhole pressure and temperature measurements are also used to validate and or calibrate static and dynamic modelling which are used to track the CO_2 plume migration and pressure temperature changes in the reservoir. In combination with surface temperature, pressure and injection rate measurements, downhole pressure and temperature measurements can be used to develop models to enable downhole pressure and temperature prediction following downhole instrumentation failures.

The use of permanent downhole gauges for pressure and temperature measurement in oil and gas applications has been proven over an extended period with many vendors offering systems with broadly similar capabilities. Typically, one (or more) quartz pressure sensors are mounted on a gauge mandrel, which is incorporated into the completion tubing. While numerous other pressure sensing technologies have been used, it is now widely accepted that quartz-based sensors give the best combination of high resolution, low calibration drift and reliability. The mandrels are designed such that the sensor is exposed to either the pressure inside the tubing or in the annulus. A TEC (Tubing Encased Conductor) is mounted on the outside of the tubing from surface to the gauge mandrel to provide both power to the gauge and transport the acquired data to surface in real time for recording and / or onwards transmission.

In situations where the use of a TEC is not desirable (or in the event of failure) a number of wireless solutions exist. These are based on similar measurement technology; however, instead of receiving power from surface they rely on battery power. Data can be transmitted up the well using either acoustic or electromagnetic techniques. However, despite the improvements in battery technology in recent years, the power requirement to transmit data results in the gauge having to be recovered to surface periodically and the battery replaced. The life span of a battery can be extended to several years by reducing the measurement frequency, potentially making these devices suitable for monitoring pressure changes below plugs or in other inaccessible locations.

An alternative approach to downhole monitoring is to store the acquired data in a memory bank attached to the gauge making it only available for analysis once the gauge has been recovered from the well. These devices can be broadly categorized as those designed for short periods (up to a few days) that are run as part of wireline logging operations or those intended for use over much longer periods, which can be left in wells for many months or even years. Where long term is required, the gauge can be hung from a nipple in the completion allowing flow to/from the well to continue with minimal disturbance.

In the case of CO_2 storage where well life spans may be very long (several decades) it is recommended that measured pressure and temperature data be used to refine prediction models of the well behaviour. In the event of a well or reservoir performance issue they can be used as a diagnostic tool. Quartz DHPT gauges will be installed in monitoring wells, CO_2 project injection and production wells with dual gauge carriers and redundancy. These will be set as deep as possible in the well – just above the packer.

9.3.2 Distributed Temperature Sensing DTS (Spatially Distributed)

Distributed Temperature Sensing (DTS) is a class of instruments that measure temperature at regular spaced intervals along a wellbore using fibre optics to both detect and transmit the signal. Measurement is based on the ability of the fibre to transmit light being altered as function of the wellbore temperature. The response time of the system depends on where in the well the fibre is located. The most common deployment method is to encapsulate multiple fibres in a single tube (typically ~1/4” diameter) which is mounted on the outside of the tubing.

The key performance metrics of the DTS system are spatial and measurement resolutions. They are dependent on a number of operating variables:

- Type of fibre
- Distance / range of investigation
- Acquisition / measurement time
- Surface Opto-Electronic
- Installation Methodology (double ended vs single end)

Published specifications suggest that most DTS systems offer a spatial resolution of 1m and temperature resolution ranging from 0.1 to 0.01°C based on best operating conditions (measurement time vs range of investigation).

The change in temperature profile along a well bore can be related to a number of events. Those applicable to Prinos relate to well integrity / pathway monitoring and indirect model-based monitoring. Leakage of CO_2 into the A-Annulus, through the tubing or the packer barrier, and B-Annulus, through the production casing cement, will result in a change in the wellbore temperature profile. Similarly, a change in fluid content of the reservoir rock matrix will cause a change in the geothermal gradient.

As with downhole pressure and temperature point measurements, DTS data will also be used to refine prediction models which can be used as a replacement for failed downhole pressure and temperature instrumentation. At Prinos it is expected that DTS will be deployed in two to four of the monitoring wells.

DTS Readiness and Limits

Fibre optics are now used routinely in the hydrocarbon industry to monitor temperature. Several CO2 storage projects have DTS systems installed as part of their monitoring system, for example Ketzin, Germany (Hennings, 2010; Wurdemann et al., 2010; Liebscher et al., 2013; Wiese, 2014), Cranfield, USA (Núñez-López, 2011; Doughty et al., 2013; Butsch et al., 2013), Otway, Australia (Zhang,2011), and Aquistore, Canada (Worth et al., 2014). Vandeweijer et al (2022) state that DTS is a mature technology.

Limitations for DTS include limited depth of investigation (0.-0.5m). DTS systems can record data continuously meaning that careful attention must be given to data handling and designing a system so as useful information can easily be interpreted. Additionally, the system at Prinos should be carefully designed to minimise the number of fibre connections points and hence limit reductions in signal.

9.3.3 Distributed Acoustic Sensing (DAS): Well Deformation and Micro-Seismic Monitoring

EnEarth also plan to deploy DAS at monitoring wells. These fibre optic devices make near continuous acoustic measurements to detect micro-seismic events. Micro-seismicity can be monitored and used to indicate if faults have become active and give early warnings regarding caprock integrity. Although the primary use of DAS micro-seismic is not for plume tracking, it can also give indirect indications of fluid movement and pressure front migration.

Monitoring, using DAS micro-seismic and temperature (using DTS) can assist with detecting leak paths and help confirm wellbore integrity especially at the casing / cement / formation boundary in the cap rock. Fibre optic acoustic sensors can be used to “listen” for sounds associated with the breakdown of well integrity. DAS systems can be deployed long term (for example over the lifetime of the Prinos project in a monitoring well) or inserted into wells of concern on a temporary basis. It can be installed either in the annulus between the tubing and the production casing or between two casing strings. At Prinos DAS is likely to be installed on tubing given the plan to use a selection of legacy wells as monitoring boreholes.

DAS Readiness and Limitations

The adoption of DAS for downhole micro-seismic monitoring is at a relatively early stage. DAS micro-seismic systems are given a technology readiness of 7-8 out of 9 by Vandeweijer et al (2022). This means that the technology is somewhere between prototype demonstration and actual system demonstration. An example of DAS micro-seismic monitoring for CO_2 storage is that carried out at the onshore Aquistore project.

DAS has the potential to derive high temporal and spatially sampled micro-seismic data datasets. Additionally, the same DAS dataset can be processed simultaneously to provide both micro-seismic and strain information (e.g., Diller and Richter, 2019). However, there are limitations, for example related to the amount of data recorded. DAS systems can record data almost continuously and so, like DTS, careful attention must be given to data handling and interpretation. The interpretation system if not well designed could lead to delays in detecting abnormalities.

Assuming good signal to noise ratio, horizontal and vertical micro-seismic event location error, for a large event like fault slip or caprock failure, could be +/-10 to 50 m, with the event detection range being 500-1000 m, depending on the size of the event (Suchta, 2025). Stanek (2025) suggests that the maximum event detection range for larger events is likely to be less than 500 m.

Downhole DAS micro-seismic systems are likely to find it difficult to detect very small events (for example leaks related to well integrity) in neighbouring wells over these distances; this could be the initial signs of an abnormality. To detect well integrity issues and well related leaks, using DAS, wells may need to be located close to each other. Additionally, the error range of DAS micro-seismic may be such that when wellbores are closely spaced (within meters of each other) it may be difficult to deduce where a leak is coming from. Instrumenting DAS across the entire depth range of the monitoring area may allow for early detection before CO_2 leaks cross the Storage Complex threshold.

Future studies should be carried out to confirm the ability (detection range and error margin) of fibre optic systems to detect well integrity breakdown and leaks, with special focus on well-to-well detection capabilities. Downhole DAS micro-seismic systems are however likely to be well suit to detecting small leaks and integrity breakdown within the borehole that they are deployed in.

In the case of wellbore integrity detection in neighbouring wells, fibre optic detection is not only dependent on the distance between the borehole with and without fibre. It is also related to what the well integrity issue is (i.e. is it CO_2 escape into the annulus or formation, and/or fluid movement through failed casing?). Additionally, DAS system sensitivity, fibre to formation coupling and noise conditions play a role in detectability. Small leaks may not produce enough noise to be detected and additionally DAS is directionally sensitive. However, there is a range of other technologies at different scales within this MMV (e.g. wireline leak detection and/or inspection tools, DAS VSP, 4D seismic) which could also help with the detection of well related leaks.

Micro-seismic event location accuracy can be increased through installation of these system in multiple boreholes and through good coupling with the formation. If fibre is installed on tubing, deviated boreholes tend to result in increased coupling with the formation compared to vertical wells.

DAS micro-seismic data records single component, rather than multi-component events, which can lead to event mechanism uncertainty, i.e. shear failure vs hydraulic fracturing vs compaction. There is the potential at Prinos to increase the event location accuracy, detection range and improve velocity models through integration of existing or future planned seabed fibre optic cables. Good DAS baseline data is essential given there is likely to be a need to filter out micro-seismic signals related to naturally occurring seismicity, originating from elsewhere in northern Greece.

9.3.4 DAS 4D Vertical Seismic Profiles (VSPs)

An additional benefit of DAS is that it can also be used as a receiver system for a VSP. In the CO_2 storage industry this is an emerging technology. DAS VSPs involve use of fibre-optic cables in conjunction with active seismic sources to build 3D seismic images around a borehole. If this process, using the same acquisition parameters is repeated, this timelapse approach is known as 4D DAS VSP. The advantages of using this system over conventional geophone VSP approaches are:

- High spatial sampling
- Reduced operational costs and increased safety: geophones do not need to be deployed whenever a VSP is required
- Enhanced 4D repeatability

For Prinos it is envisaged that 4D DAS VSP technology will be employed to detect leaks and there is some potential for it to aid in revealing plume migration patterns. This technology can be applied in any well where DAS fibre optics are installed. Currently the plan is to install fibre in 2-4 crestal monitoring wells. The triggered monitoring plan includes plans for temporary fibre installation in accessible wells, open up the ability to carry out DAS VSPs in locations away from the monitoring wells.

A baseline DAS VSP survey is proposed before CO_2 injection to allow for comparison with future 4D monitor surveys. This technology is likely to be most useful in the crestal area of the Storage Site, where the highest risk sections of the non-compliant wells are concentrated. Wellhead systems will include provisions for bores to accommodate fibre optics. DAS VSPs were deployed at the Poseidon CCS project (offshore UK) and at Aquistore (onshore, Canada).

Silixa DAS VSP Feasibility Study Results

A Prinos specific 3D DAS VSP feasibility study was carried out by Silixa (Yavuz et al, 2025), who were selected as they have a strong track record in fibre optic monitoring. Seismic ray tracing modelling was performed to evaluate the capability of DAS to produce seismic images from the Seabed to the base of the Monitoring Area. This included determining the likely resolution and spatial coverage, identifying illumination strengths and potential shadow zones as well as making suggestions for survey design. Together with the Prinos CO2 Rock Physics 4D Seismic Response Modelling (2025) these two studies give a good indication of the likely detection response of 4D DAS VSP at Prinos.

Data (checkshots, density, compressional and synthetic shear sonic) from Well P-1, was used as input. This is because this well is in a crestal position just as the proposed Prinos monitoring wells are likely to be. At the time of modelling, it was uncertain as to which legacy wells could be used for monitoring, so for modelling simplicity a vertical well was chosen. The synthetic shear sonic (Vs) log was calculated using inputs from recorded Vs logs from the Kallirahi-2 (8km to the south) and PA-36 wells (1 km to the NE). Additional inputs included example VSP data, previously acquired over the Prinos oilfield.

For the purposes of this study a well completion design, similar to that expected to be used at a monitoring well, was assumed. Fibre was assumed to be deployed on tubing. Although cemented fibre can offer higher fidelity data this type of installation has yet to be demonstrated in an offshore CCS setting.

A variety of source offsets were trialled, during ray trace modelling, and based on this the optimum offset was found to be 1500 m. A key part of this study was to determine the ability of a 3D DAS VSP to illuminate areas key to the monitoring of the Prinos CO_2 Storage project, above the Storage Complex, within the Secondary Store and within the Storage Site. Given this, maps were generated at the top Brown Marker, top Lower Main Salt and at the bottom of the Base Salt (Figure 13). An asymmetric illumination pattern is predicted at Top Brown Marker, with a maximum width of ~1100 m. On a map of all Prinos wells (Figure 14), with the monitoring wells highlighted, together with this maximum width, it can be seen that there is the potential for DAS VSPs to provide excellent coverage over the legacy wells for detecting leaks from the Storage Complex. Silixa also reviewed fibre to formation coupling quality, and found that above ~600 m for the modelled example there is likely to be week or lost coupling above this depth.

Illumination coverage is likely to be more limited over the Storage Complex (~650m maximum width) and the Storage Site (~600m maximum width). Future studies should seek to confirm the illumination zones associated with the legacy wells selected for monitoring purposes as these will be deviated from the vertical and so have a different illumination pattern.

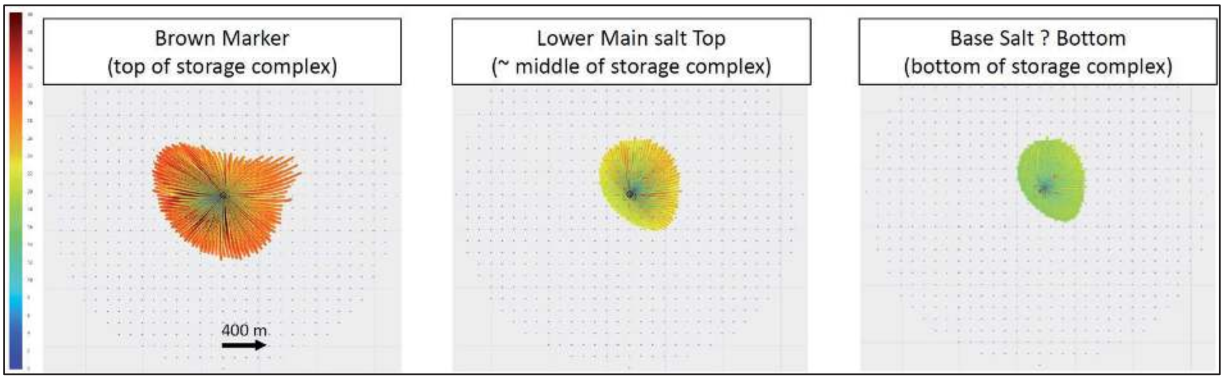


Figure 13: 3D DAS VSP illumination zones. Colours show reflection incidence angles from 0 (blue) to 40 (red) degrees

Although the Prinos CO_2 Rock Physics 4D Seismic Response Modelling (2025) investigated the feasibility of conventional towed streamer 4D seismic, an approximation of the potential for 4D DAS VSP technology at Prinos can be using the conclusions of this report. This suggests that 4D DAS VSPs should be capable of detecting saturations of CO_2 of >20% within sands of the Storage Complex and above (subject to first order controls such as sand thickness and net to gross). Over the Storage Site detection of the CO_2 plume is likely to be more challenging although time shifts at the base of reservoir, because of CO_2 injection, could be detectable. To assess the capability of 4D DAS VSPs to detect CO_2 induced changes over time, forward modelling (finite-difference 4D simulations) using the actual monitoring well trajectories as input should be carried out.

DAS VSP Detection of Leaks at non-compliant Wells

DAS-VSP has proven itself as a reliable and widely used method for subsurface imaging and time-lapse monitoring. Over the past decade, it has become a standard method for detecting subtle subsurface changes related to injection, production, and overall reservoir development.

A well-known public example is the Otway Project in Australia, where the Carina® CarbonSecure™ solution, utilising DAS-VSP, successfully detected the injection of approximately 500 tonnes of supercritical CO_2 at a depth of around 1.5km. DAS-VSP data recorded on the Constellation fibre, cemented behind the casing, captured the time-lapse seismic response of the injected plume. However, it should be noted that Otway is a well-studied site with decades of background data and modelling, allowing for optimising the DAS-VSP method to capture this very small time-lapse response. Hence, achieving this level of DAS-VSP resolution in the Prinos Project requires a well-characterised site supported by extensive background data, detailed modelling, and careful optimisation of the DAS-VSP acquisition and processing.

- Areal mapping of anomalies using DAS VSP:

Time-lapse (4D) DAS-VSP surveys enable the comparison of repeated seismic datasets to identify time-lapse anomalies that deviate from the baseline. These can be mapped in three dimensions around the monitoring well (in the zones as highlighted in our DAS-VSP feasibility report), providing an areal indication of zones potentially affected by CO_2 migration.

- Anomaly depth determination:

DAS data provides high spatial sampling along the well. Hence, with our DAS-VSP data, detected anomalies can be accurately tied to depth, enabling the determination of whether changes occur within the storage complex, caprock, or overburden.

- Temporal evolution and inferred flow rates:

Although VSP data cannot directly quantify leak rates, comparing successive surveys can reveal reservoir changes due to injection, spatially and temporally. The reservoir changes are proportional to the accumulated injected CO_2 volume.

- Model calibration:

Observed seismic anomalies obtained from DAS-VSP can be integrated with reservoir and geomechanical models to refine simulated leak-migration behaviour. This helps calibrate leak-rate models and improve confidence in forward predictions.

Overall, 4D DAS-VSP supports the detect–localise–characterise workflow within the MMV framework by identifying, constraining, and tracking potential leak-related changes around the well over time. Yavuz et al (2025) strongly recommend conducting a 4D VSP feasibility study using the four Prinos CO_2 storage project monitoring wells as input. This additional step should incorporate a detailed reservoir model and expected CO_2-related reservoir changes from forward modelling. This would enable the full evaluation of the detectability of the injected CO_2.

If a leak is detected from an intolerable well, DAS VSP data could be used in the following manner to aid mitigation:

- Map the areal extent of the anomaly and determine the depth of occurrence

- Use this data to update leak rate modelling, to provide an estimate as to how long and if the leak is likely to get to the surface
- Implement corrective measures based on leak rate modelling

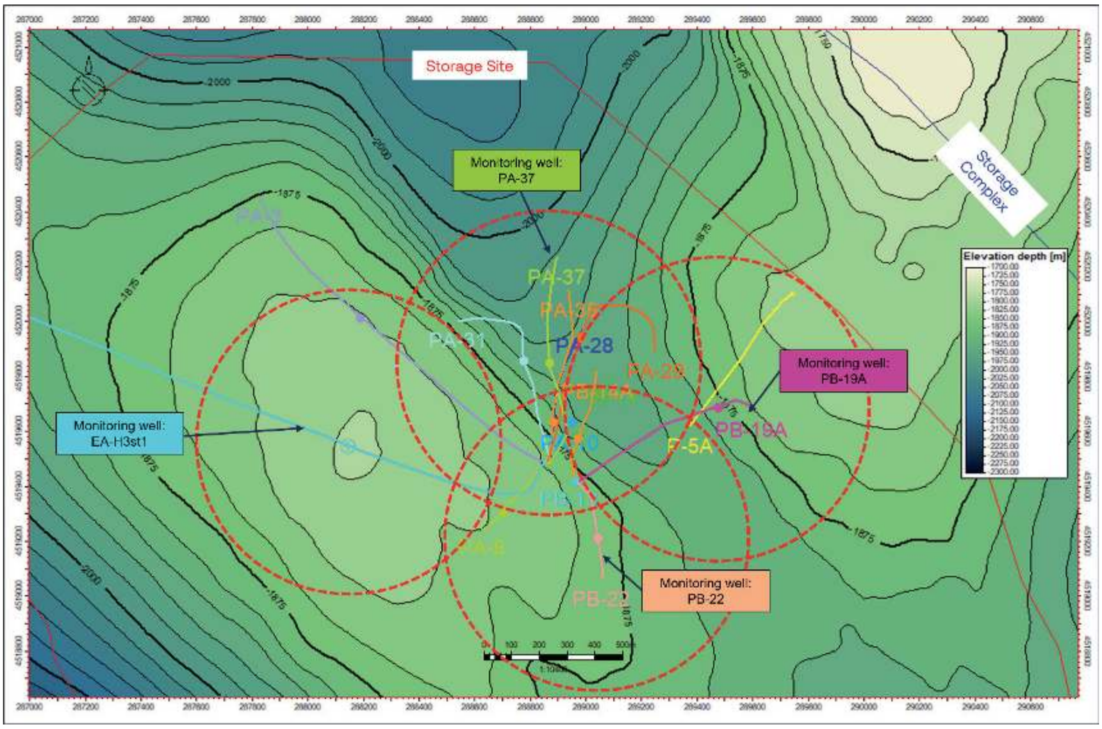


Figure 14: Approximate DAS VSP coverage (red dashes) based on currently planned monitoring well locations, overlaid on a map of Top Brown Marker depth (m). Filled circles show Top Brown Marker wellbore intersections with this surface. Further work is required to confirm DAS VSP illumination zones for each monitoring well

DAS VSP Readiness and Limitations

There are large numbers of examples of DAS VSPs being used to monitor subsurface operations, on- and offshore. However, its application to CO_2 storage is limited to the offshore Poseidon (UK, 2024) project and onshore at Quest, Aquistore, Otway and Ketzin. Vandeweijer et al (2022) give DAS VSP a technology readiness of 8 out of 9; the actual equipment has been demonstrated successfully in an operational environment.

Good coupling of fibre with the formation helps to increase signal to noise. Technologically although processing of DAS VSP data is proven, there are still improvements that could be made. Yavuz et al (2025) suggest that the diameter of illumination at Prinos for a vertical well, is ~1000 m at the Brown Marker but this decreases with increased stratigraphic depth to a diameter ~550 m at the base of the Storage Complex. Figure 13 shows that the expected illumination zones for a vertical well are not symmetrical.

Yavuz et al (2025) carried out a feasibility study for 3D DAS VSPs. However, the conventional 4D seismic feasibility study (Prinos Rock Physics Modelling, 2025) can be used to give an indication as to the potential of 4D DAS VSPs. This suggests that above the Storage Site there is good chance that 4D seismic methods will be applicable for detection of CO_2. Within the Storage Site CO_2 plume tracking is likely to be more difficult but could be possible.

9.3.5 Downhole Flow Rate

Several companies offer the ability to measure flowrate downhole in oil and gas applications. The most common technique used is a venturi type meter where the change in fluid pressure as flow is accelerated through a restriction (throat) of known diameter is used to determine flowrate. These have no moving parts and as such are inherently reliable, with the measurement being made by pressure sensors mounted above and below the throat. The throat size needs to be appropriately sized for the application (rate) to optimize measurement performance. Meters of this type have been proven in both production and injection applications, in liquid or gas phase and across a wide range of flowrates.

Typically, the devices are installed between reservoir zones to facilitate the measurement of the zonal flow contributions. In addition to the meter, TEC (Tubing Encased Conductor) to surface is required as part of the completion to both provide power to the pressure sensors and allow continuous flowrate monitoring. Depending on the design chosen it may be possible to replace the venturi section on wireline to allow a more optimal size to be used.

At present it is not envisaged that downhole flow rate measurement will be deployed in the injection wells at Prinos as flow rate measurements will be undertaken upstream of the wellhead on the surface facilities. However, there may be some benefit from using downhole flow metering in wells injecting into multiple reservoir zones to determine the zonal destination of injected CO_2.

9.3.6 Electrical Submersible Pump (ESP) Monitoring

In water production wells equipped with an ESP it may be desirable to acquire data to monitor the flow into the well, and the performance of the ESP. While ESP systems can vary significantly in terms of their configuration, they all feature a power supply cable for the pump, which can also be utilized to transmit data back to surface. A wide range of measurements can be made including fluid temperature and pressure (both at the pump intake and discharge), motor temperature and vibration. The exact suite of measurements available will depend on the ESP vendor selected, with ESP vendors also providing recommendations on the instrument sensors to use.

In addition to the downhole measurements, it is good practice to monitor the voltage and current being supplied to the pump at surface to aid in identifying any irregularities in pump behaviour, or faults in the cable.

9.4 Wireline Logging

To create an accurate baseline, wireline logging will be used to provide high-resolution, downhole data on formation properties, fluid movement, pressure changes and well-bore integrity. Leaks can occur through wellbore failures, cement defects, faults, or fractures, and wireline logging tools can help identify these issues and provide baseline characterization. Given that monitoring wells will play a key role in leak detection it is particularly important that a strong baseline of wireline logs is obtained from seabed to the base of the Monitoring Area (top Basal Salt). Consideration will be given to acquiring logs over the same interval at the CO_2 injection and water production wells.

9.4.1 Open hole

Several types of open hole logging tools are applicable to CO_2 storage applications, with the data being used for reservoir and fluid characterization including lithology, porosity, salinity, permeability indication, and fluid saturations. By combining these measurements, it can be possible to gain sufficient data to determine the capacity and injectivity range associated with a particular well. This could be achieved with a small number of logging tools including gamma ray, resistivity, neutron, density, sonic, and calliper.

Other open-hole logging tools are available to gather more detailed data and may be appropriate for use in some wells:

- Spectral gamma ray
- Borehole Imaging tools
- Formation pressure and fluid tester
- Nuclear Magnetic Resonance (NMR)
- Elemental Capture Spectroscopy (ECS)
- Cross-Dipole Sonic Logging

If intersection wells are required, these wells should be logged to aid the characterization of the Monitoring Area.

9.4.2 Cased hole

Several types of cased hole log are applicable in CO_2 storage applications with the most applied including:

- Cement bond log (CBL) – These use measurement of the amplitude or attenuation of ultrasonic waves propagating axially along a casing to determine distribution of cement outside the casing and the quality of the bond between the cement and the casing. Older generation tools record a single circumferential measurement which limits their ability to detect channels of other vertical flow paths. More modern tools feature either a series of pads or a rotating sensor head to produce a “map” of the cement bond and are more suited to CO_2 storage applications.
- Casing / tubing inspection: Due the potentially highly corrosive nature of injected CO_2 when hydrated it may be necessary to make in situ measurements of the condition of the casing and/or tubing. These tools fall into a number of different technology categories (including electronic callipers, ultrasonic tools, and electromagnetic tools), with each tool having slightly different capabilities.
- Flow profiling: The use of production logging tools (e.g. spinners) to estimate the proportion of the injected CO_2 leaving the well at any given interval of the store may be required to aid in the updating of reservoir models. In addition, the use of “warm back” surveys based on temperature logs (either wireline or DTS) during shut in periods may be used to aid in understanding which reservoir intervals CO_2 is entering into the storage formation.
- Pulsed Neutron – Pulsed neutron tools rely on the variation in interaction between neutrons and different elements. Once a baseline has been acquired it is assumed that any change in the pattern of interaction is based on changes in the fluid content of the pore spaces. In particular changes in the presence of high salinity brine and/or oxygen can be detected.
- Leak detection: A number of specialist leak detection tools based on wireline acoustic monitoring are available to aid in the identification of a leak site should any pressure anomalies be noted in a well. These tools rely on the sound signature of flow through a restriction which can be detected from a considerable distance away.

9.4.3 Temporary Fibre Optic

The same basic technology used for permanent fibre optic installations can also be deployed from surface in much the same way as wireline. Instead of being run as part of a cable on the outside of a tubular, the fibre is run inside the tubing either as a bare fibre or as part of a wireline cable with the interrogator located at or close to the wellhead. Depending on the deployment technique used it is possible to record data over a period of several days including during flowing operations.

The location of the fibre inside the tubing may result in lower quality data (particularly in the case of DAS for seismic monitoring), but the ability to deploy fibre into any accessible well could allow targeted monitoring in wells without permanent fibre optic installations.

9.5 Coring

The cutting of core samples during drilling gives the best opportunity to fully investigate the properties of the formation under controlled laboratory conditions. Coring can take a significant amount of rig time due to the requirement to trip each barrel, and the low rate of penetration achieved. Therefore, it is important that cores are cut at appropriate locations and that good core handling procedures are in place to prevent damage to the core that could compromise the subsequent analysis.

A full review of core analysis techniques is beyond the scope of this document; however, the following give an indication of some which may be appropriate for Prinos.

- **Geoscience evaluation:** core sedimentological descriptions; petrology and mineralogy
- **Routine core analysis**: X-ray (CT) scans, photography; and determination of porosity, permeability, and grain-size distribution.
- **Rock mechanics**: failure analysis, quantification of mechanical impact on rock strength because of CO_2 injection and temperature effects, uniaxial-strain bulk rock and pore volume compressibility as well as thick-wall cylinder stability evaluation.
- **Special core analysis (reservoir engineering)** to determine supercritical CO_2 / brine relative permeabilities for drainage and imbibition (hysteresis effects), threshold entry pressures, interfacial tension (IFT) and contact angles, and capillary pressures in drainage and imbibition.
- **Special core analysis (petrophysics):** mercury injection to determine pore-throat radii distribution and seal capacity.
- **Formation damage testing:** rock-CO_2-brine compatibility studies (static and dynamic) with mineralogical characterization before and after CO_2 contact, fines migration/critical velocity of solids evaluation.

9.6 Reservoir Fluid Sampling

Fluid samples from the subsurface will be collected in numerous ways at various locations. Typically, samples collected downhole, on wireline or drill pipes, and delivered to surface in sealed containers are the most representative. This is provided the sampling conditions are carefully managed to ensure the reservoir fluid stays in single phase.

In conjunction with downhole sampling, surface sampling of separated liquid and gas phases, then recombined in a lab is often used as a technique to confirm the analysis of downhole samples, which are more prone to contamination, are accurate. Measurement of separation pressure, temperature and rates is important to ensure a good quality and representative recombined fluid.

Downhole fluid analyser type tools can also be used to confirm fluid properties without bringing samples to surface. In the case of newly drilled wells these need to be collected using tools that selectively sample the formation fluid rather than the drilling or completion fluid in the well. A number of such tools are available for use on wireline and are considered proven technology. Should there be a requirement to collect downhole samples during the operational life of a well much simpler downhole sampling tools can be used.

9.7 Geosphere Monitoring Technologies

9.7.1 Geological, Geomechanical, and Dynamic Modelling

Modelling of the Monitoring Area is an inexpensive means of providing a visualization of baseline conditions, which can then be updated with measurements taken during future stages of the Prinos CO_2 Storage project.

9.7.2 SpotLight Seismic

The SpotLight technique uses a single seismic source and retrievable seabed receivers to obtain seismic images over localized areas (typically 4 seismic bins), also known as Spots. SpotLight use a proprietary algorithm, tuned by key risks and the dynamic flow model, to select Spot locations. SpotLight aims to detect irregularities in containment and conformance and works as an early warning system. If an alert is set off, triggered monitoring technologies (such as 4D seismic or 4D DAS VSP) could be enacted. SpotLight has recently been deployed at the Poseidon CCS (UK, 2024) and Greensand CCS (2022) offshore projects.

The advantages of SpotLight compared to a conventional towed streamer survey are:

- Less environmental footprint: one seismic source so less noise pollution (especially important given Prinos is in a NATURA 2000 area)
- Cost effective and agile: fewer sources and receivers, dedicated seismic acquisition vessel is not necessary
- Monitoring frequency: Can be repeated more regularly than conventional towed streamer seismic (monthly if necessary)
- Fast turn-around: Processing can take days to a month compared to several months for conventional 3D seismic acquisitions

SpotLight Feasibility Study Results

SpotLight undertook studies to determine the feasibility of implementing their technology at the Prinos CO_2 Storage project (Peruch, 2025). The aim of SpotLight’s work was to assess the potential of spot seismic as an alarm system for detecting significant deviation between the actual and the predicted CO_2 plume for conformance and containment.

Inputs to the study included a selection of raw shotpoints from the most recently acquired seismic dataset over Prinos. Additional key inputs included seismic horizons, fault sticks, well trajectories, dynamic simulation models, 3D seismic data and a seismic interval velocity model.

Raw shotpoints were used to help assess whether Spots can be acquired with sufficient repeatability and image quality to work as alarms for irregularities in CO_2 behaviour. The selection of shotpoint locations was based on a desire to assess Spot data quality in areas associated with increased leak risk and/or areas where the CO_2 plume is simulated to move towards. The results of this part of the feasibility study suggest that Spots are likely to have a strong seismic signal at Prinos.

The second part of the SpotLight feasibility study was to determine where Spot locations could be placed during the lifetime of the Prinos CO_2 project. An algorithm was used with key inputs being dynamic simulation models of the plume within the Storage Site and a detectability threshold influenced by rock physics modelling. SpotLight derived initial survey designs through the life of the project, implementing baseline surveys prior to injection and monitor spots thereafter. These suggest a maximum of 14 spots will be acquired during any one acquisition period.

The Prinos CO2 Rock Physics 4D Seismic Response Modelling (2025) study when considered in conjunction with the SpotLight feasibility work suggests it could be possible to use SpotLight to detect CO_2 within sands of the Evaporitic Sequence and above the Storage Complex. However, detection of CO_2 plume movement in the Storage Site reservoirs using seismic is likely to be more challenging, although there is some hope, subject to repeatability studies, for using base of Storage Site time shifts.

SpotLight Seismic Readiness and Limitations

SpotLight seismic technology is considered to have a high technological readiness level for monitoring CO_2 storage sites. SpotLight has worked on 25 projects to date with ~70% of these being CCS related. This includes the Poseidon (UK, 2025) and Greensand CCS (Denmark, 2022) offshore projects.

The Prinos CO_2 Rock Physics 4D Seismic Response Modelling (2025) suggests that SpotLight is best suited to leak detection. It is likely to be more challenging to detect Storage Site plume movement. This is worthy of additional study using additional well data (for example core and recorded shear velocity logs). Consideration of extending the 4D rock physics feasibility to a 3D modelling environment should be given to capture spatial variability in both static description and dynamic behaviour.

SpotLight produces seismic images of limited areal coverage (typically 4 seismic bins). Survey designs are partially tuned by dynamic flow simulation models. If these are incorrect the SpotLight survey may not illuminate abnormalities, and this is why periodic DAS VSPs are recommended. Additionally, there could be processing challenges related to the shallow water location of Prinos (e.g. seismic noise including water bottom multiples).

9.7.3 4D Seismic

Towed streamer 4D seismic has been used successfully at the Sleipner offshore CCS project to help track CO_2 plume growth (Kennet and Ola, 2011) and provide containment reassurance. The feasibility of 4D seismic is related to the unique subsurface characteristics of the imaging area. Additionally repeat seismic surveys are expensive and relatively environmentally intrusive, in addition to the significant logistic time required for available equipment and vessel mobilization. Given this EnEarth have undertaken a feasibility study to help quantify the cost vs benefits of 4D seismic (see below for further details).

At Prinos a 4D seismic baseline survey will be used to characterize the entire Monitoring Area prior to injection. A baseline survey is likely to be particularly useful for identifying pre-injection fluid bearing strata above the Brown Marker. This baseline could be a newly acquired survey or there is some potential (pending further study) to use an existing 3D seismic dataset.

If a leak is detected from the Storage Complex for example using SpotLight, a 4D seismic survey could be triggered. This may enable deduction as to how large the leak is, and thus perhaps guide remediation plans.

4D Seismic Feasibility Results

EnEarth commissioned Elemental Energies to carry out a 4D seismic feasibility study (Prinos CO_2 Rock Physics 4D Seismic Response Modelling, 2025). The main objective of this study was to understand whether CO_2 could be detected using 4D seismic within the Storage Site, Secondary Storage Reservoirs and above the Secondary Storage Caprock. Forward models were constructed of well log responses to CO_2 injection, using the inputs from dynamic simulations of plume movement.

Well P-1 was selected for modelling as it is the closest vertical well to the crest of the Prinos Storage Site. 4D seismic in this area could be important as this is where the 12 wells associated with the highest leak risk are located. Additionally rock physics modelling using a vertical well reduces the number of input assumptions and uncertainties, compared to a deviated well. Key inputs from well P-1 were logs of density, compressional and shear sonic. As mentioned previously the shear sonic log is synthetic but based on nearby recorded data.

To forward model realistic 4D scenarios for the Storage Site, three key time steps and associated reservoir properties were extracted from dynamic simulations and used to parametrise the rock physics models. These time steps were: initial (1975), baseline (2015) and max CO_2 capacity. Between Baseline and max CO_2 capacity, within the Storage Site, there is an overall acoustic impedance softening of 4-5%, which is relatively small. Benchmarking this change, along with other key reservoir variables, against a 4D technical score card (Lumley, 1997) yields a score of 13/25 versus a pass threshold of 15. This suggests that CO_2 plume detection within the primary storage reservoirs could be technically challenging.

However notional 4D time shifts, computed from the maximum storage capacity 4D scenario suggest a maximum two-way time shift of 3ms at the base of the Storage Site. This should be detectable with high quality repeat seismic measurements, based on North Sea 4D acquisition examples (Hatchell 2005). This gives some hope that 4D seismic can be used to track the Prinos CO_2 plume in the Storage Site reservoir. Additional feasibility studies, focusing on repeatability, should be used to fully assess if this technology can image the CO_2 plume in the Storage Site reservoir.

Conditions for monitoring potential CO_2 migration into the Secondary Store are more favourable. Using inputs from the Prinos CO_2 Leak Rate Modelling (2025) peak acoustic impedance changes in this interval of 10-18% softening were modelled. Applying the rock physics characteristics of this interval to Lumley's (1997) 4D technical score card results in a pass mark of 16/25, at 20% CO_2 saturation. This would be larger for higher CO_2 saturations.

The Storage Complex overburden is more difficult to model due to limited petro-elastic data. Using geologically plausible assumptions it is observed for small changes in CO_2 saturation (2-4%) that significant changes in AI are observed (~13%).

To address data gaps in this preliminary 4D study the following should be carried out:

- Acquisition of high-quality log data (Dts, Dtp, Rhob) over the Monitoring Area
- Acquisition of core to help characterise the effective stress vs dry frame modulus
- Re-assessment of 4D seismic feasibility once this new data becomes available
- Undertake a 4D repeatability analysis of the 2015 Kavala Gulf 3D seismic P1/P90 data to understand its suitability as a 4D baseline

Additional studies should also consider the challenges associated with acquiring 4D seismic (with streamers perhaps >4km in length) in the vicinity of surface infrastructure (such as the Prinos oilfield platforms and the planned CO_2 project facilities). In 2015 seismic was acquired with 8*5.1 km long streamers, but beneath the Prinos platforms an undershooting operation was required. With this in place only a narrow and shallow (~500 m TVDSS) gap, above the top of the Storage Complex is present.

4D Seismic Readiness and Limitations

As discussed, the Prinos CO_2 Rock Physics 4D Seismic Response Modelling (2025) suggests it may be challenging to detect the CO_2 plume within the Storage Site. Additional studies, into 4D survey repeatability are required. For example, is the geometry and signal to noise ratio of the existing 3D seismic data suitable for a 4D baseline, can the recording parameters be matched? If it is not possible to use an existing 3D seismic dataset as a baseline, then a new shoot is required.

The Prinos CO_2 Storage project is located within a protected species (including bottle nosed dolphins) zone; NATURA 2000 GR1150014. The MMV plan has been designed to minimize impact on protected species, particularly when it comes to seismic. The base MMV plan is reliant on a baseline 4D seismic survey. It is possible that an existing dataset could be used for this purpose.

Repeat 4D seismic surveys will be targeted, and only in-acted as a contingency measure. The principal seismic monitoring method employed during the project life will be SpotLight, which as previously mentioned has a light environmental footprint (one seismic source, and short acquisition periods). DAS VSPs will also be a source of seismic noise, but again acquisition is likely to be shorter than a conventional seismic survey and employ far less seismic sources.

When seismic sources are used, EnEarth will ensure that these are used in a way that is conscious of environmental matters. For example, avoiding acquisition at particular periods, soft start of seismic guns, and use of marine mammal observers.

9.8 Interference Pressure Tests and Tracers

Well interference tests involve injecting or withdrawing fluid in one well while monitoring for pressure responses in observation wells. This helps assess and characterise reservoir connectivity and pressure communication between the wells involved, and potentially leakage pathways. The rate of pressure fall-off after an injection pulse can also be used to indicate how much CO_2 is being trapped by residual and dissolution trapping mechanisms.

Reservoir connectivity within the Prinos field is well understood thanks to the production and pressure data gathered during its long production life and the calibrated reservoir models developed to manage hydrocarbon recovery. However, the connectivity between the field’s crest where legacy wells have been drilled and the planned downdip CO_2 injectors and water producers is more uncertain. Also, there is residual uncertainty in the degree of communication with Epsilon which could influence plume migration. The merit of using interference well testing techniques at Prinos to confirm reservoir connectivity between the wells should be evaluated prior to full development. Careful planning of interference test is paramount to the successful data acquisition.

Similarly, the role and benefit of chemical tracers should be reviewed in the context of the Prinos CO_2 Storage project. These techniques are used for a range of applications from monitoring well clean-up, verifying production/injection conformance, confirming reservoir connectivity between wells, identifying leaks in legacy wells. Tracers can either be injected with the disposal fluid (CO_2) or installed as part of the lower completion. Several tracer companies have recently developed gas tracers for CO_2 storage applications (see BP/Sonatrach Salah CCS project) with the technology continuing to progress. This monitoring technique requires dedicated regular fluid sampling at the wellhead and analysis in the lab, such as careful planning and operational execution.

9.9 Environmental Monitoring

EnEarth’s approach to environmental monitoring is strongly influenced by International Oil and Gas Producers (IOGP, 2017 and 2022) guidelines. A baseline data acquisition of environmental surveys is proposed. These could include sampling of seabed sediments, marine vegetation, and fauna, as well as imaging the seabed and mapping any existing sites of gas seepage. During injection, environmental surveys will be carried out in high leak risk areas, whereas during pre-injection and post-closure environmental surveys will cover the entire monitoring Complex.

9.9.1 Multi Beam Echo Sounder (MEBS) and Side Scan Sonar (SSS)

MBES and SSS are active acoustic tools used to characterise the seabed. They can also be used to detect gas rising from the seabed.

MBES can be used to produce bathymetric (depth) maps of the seafloor (vertical resolution centimetres), using fan shaped arrays of acoustic waves. The intensity of backscatter can be related to the acoustic properties of the seabed material and used to differentiate between different sediment types.

MBES devices can be ship hull mounted or attached to ROVs (remotely operated vehicles) and AUVs (autonomous underwater vehicles). MBES can provide a baseline of detailed seafloor topography prior to CO_2 injection. If an alarm is triggered from other monitoring systems targeted MBES surveys can be deployed to identify uplift, subsidence, or pockmarks that may indicate gas migration. MBES can also be used to detect gas bubbles in the water column.

SSS measures the intensity of acoustic reflections, creating a detailed image (high horizontal resolution; centimetres) of the seabed's texture and features but does not measure depth. SSS devices are usually towed behind a vessel or mounted on AUVs and ROVs. SSS can be used to detect fractures, seeps, bacterial mats, or bubble streams that may indicate CO_2 escape. Repeat surveys can reveal changes in sediment patterns, new seepage structures, or disturbances.

9.9.2 WellSentinel

EnEarth plan to use a passive, continuous subsea CO_2 monitoring system, known as WellSentinel. In contrast to conventional subsea well monitoring and leak detection methods, WellSentinel is a long-term remote solution, operating without the need for active power or data communication.

A specialised gathering system (Figure 15) directs leaked fluid, at the seabed, onto a proprietary trigger mechanism, which degrades if CO_2, oil or gas are present. This releases an alert beacon to the surface, sending an individual coded signal via satellite to alert EnEarth. This technology reduces the need for vessel-based inspection.

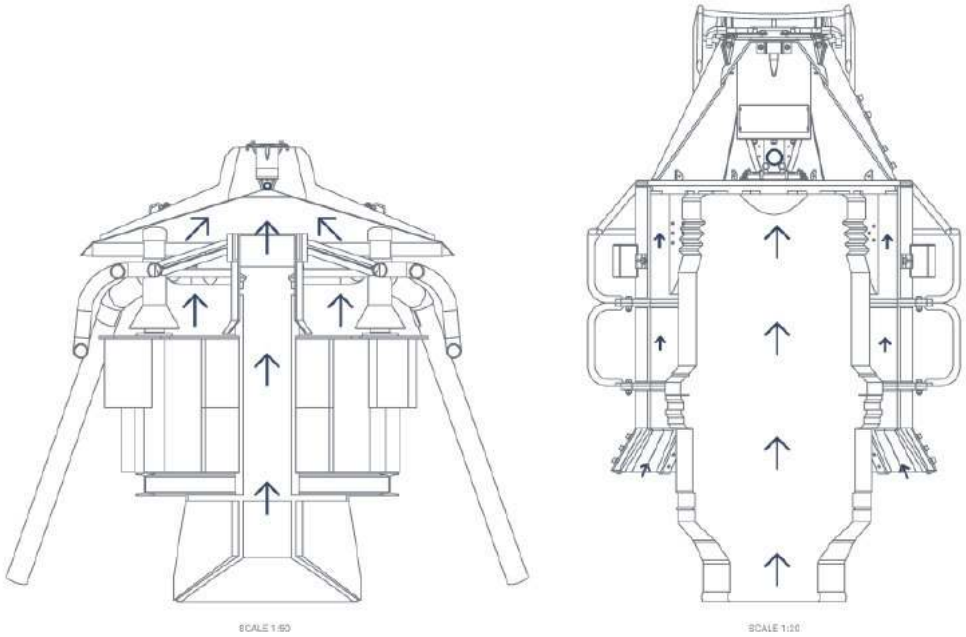


Figure 15: Example of a WellSentinel gathering systems

WellSentinel offer a range of gathering systems, allowing for monitoring across an extensive variety of subsea structures. In the case of Prinos, a WellSentinel Limpet could be installed directly above legacy hydrocarbon exploration and appraisal wells. WellSentinel can also, provide systems which can be sited above abandoned legacy production wellbores.

WellSentinel systems can be deployed for up to 20 years without intervention. It is envisaged that at Prinos the triggering device will be designed to detect oil, gas and CO_2 release. Gas triggers are required as dynamic reservoir simulations show that the injection of CO_2 results in liberation of natural gas from reservoir oil.

The alarm system would be set above background fluxes. The WellSentinel system will be tested with Prinos reservoir fluid samples to ensure the veracity of the triggers before deployment.

The company has yet to deploy a system on a CO_2 storage project, but their gathering systems have been used across the full oil and gas subsea well lifecycle, from deepwater drilling, producing Christmas trees to suspended wells. The trigger system for a CO_2 leak has been proven to work in laboratory tests and can be readily deployed on gathering systems, which have been extensively proven in a subsea environment including at water depths significantly deeper than at Prinos. Planning for WellSentinel installation will carefully take into account local fishing activity.

9.9.3 Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs)

ROVs can be used for visual inspections of the seafloor and subsea infrastructure. High-definition cameras can confirm features such as bubble streams, fractures, or bacterial mats that may indicate leakage. ROVs can be deployed to investigate anomalies detected by other monitoring techniques. They can also collect physical samples near potential leakage sites for lab analysis (e.g., pH, dissolved CO_2, isotopic composition) or be used to install other monitoring instruments or indeed repair existing instrumentation. ROVs can be equipped with CO_2 sensors and/or mass spectrometers to directly detect and quantify gas emissions in suspected leak zones. ROVs are operated in real time by pilots and as such allow for targeted investigation.

AUVs can be used to monitor broad areas for changes over time in bathymetry, backscatter (bubble detection) and water chemistry. They can be equipped with MBES, SSS and sub bottom profilers to allow for detailed seafloor and shallow subsurface mapping. AUVs can be programmed to search for CO_2 indicators across wide areas. The key strengths of AUVs are in their ability to operate independently over large areas and for extended durations. ROVs and AUVs are complementary technologies. ROVs are useful at providing detailed inspections of anomalies while ROVs are more suited to large area surveys.

AUVs use for detecting CO_2 underwater releases have been demonstrated in the UK North Sea: offshore Yorkshire (Craig, 2017) and at Goldeneye (Flohr et al, 2021). Some of the current limitations associated with AUVs include location tracking accuracy and mission length challenges. While AUVs show technical promise this technology is still developing and is unlikely to be deployed at the beginning of the Prinos project but could be a valuable tool in the future once the technology has matured.

EnEarth participates in the Horizon project COREu, brings together over 40 key partners from industry and science. Part of the scope of the COREu collaboration is a full environmental study covering baseline, injection and post CO_2 injection. These technologies could be implemented to prove concept of their value as part of the environmental studies for the Prinos CO_2 storage project.

9.9.4 Shallow Seismic Surveys

Shallow seismic surveys, optimized for imaging the upper 300 m of the subsurface are likely to be employed to allow for the selection of appropriate positions for wells and facilities. This is likely to involve the use of sub-bottom profiling or high-resolution multi-channel seismic. There is a possibility that the existing 3D seismic, shot for hydrocarbon exploitation in 2015, could be reprocessed over the shallow section and used for site survey purposes. However International Oil and Gas Producer (IOGP, 2022) guidelines suggest that site survey seismic surveys should be less than 10 years old.

9.9.5 Satellite Monitoring

EnEarth recommend that in the post transfer period satellite technology is used as a means to detect CO_2 leaks. This could allow for a greater sampling frequency than use of sub-sea methods such as MBES, SSS and ROV or aerial methods of monitoring. Satellites, such as GHGSAT-C10, can be used to detect atmospheric CO_2 emissions and sea surface characteristics such as temperature, colour and/or biological activity which could indicate leakage effects can also be measured, using (other) satellites. Further studies are recommended to deduce spatial resolution and instrument sensitivity to CO_2.

9.9.6 Seismic Hazard Monitoring

Monitoring of naturally occurring earthquakes (as opposed to induced seismicity) is required to understand the seismic hazard profile and help distinguish between natural and induced seismicity. Post closure monitoring for seismic hazards is also important to ensure containment.

The Storage Site is located close to the centre of the Permanent Regional Seismological Network operated by Aristotle University of Thessaloniki. EnEarth could make use of this seismograph network to provide stakeholders with reassurance regarding the likelihood of seismic hazards. Additionally, the Prinos CO_2 Storage Project will make use of DAS downhole fibre-optic sensors which are capable of detecting micro-seismicity.

Also, as stated above, EnEarth participates in the Horizon project COREu. Part of the scope of the COREu collaboration are seismicity monitoring studies at baseline, injection and post CO_2 injection.

10. Prinos MMV Plan

10.1 Structure of Plan

The Prinos MMV plan is designed so that a well-defined baseline characterization is acquired. This will be used in conjunction with measurements made throughout the store life and modelling to understand the behaviour of the store and the CO_2 contained within.

If a leak or other deviation from expected behaviour is detected during injection the contingency monitoring plan will be enacted to determine with certainty the source of the anomaly and quantify its magnitude. Once sufficient detail on the anomaly has been gathered corrective measures (Prinos CO_2 Corrective Measures Plan, 2025) will be implemented to ensure any negative impacts are minimized (Figure 16). Following the end of the injection; monitoring will continue in the post closure period. Detailed schedules defining the timings of various monitoring techniques and alarm thresholds are available (see Prinos Full Lifecycle Monitoring Schedule, 2025). Legacy well related leaks are the key risk at Prinos and the approach of the plume to these wells will be closely monitored. When monitoring and modelling suggest that the CO_2 plume is within the vicinity of intolerable wells triggered monitoring will be initiated.

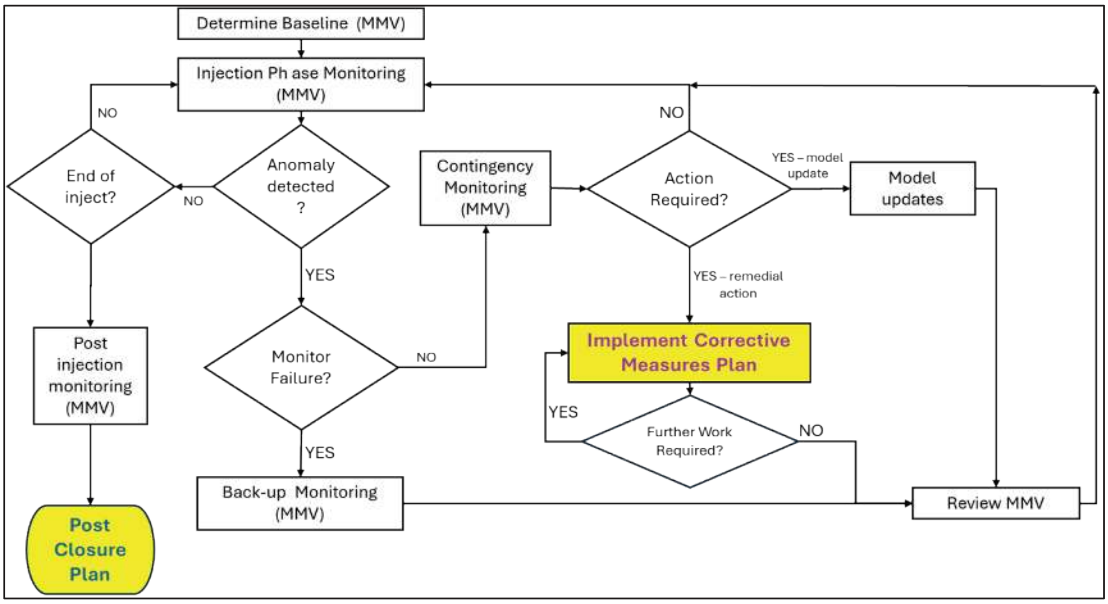


Figure 16: The relationship between the Prinos MMV plan, the Post Closure and Corrective Measures Plans

10.2 Model Update Protocol – Dynamic Model

(In accordance with Directive 2009/31/EC, Article 13 and Annex II)

10.2.1 Purpose and Scope

This Model Update Protocol defines the procedures by which the dynamic model of the Storage Site will be updated throughout the lifecycle of the CO_2 storage project. It ensures that model predictions remain consistent with measured system behaviour and that all updates are fully traceable, scientifically justified, and compliant with the requirements of Directive 2009/31/EC. The dynamic model represents the multiphase flow, pressure evolution, and trapping mechanisms of injected CO_2 and associated formation fluids within the storage reservoir and confining formations.

10.2.2 Regulatory Basis

- Directive 2009/31/EC, Article 13(1)(c): Monitoring shall compare actual and modelled behaviour.
- Article 13(2): The monitoring plan shall be updated when discrepancies occur between observed and modelled behaviour.
- Annex II (3–5): The dynamic simulation model must be updated with the results of monitoring and recalibrated to improve predictive capability.
- Annex II (10): All data, models, and interpretations must be archived and traceable.

10.2.3 Objectives of Model Updating

The objectives of the dynamic model update are to:

- Integrate new MMV (Measurement, Monitoring and Verification) data into the model;
- Recalibrate the model to ensure consistency between predicted and observed CO_2 behaviour;
- Improve the accuracy of future forecasts regarding plume migration, pressure distribution, and trapping efficiency;
- Support ongoing risk assessment, containment assurance, and decision-making for site operation and closure.

10.2.4 Update Triggers and Frequency

Model updates shall occur:

- **Start injection**: start up phase after data gathering (well tests, logging, RFT etc) to calibrate model performance from start
- **Periodically**: At minimum every 5 years coinciding with MMV reporting cycles;
- **Conditionally**: Whenever new data or significant deviations between predicted and observed parameters are identified;
- **At project milestones**: Prior to changes in injection strategy, end of injection, or transition to post-closure.

10.2.5 Data Sources for Model Updating

Monitoring Objective	Tool / Technique	Model Parameter or Output Calibrated
Reservoir pressure and temperature	Downhole pressure/temperature gauges, permanent sensors, DTS	Pressure field, transmissivity, boundary conditions
CO_2 plume delineation	VSP, SpotLight, monitoring wells	CO_2 saturation distribution, migration pathway, plume geometry
Injection performance	Injection rate and wellhead pressure logs	Well injectivity, near-wellbore properties, relative permeability curves
Formation fluid chemistry	Fluid sampling and geochemical analysis	Solubility trapping, geochemical reaction rates
Overburden monitoring	Monitoring wells, pressure sensors	Leakage pathway validation, vertical pressure communication
Geomechanical response	DAS micro-seismic monitoring	Stress-strain calibration, fracture risk limits
Thermal behaviour	DTS, temperature gauges or logging	Thermal front validation, multiphase flow adjustment

10.2.6 Model Update Procedure

Data Preparation

- Collate all new MMV datasets and perform quality control (QC) and consistency checks.
- Convert raw monitoring results into model-compatible formats.
- Quantify data uncertainty to inform sensitivity analysis.

History Matching and Calibration

- Compare observed monitoring data with previous dynamic model forecasts.
- Perform history matching using manual or automated techniques.
- Adjust key parameters (permeability, porosity, relative permeability, etc.) within physical bounds.

Model Validation

- Compare observed monitoring data with previous dynamic model forecasts.
- Perform history matching using manual or automated techniques.
- Adjust key parameters (permeability, porosity, relative permeability, etc.) within physical bounds.

Forecasting and Scenario Analysis

- Generate forward simulations to predict plume migration and stabilization.
- Update risk assessment, corrective measures plan, and post-closure plan if necessary.

Documentation and Archiving

- Store updated model versions and data with version control.
- Maintain a traceable history of all updates.

10.2.7 Reporting

The operator shall provide a summary of MMV data integrated, calibration steps, parameter adjustments, comparison of observed vs. predicted behaviour, updated forecasts, and compliance assessment within the Annual Storage Complex Performance Report to the Competent Authority. Any significant deviation from predicted performance shall be immediately reported and corrective measures implemented.

10.2.8 Tools and Software

Reservoir simulation: Petrel, CMG GEM,

Geomechanical coupling: FLAC3D,

Geochemical modelling: PHREEQC, CMG GEM

Data integration and visualization: Petrel, CMG

10.2.9 Quality Assurance and Control

All model updates are subject to peer review and, where requested, independent verification. Updates are logged in the Model Update Register including data sources, rationale for changes, and outcomes.

10.2.10 Version Control and Recordkeeping

All versions of the dynamic model are recorded with identifiers, dates, and responsible personnel. Previous versions are archived for full traceability and audit purposes.

10.3 Phasing of Plan

The Prinos MMV plan considers five key phases (see Figure 17,

Table *6*, Table 7):

1) a baseline prior to CO_2 injection,
2) attribution monitoring to determine the source of any CO_2,
3) a period of gathering data and monitoring during CO_2 injection,
4) a contingency plan which will be enacted should an irregularity be detected,
5) post closure surveying to ensure long-term containment.

10.3.1 Baseline Surveys

The opportunity should be taken to gather as much baseline data as early as possible. In the case of Prinos the data acquired during the construction and operation of the hydrocarbon production facilities reduces the requirement for baseline data acquisition relative to a previously undeveloped location. However, a significant volume of new data will still be required both on a store wide and on a well basis.

10.3.2 Attribution Monitoring

The aim of attribution monitoring is to differentiate naturally occurring CO_2 from CO_2 that originated from storage operations.

10.3.3 Injection Monitoring

In constructing this MMV EnEarth have reviewed geological and engineering related risks related to the Prinos CO_2 Storage project. During the injection phase EnEarth plan to gather data, input this into models (geological, geomechanical and dynamic) and monitor. This will be used to inform as to whether the contingency monitoring plan is enacted. SpotLight seismic and DAS VSPs will be a key part of the monitoring plan, working as alarm systems for potential containment anomalies, including those related to the 12 non-compliant legacy wells. During the injection phase targeted, intermittent environmental monitoring will be carried out over high-risk areas.

10.3.4 Contingency Monitoring

The contingency (triggered) monitoring plan involves the acquisition of data to identify and quantify anomalies. This could include additional 4D DAS VSPs, environmental surveys, well logging, interference tests, temporary installation of DAS and DTS arrays as well as targeted 4D seismic surveys.

If an irregularity is identified in any instrumented (injection, production, or monitoring) well, the data from all sensors associated with the well will be used to determine whether the anomaly relates to measurement error or is a valid reading. Should an irregularity be verified and indicative of a barrier failure within a new CO_2 project well or legacy well, a range of additional measurements should be triggered. In cases where new CO_2 pathways are identified or significant deviations from expected behaviour are encountered the monitoring plan will be updated. If action is required, the Corrective Measures Plan (2025) will be implemented.

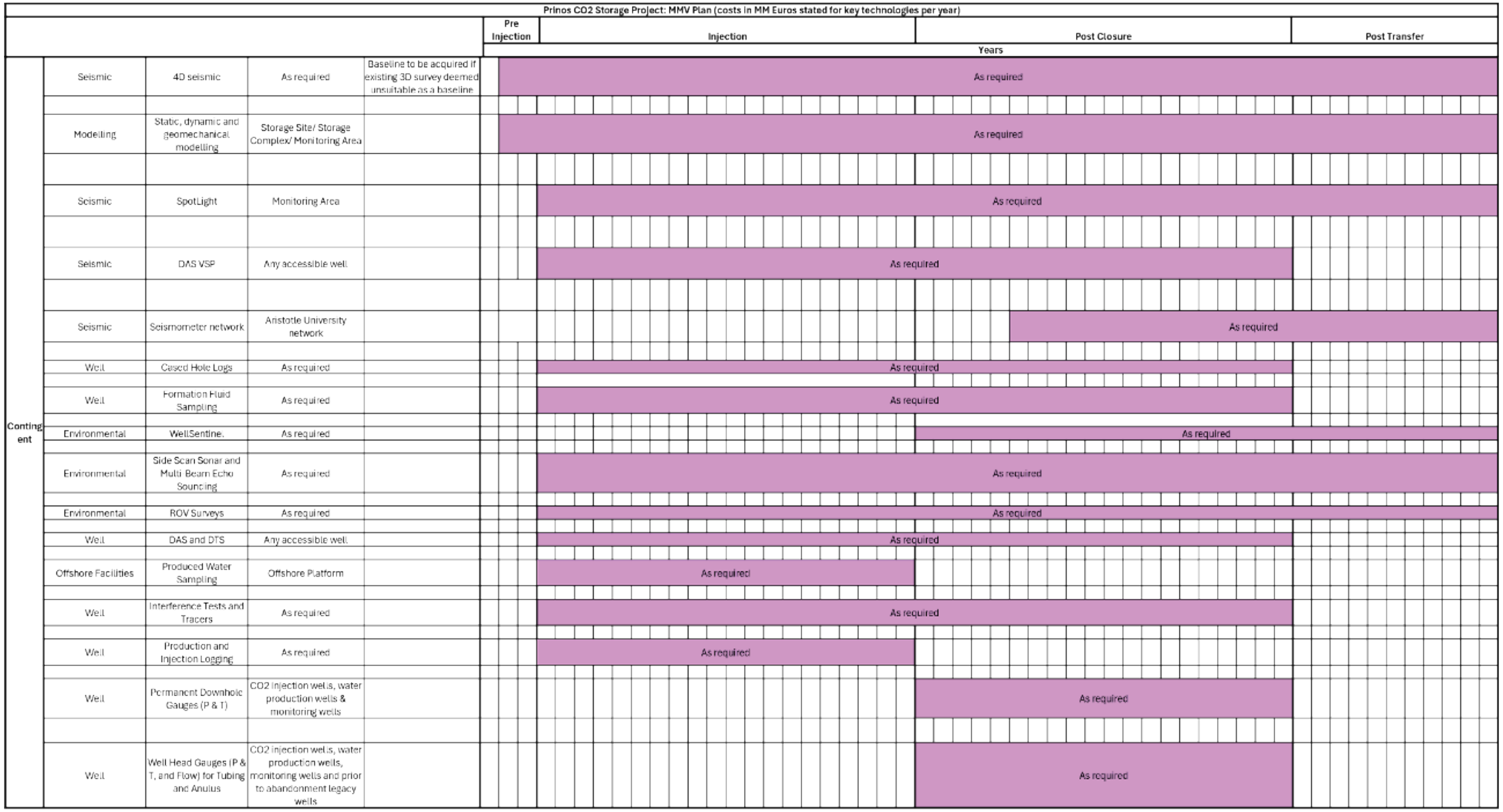
10.3.5 Post Closure Monitoring

Following the cessation of CO_2 injection operations and a defined post-injection monitoring period, the site will progress to the closure phase. EnEarth’s post closure plans are detailed in the Prinos CO_2 Post Closure Report (2025). To demonstrate conformance and containment, monitoring will not cease at the end of injection / production. Provided irregularities have not been identified by the base monitoring plan during injection operations, it is proposed to include environmental monitoring at years 5 and 15 after injection operations have ceased. Post injection SpotLight surveys will also be carried out to confirm containment through the post closure period (see table 10). A final risk assessment will be undertaken to demonstrate that the long-term risk to containment of the CO_2 is as low as reasonably practical.

Prinos CO2 Storage Project: MMV Plan (costs in MM Euros stated for key technologies per year)																											
					Pre Injection			Injection																			
					Years																						
	Technical Category	Monitoring Technology	Location	Comments	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Firm	Modelling	Static, dynamic and geomechanical modelling	Storage Site/ Storage Complex/ Monitoring Area		4.25	🟧	🟧	18	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Seismic	4D seismic baseline- use of existing survey	Monitoring Area or as Required		🟧	🟧																					
	Seismic	SpotLight	Monitoring Area	Locations to be tuned by dynamic reservoir models and risks			0.50	0.50		0.50		0.50		0.50		0.50		0.50		0.50		0.50		0.50		0.50	
	Seismic	DAS VSP	Wells PB-19A, PA37, PB-22, EA-H3				0.06	0.12	0.12		0.12		0.12		0.12		0.12		0.12		0.12			0.12			0.12
	Seismic	Seismometer network	Aristotle University network				🟧	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Environmental	Oceanic CO2 emission monitoring	Satellite																								
	Environmental	WellSentinel	Wells P-1, P-2, P-3, P-4, P-5, P-6, E-1, PN-1, EL-1				3.21	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Environmental	Side Scan Sonar and Multi-Beam Echo Sounding	Monitoring Area			1.2						1.2					1.2					1.2				1.2	
	Environmental	ROV Surveys	Visual inspection of subsea infrastructure within the Monitoring Area and at selected high containment risk areas			🟧						🟩					🟩					🟩				🟩	
	Pipeline	P & T, Flow rate, Chemical Sensors	Targeted zones along pipeline					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Offshore Facilities	Fugitive Emission Detectors	Offshore Platforms			🟧	🟧	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Offshore Facilities	Produced Water Sampling	Offshore Platform					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Offshore Facilities	Facilities Gas Samples	Onshore Facilities					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Well	Corrosion Coupons	CO2 injection wells & water production wells					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Well	Electrical Submersible Pump (ESP) Monitoring	Water production wells					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Well	Coring (and Analysis)	Early CO2 and water production wells			🟧	🟧																				
	Well	Open and Cased Hole Logging	CO2 injection wells, water production wells & monitoring wells			🟧	🟧																				
	Well	Formation Fluid Sampling	CO2 and water production wells			🟧	🟧																				
	Well	Injectivity Testing	Early CO2 and water production wells			🟧	🟧																				
	Well	Production Logging Tools	CO2 and water production wells					🟩		🟩		🟩			🟩			🟩			🟩			🟩			🟩
	Well	DAS and DTS	Wells PB-19A, PA37, PB-22, EA-H3				2.30	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
	Well	Permanent Downhole Gauges (P & T)	CO2 injection wells, water production wells & monitoring wells				0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	Well	Well Head Gauges (P & T, and Flow) for Tubing and Anulus	CO2 injection wells, water production wells, monitoring wells and prior to abandonment legacy wells				0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	All	Post Closure Risk Assessment	Monitoring Area	A final risk assessment will be undertaken to demonstrate the long-term risks are as low as reasonably practical. If it is not additional monitoring to address the specific risks will be required																							

		Post Closure																				Post Transfer										
Technical Category	Monitoring Technology	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Modelling	Static, dynamic and geomechanical modelling	2				2					Contingent					Contingent					Contingent											
Seismic	4D seismic baseline- use of existing survey																															
Seismic	SpotLight		0.50			0.50					0.50					0.50					0.50											
Seismic	DAS VSP																															
Seismic	Seismometer network	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦											
Environmental	Oceanic CO2 emission monitoring	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	Recommended for 30 years post-transfer	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
Environmental	WellSentinel	As required (contingent)	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪											
Environmental	Side Scan Sonar and Multi-Beam Echo Sounding					1.2										1.2																
Environmental	ROV Surveys					🟦										🟦																
Pipeline	P & T, Flow rate, Chemical Sensors	🟦																														
Offshore Facilities	Fugitive Emission Detectors	🟦	🟦																													
Offshore Facilities	Produced Water Sampling																															
Offshore Facilities	Facilities Gas Samples																															
Well	Corrosion Coupons																															
Well	Electrical Submersible Pump (ESP) Monitoring																															
Well	Coring (and Analysis)																															
Well	Open and Cased Hole Logging																															
Well	Formation Fluid Sampling																															
Well	Injectivity Testing																															
Well	Production Logging Tools																															
Well	DAS and DTS	0.68	0.68																													
Well	Permanent Downhole Gauges (P & T)	0.03	0.03																													
Well	Well Head Gauges (P & T, and Flow) for Tubing and Anulus	0.03	0.03																													
All	Post Closure Risk Assessment					🟦															🟦											

Table 6: Prinos MMV firm monitoring schedule



Prinos CO2 Storage Project: MMV Plan (costs in MM Euros stated for key technologies per year)								
					Pre Injection	Injection	Post Closure	Post Transfer
					Years			
Contingent	Seismic	4D seismic	As required	Baseline to be acquired if existing 3D survey deemed unsuitable as a baseline	As required	As required	As required	As required
	Modelling	Static, dynamic and geomechanical modelling	Storage Site/ Storage Complex/ Monitoring Area		As required	As required	As required	As required
	Seismic	SpotLight	Monitoring Area			As required	As required	As required
	Seismic	DAS VSP	Any accessible well			As required	As required	
	Seismic	Seismometer network	Aristotle University network				As required	As required
	Well	Cased Hole Logs	As required			As required	As required	
	Well	Formation Fluid Sampling	As required			As required	As required	
	Environmental	WellSentinel.	As required				As required	As required
	Environmental	Side Scan Sonar and Multi Beam Echo Sounding	As required			As required	As required	As required
	Environmental	ROV Surveys	As required			As required	As required	As required
	Well	DAS and DTS	Any accessible well			As required	As required	
	Offshore Facilities	Produced Water Sampling	Offshore Platform			As required		
	Well	Interference Tests and Tracers	As required			As required	As required	
	Well	Production and Injection Logging	As required			As required		
	Well	Permanent Downhole Gauges (P & T)	CO2 injection wells, water production wells & monitoring wells				As required	
	Well	Well Head Gauges (P & T, and Flow) for Tubing and Anulus	CO2 injection wells, water production wells, monitoring wells and prior to abandonment legacy wells				As required	

Table 7: Contingent monitoring schedule for the Prinos CO_2 Storage Project

Parameters to be Monitored	Technique Adopted	Category of Monitoring			Project Phase and Frequency				Location
		Mandatory	Required	Contingency	Pre-Inj	Inj	Post Closure	Post Transfer	
Produced water composition	Water samples	x			Baseline	Periodic / Contingent			Offshore facilities
Injected gas composition	Gas samples/ chemical sensors	x				Periodic/ Continuous			Onshore and offshore facilities
Pipeline	Pipeline flow rates, pressures and temperatures	x				Continuous	Continuous until decom		Various points along the pipeline, including pipeline inlets and outlets
	Corrosion Coupons		x			Continuous			Within pipeline
Facilities	Fugitive emission detectors	x			Baseline	Continuous	Continuous until decom		Onshore and offshore facilities
Environment	Multi Beam Echo Sounding	x			Baseline	Periodic/ Contingent	Periodic/ Contingent	Contingent	Monitoring area or targeted areas based on other measurements
	Side Scan Sonar	x			Baseline	Periodic/ Contingent	Periodic/ Contingent	Contingent	
	Satellite oceanic CO2 emission monitoring		x				Continuous	Continuous	Monitoring area
	Remotely Operated Vehicle (ROV)	x			Baseline	Periodic/ Contingent	Periodic/ Contingent	Contingent	- Subsea infrastructure within the monitoring area - At selected high containment risk areas - In areas where additional scrutiny is required, based on other measurements
	Well Sentinel		x	x	Baseline	Continuous	Contingent	Contingent	Wells P-1, P-2, P-3, P-4, P-5, P-6, E-1, PN-1, EL-1
Plume movement and Integrity (Geology and Wells)	Flow meter	x				Continuous	Continuous until decom		CO2 injection and water production wellheads
	Pressure gauges	x			Baseline	Continuous	Continuous until decom		Well head and downhole (injection, production and monitoring wells)
	Wellhead and downhole temperature gauges	x			Baseline	Continuous	Continuous until decom		Injection, water production and monitoring wells
	Static, dynamic and geomechanical modelling	x		x	Baseline	Periodic / Contingent	Periodic / Contingent	Contingent	As required across: storage site, storage complex, monitoring area
	SpotLight		x	x	Baseline	Periodic/ Contingent	Periodic/ Contingent	Contingent	Monitoring area, locations tuned by dynamic reservoir models and risks
	DAS VSP		x	x	Baseline	Periodic/ Contingent	Contingent until decom		Monitoring wells and temporary installations in other accessible wells if necessary
	4D seismic		x	x	Baseline	Contingent	Contingent	Contingent	Monitoring area or targeted areas based on other measurements
	DAS and DTS		x	x	Baseline	Continuous / Contingent	Continuous / Contingent until decom		- Monitoring wells - As a contingency fibre can be temporarily installed in accessible wells
	Cased hole logging		x	x	Baseline	Contingent	Contingent until decom		- CO2 injection and water production wells - In a contingency any accessible legacy well
	Injection and water production logging (PLT)		x	x		Periodic/ Contingent			CO2 injection and water production wells
	Formation fluid sampling		x	x	Baseline	Contingent	Contingent until decom		Injection, production, monitoring and if necessary other accessible wellbores
	Interference tests & tracers			x		Contingent	Contingent until decom		- CO2 injection and water production wells
	Open hole logging and coring		x		Baseline				Injection and water production wells will be logged to aid prediction of CO2 movement
	ESP monitoring equipment		x			Continuous			Water production wells
	Functional and integrity testing (XMT and SSSV)		x	x	Baseline	Periodic/ Contingent	Periodic/ Contingent		All accessible wells
	Pressure testing (casing integrity)		x	x	Baseline	Periodic/ Contingent	Periodic/ Contingent		All accessible wells
Tectonic activity	Seismometer network		x	x	Baseline	Continuous	Continuous	Contingent	Aristotle University Permanent Regional Seismological Network
	DAS		x	x	Baseline	Continuous/ Contingent	Continuous / Contingent until decom		- At monitoring wells EA-H3, PA-37, PB-19A, PB-22 - If necessary temporary DAS at other accessible wells

Table 8: Monitoring parameters, location and project phase frequency

10.4 Monitoring Rationale: Baseline Measurements

10.4.1 Environment

Baseline sampling of seabed sediments, marine vegetation and fauna will be carried out. When combined with existing data on the surrounding environment this will be used to establish a full understanding of the biosphere within the Monitoring Area.

A survey of the Monitoring Area using MBES and SSS will be carried out to map the seabed with particular emphasis on detecting existing seeps and evidence of bubble streams. Additionally, a sub-bottom profiler could be deployed to identify shallow (tens of meters) subsurface features that may be serving as CO_2 leakage pathways. Should any potential gas seeps be identified, an ROV (or diver) will be deployed to make a photographic record of the seabed, and if practicable capture a sample of the gas stream for analysis. Baseline data is also required for the WellSentinel seabed CO_2, oil and gas detection system to avoid false positives.

10.4.2 CO2 Injector and Water Producing Wells

Drilling of CO2 injector and water producing wells provides an opportunity to gather data prior to injection at the store, with drilling results giving the potential to alter the detailed development plan and MMV if required. Key data to be acquired during drilling of new CO_2 injector and water producing wells includes:

- A comprehensive suite of open hole logs to determine the formation properties, pressures, and temperatures through the entire thickness of the Monitoring Area in the vicinity of the proposed CO_2 injection and water production well locations
- Coring should be considered at a number of different depth intervals
- Fluid sampling should be carried out, from the Storage Site and overburden, in-order to act as a baseline for future samples taken in the event of unexpected fluid movement
- Well testing to understand the flow behaviour of both injection and production wells. The rate and direction of flow, as well as fluid type should be as close as practical to those the CO_2 project wells are likely to be exposed to during store operation.

10.4.3 Monitoring Wells

Some of the legacy Prinos oilfield wells will be converted to monitoring wells. These are located at the crest of the Prinos structure, in relatively close proximity to the “non-compliant” wells. The monitoring wells will be equipped with downhole technology (such as DAS) which may be able to detect the acoustic signals associated with potential leaks from nearby wells. DAS VSPs can also be run periodically to check for the absence of significant leaks from the Storage Complex.

The key baseline consideration is understanding the current integrity status of the wells. More than one monitoring well is required, especially given the need to increase the event location accuracy of DAS micro-seismic. EnEarth have identified the following legacy wells, as being potential candidates for conversion to monitoring wells (Figure 17) with the rationale behind this listed below:

- PB-19A:
    - To monitor plume migration towards the northern side of the storage site
    - To monitor the plume arrival / pressure towards legacy well P-5A

- PA-37:
    - To monitor the connectivity between the crest and the aquifer
    - To monitor the plume and pressure for key legacy wells: (PA-37, PA-35, PA-28, PA-33, PB-14)
- PB-22
    - To monitor plume migration towards the planned water producers
- EA-H3
    - To monitor the plume and pressure towards western edge of the Storage Site

Monitoring wells will also be positioned based on the detection ranges of the technologies in this MMV (e.g. DAS micro-seismic and 4D DAS VSP). Several CO2 storage projects have experienced unexpected plume movement. If this occurs at Prinos this may necessitate the use of additional legacy wells, to those listed above, for monitoring or even the drilling of new monitoring well boreholes (refer to 6.1.2).

One of the risks is lateral migration out of the Storage Complex and into the Epsilon oilfield. This can potentially be identified using SpotLight seismic. A dedicated monitoring well in the saddle area between Epsilon and Prinos could add further means of detecting irregularities related to this risk.

10.4.4 Legacy Wells

While conducting environmental surveys, photographic records will be made of the seabed status of each of the open water legacy exploration and appraisal wells. Should the exact E&A well location not be apparent on the MBES and SSS data, it may be necessary to run a magnetometer search will be used to locate the well. The baseline condition of the existing platform wells will be taken from the current well integrity management system.

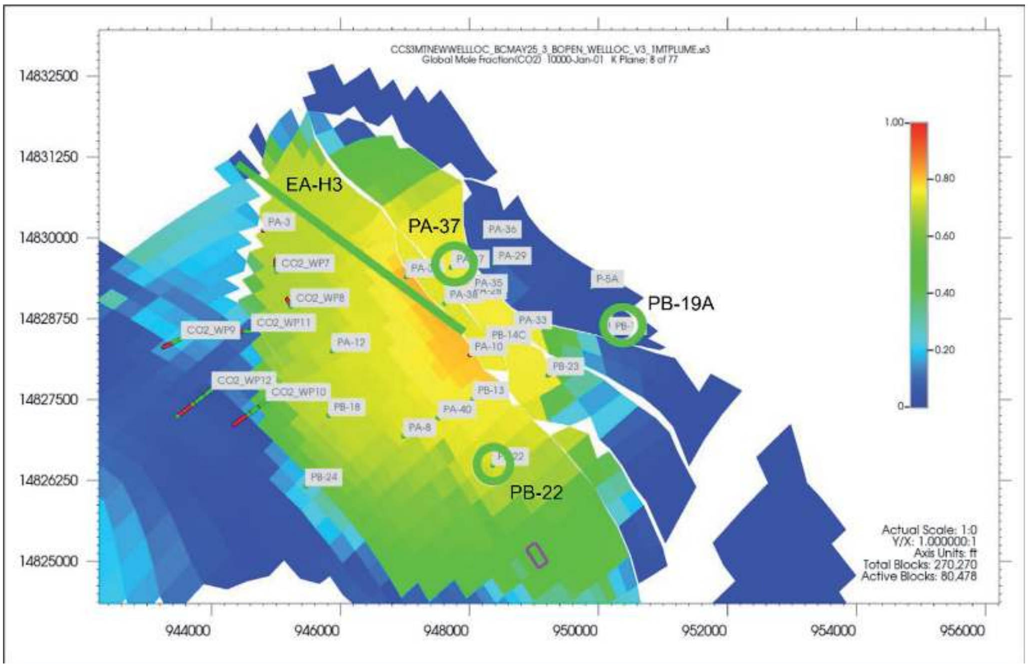


Figure 17:: Legacy wells which could be converted into monitoring wells, overlaid on a map of simulated CO2 mole fraction

10.4.5 Geosphere

Baseline geosphere data will include geological, geomechanical and dynamic models, which will be updated as new data (for example data obtained from new wells) becomes available. A SpotLight survey will be acquired as a baseline for future acquisitions. A contingent/triggered monitoring tool could include 4D seismic and given this a baseline survey is required. The most recent of EnEarth’s 3D seismic surveys, acquired in 2015, could be used for this purpose although further studies are required to confirm this. If not, then a new baseline survey will be acquired prior to injection.

Downhole DAS will be used during injection for micro-seismic and well integrity monitoring and as such a baseline of data is required. Given DAS will also periodically used for 4D VSP surveys pre-injection baseline surveys for this are necessary.

10.4.6 CO_2 Injection and Water Production Wells

The CO_2 injection and water production wells are to be located downdip relative to the existing hydrocarbon development. As a result, the reservoir properties in much of the store are not fully characterized. To reduce uncertainty, further data will be acquired during the drilling of the development wells and if appropriate used to update models of the store prior to injection commencing.

All of the data required to further improve understanding of the subsurface at the injection and production locations will be acquired using standard oilfield logging tools (Table 9, either LWD or wireline conveyed) prior to the installation of any completion that is in contact with the formation.

Hole Section	Log						
	Calliper	Gamma Ray	Density & Neutron	Sonic	Resistivity	Neutron Porosity	Dipole Sonic (Scanner or XMAC)
17-1/2”	🟩	🟩	🟩				
12-1/4”	🟩	🟩		🟩	🟩		
8-1/2”	🟩	🟩	🟩	🟩	🟩	🟩	🟩

Table 9: Proposed logging per hole section for Prinos CO_2 injection and water production wells

In addition to the open-hole data, cased hole logs will be deployed in new wells to establish baselines for performance and integrity monitoring.

- Pulsed neutron logging may be required to establish a representative baseline for CO_2 distribution monitoring
- CBL tools could be used to verify annular cement quality during construction and prior to injection
- Casing and/or tubing inspection logging to serve as a baseline to allow accurate quantification of any changes

A comprehensive pressure testing regime will be employed during the drilling and completion of the wells to verify good initial well integrity.

10.5 Attribution Measurements

Attribution of CO_2 should only be required under specific circumstances. Should it be required a number of techniques may be applicable to enable the source of any given flow of CO_2 (or hydrocarbons, given the Storage Site includes a partially depleted oilfield) to be determined. Typically, this is achieved by comparing the chemical composition and/or isotope ratios in a sample, to those in known standards. In this case the standards are likely to be baseline samples of naturally occurring CO_2 (or hydrocarbon) and samples of the injected CO_2. If required, all laboratory analysis should be carried out by independent bodies using techniques in accordance with the appropriate international standards.

EnEarth participates in the Horizon project COREu and part of the scope of this collaboration is a full environmental study at baseline, injection and post CO_2 injection. This includes capturing samples and performance of E-DNA analysis of the background CO_2 naturally existing in the sea above the storage site. The results could then be compared to any potential future leakage to exhibit the source of the CO2 leak.

10.6 Monitoring Rationale: Injection Monitoring

10.6.1 Environment

During injection periodic MBES and SSS surveys will be carried out to identify changes which could indicate a leak. In high-risk areas benthic and sediment sampling will be undertaken as well as ROV inspections. WellSentinel gathering systems will be positioned above E & A wells to detect CO_2 and oil leaks if they reach the seabed. Sensors on the host facilities will be in place to detect fugitive emissions to the air.

A triggered monitoring phase will be initiated once the CO_2 plume approaches the vicinity of the non-compliant wells. This responsive monitoring approach ensures that additional data acquisition is activated when plume migration indicates a potential risk to legacy infrastructure. By implementing targeted surveillance at this stage, the MMV program enhances its ability to detect and assess any anomalies in pressure or plume behaviour near non-compliant wells, thereby supporting timely mitigation measures and maintaining the integrity of the storage complex.

10.6.2 Geosphere

Modelling (including geological, geomechanical and dynamic) will continue throughout the injection phase and will be updated periodically with new measurements. SpotLight seismic will be a key technology that will be used as an alarm system for abnormalities. Additional confidence in containment and conformance monitoring, particularly over the crest of the Storage Site, could be had through use of periodic 4D DAS VSPs. Given it could be challenging (Prinos Rock Physics Modelling, 2025) to monitor conformance within the Storage Site, downhole DAS micro-seismic may provide an additional means of tracking the plume. This technology can also be used to monitor induced seismicity and well integrity.

10.6.3 Injection and Water Production and Wells

All the new wells will be under continuous monitoring throughout the injection period. The exact monitoring configuration will vary between wells, but as a minimum each well should be equipped with (Figure 18):

- Downhole pressure and temperature, with redundancy, set as deep as possible in the well – just above the packer
- Standard O&G annulus monitoring gauges and alarms at surface on all wells

- Provision for the use of corrosion coupons in the flow stream

Additional monitoring equipment to be installed may depend on a number of factors including the type of well (injection or production), the well location and in the case of wells drilled in subsequent phases of the development lessons learnt from the previous phases. This may include:

- ESP power demand (current and voltage) at surface
- ESP monitoring equipment to ensure optimal performance of the ESP will be installed, including intake and discharge pressures, motor parameters (temperature, vibration, etc.)

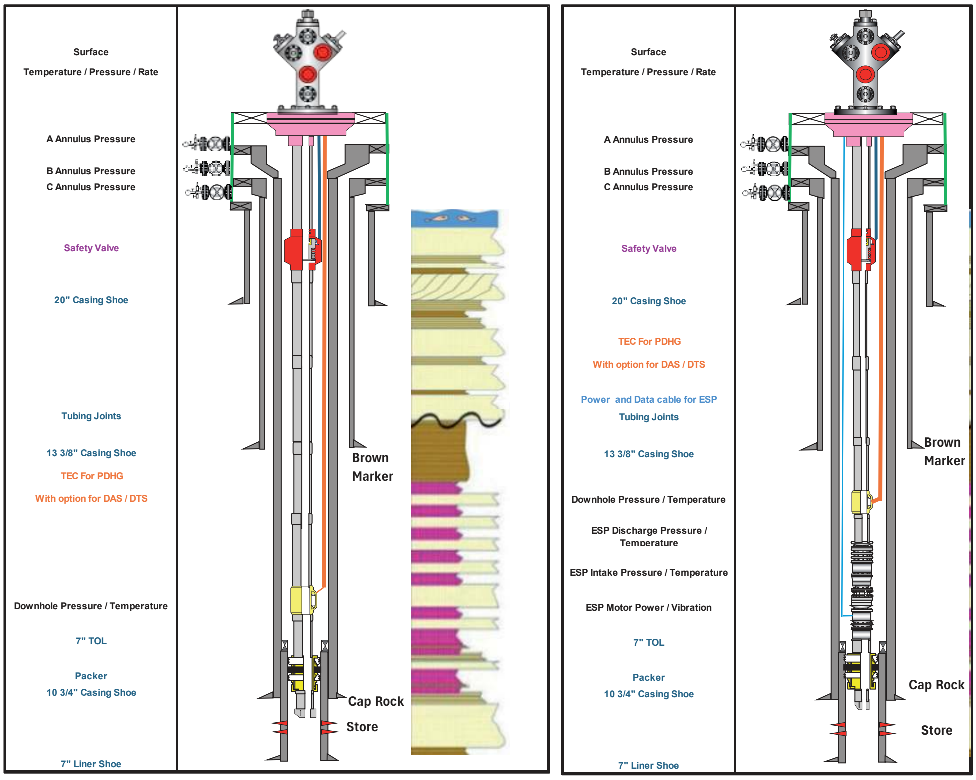


Figure 18: Notional well schematics and monitoring techniques for a CO2 injection well (left) and water production well (right)

The well design will allow a number of additional measurements to be made on a periodic basis:

- Casing and/or tubing inspection logging to understand any deterioration in well condition
- Fluid (produced or injected) sampling will be taken at regular intervals to ensure that the injected fluid is in line with the agreed specifications for the well design thus ensuring well longevity
- Production/injection logging utilizing standard O&G production logging tools may be carried out periodically to determine the injection/production profile

10.6.4 Legacy Wells

WellSentinel systems might be deployed at each of the open water well locations within the Monitoring Area, to allow for detection of errant emissions of CO_2 and oil. Potential irregularities will be monitored using a range of technologies in monitoring wells (including 4D DAS VSP), environmental surveys and SpotLight.

10.6.5 Monitoring Wells

Monitoring wells will be monitored on a continuous basis to allow for comparison of changes in temperature and pressure at the monitoring well locations to model predictions. In addition, fibre optic systems (DAS) could potentially provide warning of leaks developing in nearby wells and plume related abnormalities.

10.6.6 Pipeline Monitoring

The pipeline from shore to the offshore installation for the delivery of CO_2 for injection will be monitored to ensure that no leaks are occurring and that the composition, flowrate, temperature and pressure of the flow remains within the operating limits. In addition, use will be made of corrosion coupons at the ends of the pipeline to allow estimation of pipeline corrosion rate.

The composition of the CO_2 stream will vary overtime as it will be dependent on the source of the CO_2 and the performance of any processing facilities between the capture location and the entry of CO_2 to the pipeline. The primary method for ensuring that the level of impurities withing the injection stream is maintained within the required specification will be laboratory analysis of samples. The specification of the CO_2 and the level of analysis to be carried out will be defined during FEED, while sample frequency will depend on the range of sources CO_2.

Flowrate, temperature and pressure will be continually monitored at both ends of the pipeline and compared to predicted behaviour in a real time transient pipeline model to ensure rapid detection of any leak. To ensure accuracy the model will take into account the status of all valves and the composition of the flow.

10.7 Monitoring Rationale Post Closure Measurements and Monitoring

After a CO_2 storage project has been closed (i.e., CO_2 injection has stopped and the site is sealed), post-closure monitoring is required to ensure long-term containment, environmental safety, and compliance with regulations. EU (EU Commission Guidance Document 2, 2024) requires monitoring for at least 20 years after closure or until proof of CO_2 containment is demonstrated.

10.7.1 Environment

Provided significant irregularities have not been identified by the base monitoring plan during injection operations environmental monitoring will be performed on years 5 and 15 after injection operations have ceased. MBES, SSS and sub-bottom profiling could be applied across the full monitoring area. Additional ROV surveys (including sediment and fluid sampling) will be undertaken at locations of the old exploration and appraisal wells, and any sites where anomalies have been detected during the injection period. These marine based methods will be complemented by satellite monitoring of sea surface and atmospheric conditions.

10.7.2 Geosphere

Passive seismic observation will be carried out continuously to ensure storage site integrity. If irregularities have not been observed during the project, SpotLight seismic will be carried out during the post closure at years 22, 25, 30, 35 and 40 as per table 10 as a check on containment and conformance. If irregularities are observed there is the option of using 4D seismic as a tool to help locate and quantify such. Geological, dynamic and geomechanical modelling will provide a relatively inexpensive means of providing assurance with regards to conformance and containment. Natural tectonic activity, which may post a containment threat, can be monitored post closure with access to a seismometer network such as that provided by Aristotle University.

10.7.3 Wells

During the period between the end of operations and well abandonment, routine monitoring may continue (during injection, water production and monitoring wells). This may include passive monitoring of the DAS and DTS systems in specific wells, as well as recording the pressure and temperature, both at wellhead and downhole. If necessary, post closure, a contingent monitoring method could include acquisition of DAS VSPs.

The de-commissioning schedule will take into account any requirements to utilise any of the downhole sensors (including DAS systems, formation fluid sampling, and cased hole logging) for post closure monitoring. If necessary cased hole logging and formation fluid sampling can be undertaken prior to decommissioning. While the minimum monitoring period will only be defined based on the models available at the time of site closure, it is anticipated to be several years.

Once barriers have been placed in the wells to isolate the store it is likely that all of the instrumentation used to monitor the wells will cease to be available, although ongoing developments in terms of wireless data transmission and temporary fibre optic installations may allow some form of monitoring to continue. It is anticipated that a key indicator of conformance with the predicted plume behaviour will be a store wide decline in pressure; hence there may be a requirement to retain at least one pressure monitoring point for an extended time after site closure.

The WellSentinel devices that cap exploration and appraisal wells, will initially be left in place until such time as the risk of any releases has declined to a point that they are considered no longer to provide significant benefit.

10.7.4 Topsides, Substructure and Subsea Infrastructure

Commencing from the site closure, until the pipelines and other subsea infrastructure are no longer required to contain high pressure CO_2 (e.g. either de-pressurised or flooded) pressure monitoring will continue to enable detection of any anomaly. Similarly monitoring of any releases from the platform (including any venting) will continue until high pressure CO_2 is no longer present either within the facility and all of the wells have been suitably plugged.

Environmental monitoring of the area in the post-closure phase while infrastructure is being removed will be in line with the existing plans for the decommissioning phase documented in *Environmental & Social Impact Assessment (ESIA) For Prinos Offshore Development Project (Chapter 2).*

Following decommissioning of the platform and removal of debris from the platform safety zone, surveys (sonar and/or ROV) will be carried out to demonstrate that the seabed is free of obstructions. Any subsea infrastructure decommissioned in situ will be monitored in line with any agreements made with the authority with jurisdiction at the time of closure and decommissioning planning.

10.8 Monitoring Rationale: Post Transfer

Directive 2009/31/EC states that there is at least a 20-year post-closure monitoring period before the operator may request transfer to the competent authority — but the competent authority can accept transfer earlier if it is convinced that the statutory criteria are met. Prior to handover a final risk assessment will be carried out to demonstrate:

- The actual behaviour of the injected CO_2 conforms to modelled behaviour
- There is no detectable leakage
- The Storage Site is evolving towards a situation of long-term stability

After transfer the competent authority assumes responsibility for the store. Handover will include a series of recommendations as to future monitoring requirements. This could include sea-surface satellite monitoring, post transfer for a 30 year period. If anomalies are detected, in this period, monitoring must be re-intensified for example with the introduction of seabed surveys using multi-beam echo sounding and if necessary ROV inspections. The location of the leak will govern the type of contingent monitoring, but could include geophysical surveys, and subsequent remedial actions.

10.9 Monitoring Rationale: Contingency Measurements and Monitoring

In cases where new CO_2 pathways are identified or significant deviations from expected behaviour are encountered contingency (triggered) monitoring will be carried out as set out below. In addition, the monitoring plan will be reviewed and updated as required.

10.9.1 Environment

If any of the WellSentinel devices trigger an alarm or if any of the periodic environmental surveys raise an alert the cause will be further investigated. This could include a range of technologies including ROV inspection, fluid, and sediment sampling, and additional MBES and SSS surveys.

10.9.2 Geosphere

Additional modelling could be used to help quantify and track containment and/or conformance irregularities. Wireline logging could be used in wells critical to anomaly detection. Well interference testing could be useful in narrowing down the anomalous region. Targeted 4D seismic is likely to be useful at identifying leaks and/or migration into the Evaporitic Sequence. It is possible that 4D may be able to track the plume, so if other monitoring techniques suggest a lack of conformance 4D may be able to help, although further repeatability studies are needed to confirm this.

Fibre optic technology could also be used to locate and quantify the size of abnormalities. Additional DAS VSP surveys could be run in any wells with DAS installed.

10.9.3 Wells

If an anomaly is detected within a well (e.g. the failure of a well barrier) attempts will be made to identify the location and cause of the failure. These are likely to include the use of wireline to run inspection tools (multi-finger callipers, metal thickness tools, etc.) and leak detection tools to aid in the planning of remedial actions.

If an irregularity is detected by DAS, flowing (injection / production) wells may be shut in. This will reduce background noise and so aid in identification of the source of the leak. The key objective of the contingency monitoring, in this instance, is to locate the barrier failure and aid in corrective measure planning. Where practical a pressure test should be conducted to confirm the presence of a barrier failure. Unless the pressure test confirms that no failure has occurred a series of wireline logs should be run. These are likely to include leak detection and/or inspection tools; although the exact tools to used and the logging program requires to be optimized on a case-by-case basis.

There is also the option to install fibre optics (DAS and DTS) temporarily in legacy wells, above any existing cement plugs. If seismicity is detected above alarm levels, injection will be scaled back and the cause investigated to prevent escalation of the hazard.

10.9.4 Pipelines

If an anomaly is detected in pipeline behaviour attempts will be made to identify the location and cause. In the case of a leak this will involve the detection of bubbles entering the water column, by means of MBES / SSS surveys. If any anomaly is detected during these surveys, further investigations using divers or ROVs will be used to fully understand the source of the anomaly. Should any fibre optic cable be available for DAS close to the pipeline this will used to aid in localisation of the leak site.

While it is not anticipated that corrosion will present a threat to pipeline integrity, should the corrosion coupons indicate potential for the pipeline condition to be deteriorating faster than anticipated, the use of intelligent pigs to inspect the pipeline will be considered.

10.10Back-up Monitoring

Due to the required extended well life, the potential for failures of monitoring equipment must be acknowledged. While much of the environmental and geosphere monitoring equipment will be either temporary or easily accessible for repair, replacement of equipment within the wells may involve significant expense.

The provision of back-up systems to mitigate critical failures may be appropriate within the surface facility. In addition, a suitable inventory of spare parts and ongoing support from suppliers may be required.

Downhole sensor replacement is likely to be much more expensive, with the need to workover a well to replace any monitoring equipment. For downhole pressure monitoring it should be possible to characterize the pressure relationships between flowrate, surface pressure and downhole pressure. Once this has been done a reasonable estimate of downhole pressure will be available from surface measures should there be a downhole failure. If the results from this relationship are not considered sufficient the use of slickline retrievable gauges (either memory or with wireless surface readout) may be considered. To facilitate this option the inclusion of a landing nipple close to the completion packer depth is planned.

10.11 MMV Plan Summary

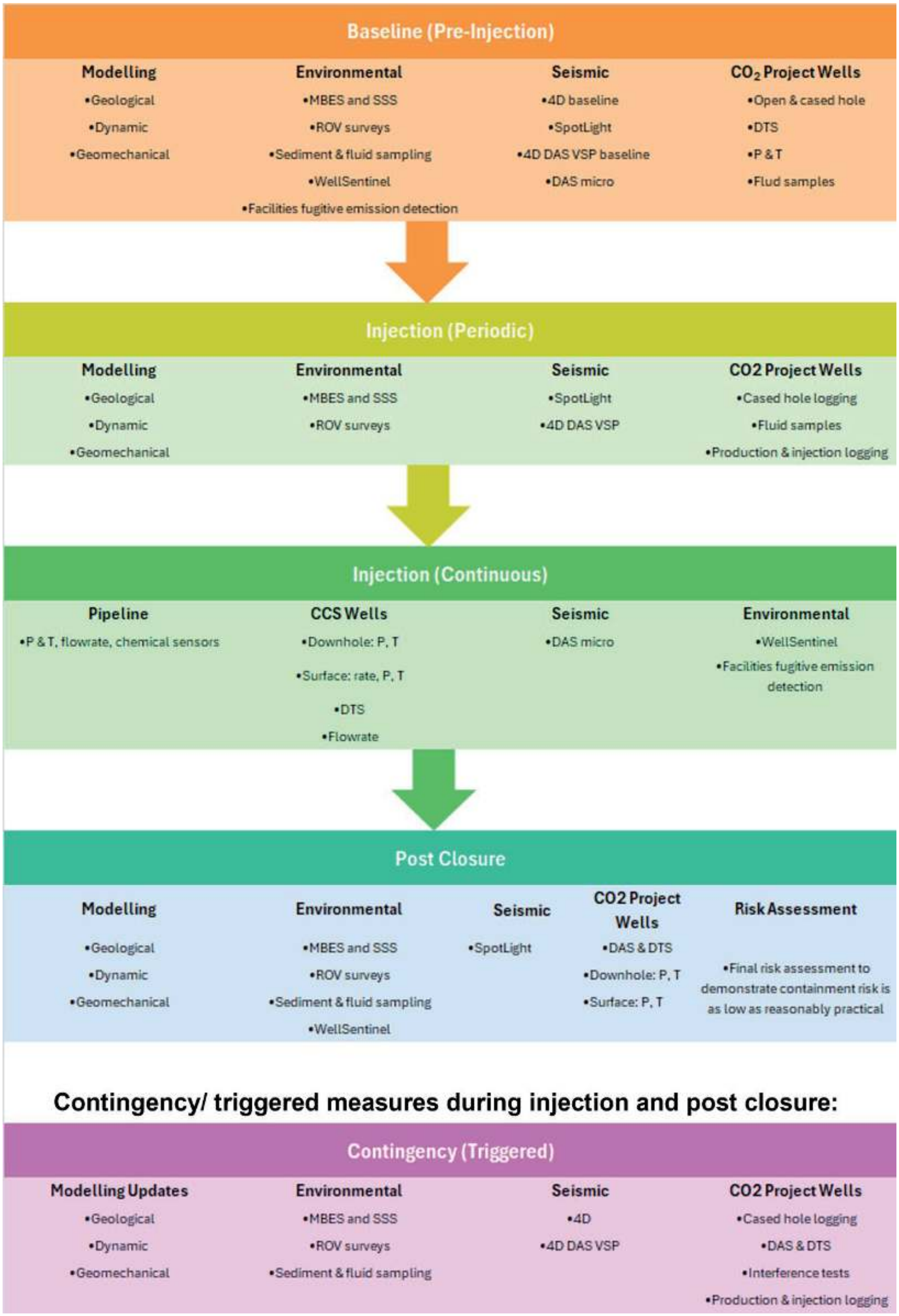


Figure 19: Prinos CO2 Storage MMV plan. “CO2 Project Wells” refers to technology options related to CO2 injectors, producers & monitoring wells

11. Plan Implementation, Reporting and Performance Management

11.1 Reporting and documentation

A key objective of the MMV is to demonstrate to the relevant authorities and regulators that CO_2 injection into the store is being managed correctly and its behaviour is understood. It is possible that regular reporting to other stakeholders may be required, in particular any requirements relating to the EU Emissions Trading Scheme, and these requirements will be incorporated into future revisions of the MMV plan.

While the measurements to be reported and the frequency of reporting to HEREMA (or others) are yet to be fully defined it is envisaged that:

- Measurements will include:
    - The mass/volume quantity of CO_2 delivered to the injection facility
    - The mass/volume quantity of CO_2 injected into each well
    - Information on the level of impurities in the injected CO_2 (fluid composition)
    - Any volumes of CO_2 recorded as having left the Storage Site (including CO_2 produced in conjunction with produced water or hydrocarbon)
    - Key storage parameters – store pressure and CO_2 distribution
- Reporting frequency will vary between measurements:
    - As a minimum a review of monitoring data will be provided on an annual basis
    - CO_2 quantities and composition delivered to the facility and injected will be reported on a more frequent basis
- Any significant irregularity detected will be reported in a timely manner
- The drilling of wells and their plugging and abandonment will be reported
- During the injection period, modelling updates and proof of predictability of the forecasts will be reported in a timely manner
- Further reports and documentation may be required either periodically on a contingent basis throughout the entire duration of construction and injection operations, and the post closure period.

11.2 Data Retention and Ownership

It is the intention of EnEarth to retain all the baseline data throughout store life to aid in the detection of any irregularities or anomalous behaviours. This will include:

- Raw (and processed) data from all seismic surveys
- Raw (and processed) data from all environmental surveys
- Key data acquired from the injector, water producer and monitoring wells
- Key data attained during the drilling of all the CO_2 injection and water production wells

- Full details on the construction of all wells

During the injection period, the continuous monitoring of the store is likely to generate very large volumes of raw data, particularly the use of fibre optic sensor arrays. The retention period for raw monitoring data will be reviewed on a regular basis based on the value of the information for the project. There is the potential for much of this data not to be retained in an immediately accessible format for prolonged periods of time. This data should be retained in a suitable archive and made available on an “if required” basis for a yet to be defined period (potentially beyond the end of injection).

In contrast the processed data and resulting reports should be retained throughout store life. This will aid in the preparation of the documentation required to facilitate responsibility for the store being transferred to the regulator.

Following the end of injection operations the amount of monitoring data being gathered is likely to decline; however, it will not cease immediately and there may be a number of additional surveys carried out. The monitoring data will be handled in a comparable manner to that acquired during the injection period; however, the raw data from all specific end of injection surveys will be retained in full.

Where deemed appropriate, elements of the data acquired, the analysis and resulting models may be made publicly available by EnEarth or other stakeholders. Should any stakeholder wish to make data public this must balance EnEarth’s rights to retain proprietary data while respecting the public need for transparency and openness about results and the social value of pooling of data across sites. The public value of data access should also be factored in, especially given the need to rapidly accelerate and disseminate learning about such an important topic as CO2 storage.

11.3 Interpreting Monitoring Results and Site Performance

Should a leak be detected or an irregularity results in a significant increase in leakage risk, the appropriate regulatory bodies must be informed and corrective actions taken immediately. The detailed definition of thresholds for what constitutes a significant deviation from predicted behaviour will be determined prior to injection. These definitions should include both the magnitude and timeframe for any change required to trigger action and will be clearly set out in operating procedures.

Monitoring of the store site will be based on comparison between the predicted store site behaviour (as modelled) and the monitoring data recorded. As stated in EU Guidance Document 2, Annex II, the CCS Directive sets out the following requirements for interpretation and updating:

- “The data collected from the monitoring shall be collated and interpreted. The observed results shall be compared with the behaviour predicted in dynamic simulation of the 3D pressure-volume and saturation behaviour (of CO_2) undertaken in the context of the security characterisation pursuant to Article 4 and Annex I Step 3.”
- “Where there is a significant deviation between the observed and the predicted behaviour, the 3D model shall be recalibrated to reflect the observed behaviour. The recalibration shall be based on the data observations from the monitoring plan, and where necessary to provide confidence in the recalibration assumptions, additional data shall be obtained.”
- “The risk assessment for the site/Complex (steps 2 and 3 of Annex I) shall be repeated using the recalibrated model(s) so as to generate new hazard scenarios and flux rates and to revise and update the risk assessment.”
- “Where new CO_2 sources**,** pathways and flux rates or observed significant deviations from previous assessments are identified as a result of history matching and model recalibration, the monitoring plan shall be updated accordingly.”

11.4 Inspections

Inspections (both routine and non-routine) by the competent authority are required under Article 15 of the CCS Directive. The purpose of these inspections is to check and promote compliance with the CCS Directive and to monitor the effects on the environment and on human health.

EnEarth will co-operate fully with all requests for inspection. Inspection activities may include site visits, auditing of record-keeping, evaluations of risk assessments, static and dynamic models, and monitoring plans to ascertain that there are no negative effects to the environment or human health.

11.5 Updating the Plan

The Prinos CO_2 MMV plan will be regularly updated to take account of changes to the assessed risks, to the environment and human health, new scientific knowledge, and improvements in the best available technology. The MMV plan may also require updating if significant deviations from predicted behaviour are identified.

11.6 Review

While it is the intention of EnEarth to proactively review and update the monitoring plan it is recognized that HEREMA may seek updates to the plan at any time if they deem it necessary. Should no update be made for a period of five years a review will be conducted in accordance with EU Commission Guidance Document 2 (2024) that states, “that monitoring plans must be updated at least every five years”.

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13. Appendix 1 – Definitions

A list of general definitions which relate to wording used in this document are listed below.

Capacity the total mass (or equivalent volume at reference conditions) of CO_2 stored within a given site.

Caprock Geological formation(s) overlying the Storage Site or Complex that effectively restricts upward migration of CO_2 or charged CO_2 formation fluids. The caprock should have sufficiently low permeability to ensure ‘permanent containment’ of CO_2.

Closure means the definite cessation of CO_2 injection into that Storage Site.

Conformance refers to the consistency between the actual behaviour of injected CO_2 and the modelled forecast.

Containment Permanent containment means that injected CO_2 will be effectively trapped by trapping mechanisms in perpetuity, within the Storage Complex. describes the long-term security related to permanent CO_2 storage within a Storage Complex.

Corrective measures mean any actions, measures or activities taken to correct significant irregularities, or to close leakages in order to prevent or stop the release of CO_2 from the Storage Complex.

CO_2 plume means the dispersing volume of CO_2 within the Storage Complex.

Geological storage of CO_2 means permanent storage in underground geological formations.

Hydraulic reservoir means a hydraulically connected pore space where pressure communication can be measured by technical means and which is bordered by flow barriers, such as faults, salt domes, lithological boundaries, or by the wedging out or outcropping of formation.

Leakage means any release of CO_2 from the Storage Complex.

Migration means the movement of CO_2 within the Storage Complex.

Overburden The overburden is the lithostratigraphic volume of rock overlying the storage reservoir up to the surface or seabed.

Post-closure means the period after the closure of a Storage Site.

Seals In the context of geological storage this term is often used interchangeably with Caprock.

Significant irregularity means any irregularity in the injection or storage operations or in the condition of the Storage Complex itself, which implies the risk of a leakage or risk to the environment or human health.

Storage Complex means the Storage Site and surrounding geological domain which can influence overall storage integrity and security; that is secondary containment formations.

Storage Site means a defined volume area within a geological formation used for the geological storage of CO_2 and associated surface and injection facilities.

Surrounding area means the surface and subsurface area surrounding the Storage Complex where leakage or negative effects on the environment or human health are realistically possible.

14. Appendix 2: Cost Estimate Details

14.1 Environmental Monitoring Costs Estimates

Cost estimate provided on 23rd September 2025:

Environmental Baseline Study Cost Estimate

- Mobilisation and demobilisation: £170,000
- Fieldwork (4 days @ £40,000/day): £160,000
- Interpretation and analysis (est.): £200,000
  Total: £530,000

On this basis, a realistic budget would be in the order of £600,000 (€684,000).

In terms of a site survey, the same vessel asset could conduct the required scope. Based on a nominal survey area of 1 km x 1 km, the budgetary estimate is approximately £1,000,000 (€1,140,000).

Notes:

1. Mobilisation and demobilisation fee actual costs will be determined by vessel location and transit time.
2. Estimate assumes the use of a dedicated survey platform capable of both geophysical and shallow geotechnical work.
3. Weather downtime is excluded.
4. The requirement for a site survey will ultimately be determined by the desk study and review of existing data, to assess shallow gas risk to ALARP.
5. Mobilisation/demobilisation is the major cost driver. Combining operations (e.g., environmental and geophysical) would therefore be highly beneficial.
6. Acquisition of geophysical data would assist in correlating ongoing geotechnical data across the proposed jack-up rig location, thereby refining foundation condition assessments.

The environmental survey equipment comprises:

- Multi-beam
- Sidescan Sonar
- Drop down camera and video
- Grab sampling
- Water sampling

14.2 DAS VSP Estimated Costs

Detailed costs estimates were provided on 18th June 2025and are included in the DAS VSP feasibility study conducted by Silixa (Yavuz et al, 2025).

14.3 Targeted Seismic Estimated Costs

On 16th June 2025, via personal communication with Elemental Energies yearly costs (all inclusive) for targeted seismic were estimated to be “400,000-500,000 Euros, irrespective of the number of Spots”. Currently awaiting a formal budgetary offer from SpotLight

14.4 Well Sentinel Estimated Costs

Each WellSentinel is planned at an estimated cost of €350,000, inclusive of Sentinel installation and commissioning fees. WellSentinel equipment included in the costs are outlined below:

1. Monitoring Module

   - The standard core WellSentinel monitoring element, incorporating hydrocarbon and CO_2 detection Triggers.
   - Includes an integrated Trigger Mechanism and Alert Beacon to provide real-time leak detection, alert beacon release and transmission of alerts via satellite.
   - Units are manufactured and assembled by Sentinel in Aberdeen and shipped to the project site for installation.

2. Gathering Structure

   - A fabricated subsea structure designed to capture and concentrate any hydrocarbon or CO_2 leaks rising through the water column at the seabed.
   - Acts as the collection and focuses emissions for monitoring and leak detection.
   - These units will be fabricated locally to reduce fabrication costs, mobilisation, minimize emissions, and support local industry participation.

3. Engineering, Project Management, and Personnel Support

   - Ongoing costs for engineering design, installation support, integration testing, and project oversight.
   - Includes specialist personnel from Sentinel and local contractors during installation and commissioning phases.

In addition, there will be an annual operating fee of €6,000 per system, which covers satellite monitoring and alert services.

4. Satellite Monitoring and Alert Service

   - Annual €6,000 per system fee to maintain satellite connectivity, data processing, and alert systems.
   - Covers 24/7 monitoring and notification services in the event of a system trigger.
   - Billed annually for the duration of the operational phase.

WellSentinel costs are draft, subject to site surveys of the legacy wells and the seabed conditions which could impact the final design and cost estimates.

Please note that installation and marine contracting services (including ROV and Vessel supply) fall outside the scope of supply. Sentinel will provide full support to the end client’s selected third-party installation contractor.

These systems are scheduled for deployment during both the baseline and injection phases of the CO_2 project.

ANNEX III

PRINOS CO_2 STORAGE

Prinos Post Closure Plan

EnEarth

October 14th, 2025

Executive Summary

This Post-Closure Plan has been prepared for the Prinos CO_2 Storage project, located in the Kavala Basin, Greece, and is submitted in accordance with the regulatory requirements of the Hellenic Hydrocarbons and Energy Resources Management Company S.A. (HEREMA), acting as the Competent Authority under Directive 2009/31/EC on the Geological Storage of Carbon Dioxide.

The purpose of this plan is to set out the measures that will be implemented following the cessation of CO_2 injection operations to ensure the long-term containment, safety, and environmental integrity of the designated geological storage site. It outlines the approach for monitoring, risk mitigation, site stewardship, and eventual transfer of responsibility to HEREMA, in accordance with Guidance Document 3: Criteria for Transfer of Responsibility to the Competent Authority.

This document provides a structured framework for the post-closure phase, including:

- Post-Injection Monitoring and Verification: A detailed programme of subsurface and environmental monitoring that will be implemented to verify the continued secure containment of injected CO_2, using site-specific risk assessments and simulation modelling as a basis.
- Corrective Measures Plan: Procedures to be enacted in the event of any detectable irregularities or leakage risk, including monitoring thresholds, notification protocols to HEREMA, and activation of remediation strategies.
- Site Closure Criteria and Handover Process: The technical and administrative conditions under which site closure will be initiated and the formal process for requesting the transfer of responsibility to HEREMA once long-term stability is demonstrated.
- Waste and Infrastructure Decommissioning: A summary of the planned decommissioning of surface infrastructure and wells, including the removal of non-essential equipment and environmental site restoration.

This Post-Closure Plan has been developed to meet the specific technical and regulatory requirements of HEREMA and supports the broader national and EU objectives of safe, long-term CO_2 storage as part of Greece’s climate mitigation commitments. The plan will be reviewed and updated periodically to reflect advances in monitoring technologies, new data from site operations, and any additional guidance issued by HEREMA or the European Commission.

Contents

1. Introduction

This post-closure report documents the intended final status and outcomes of the Prinos CO_2 Storage Project, located in Gulf of Kavala, Greece. The project has been developed as part of national and European Union climate strategies aimed at reducing greenhouse gas emissions and promoting the safe and permanent geological storage of carbon dioxide (CO_2).

The site will receive the captured CO_2 via pipeline and transport it offshore in suitable conditions for injection into the saline aquifer of Prinos the field located offshore in the Northern Aegean, for long-term storage. The site has been selected based on extensive geological characterization, risk assessment, and alignment with EU Directive 2009/31/EC on the geological storage of carbon dioxide.

Following the cessation of CO_2 injection operations, the site will progress into the post closure phase, incorporating post-injection monitoring and decommissioning. This report is prepared to fulfil regulatory obligations and to ensure transparency in summarising the planned environmental, technical, and social outcomes of the project's post-closure activities.

The overall approach for post closure planning is closely linked to the store development plan and the monitoring of the complex during (and after) injection.

Post-closures measures should be:

- Targeted at ensuring the long-term containment of the injected CO_2 and the demonstration of such containment.
- Risk based; linked to identified risks from the site and complex characterization (and risk assessment) and subject to the limitations of available technologies.
- Specific to the storage site and complex.
- Used immediately after the closure of the site (end of injection).
- Ready to use at the start of injection or any subsequent time up to and including the planned end of injection – if required.

Monitoring and post closure activities for the store are closely linked, and the plans and activities have been developed along with the risk assessment. Monitoring during store life will be designed to enable both EnEarth (as site operator) and the competent authorities to have confidence in the condition and behaviour of the site at the time of closure. It is expected that any significant irregularities in the storage complex during either the injection period or the time frame covered by this post closure plan will be detected and corrective measures taken. In addition, monitoring will have been used to assess the effectiveness of any corrective measures, including verification of their effectiveness. The planned monitoring for the Prinos store is detailed in the MMV report (EnEarth Prinos CO_2 Storage MMV, 2025). The corrective measures are specific to the actual leakage or significant irregularity, taking account of the precise location, nature, and the specific situation and circumstances in which the leak occurred.

The relationships between this 'Post Closure Plan', and the 'Measurement Monitoring and Verification Plan' and the 'Corrective Measures Plan' is illustrated in Figure 1 below

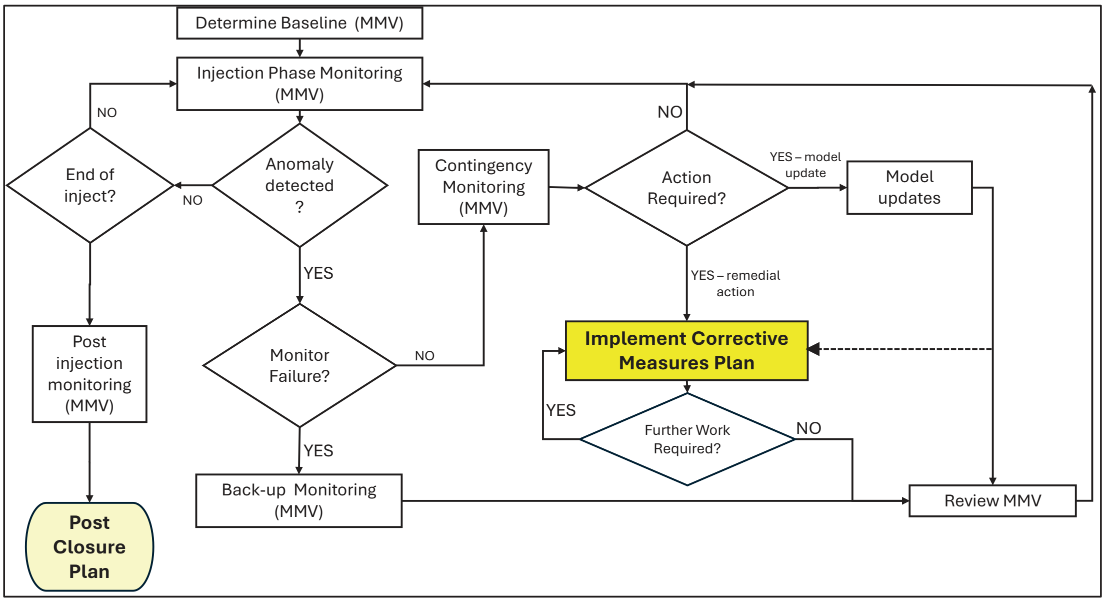


Figure 1: Interaction between monitoring process and corrective measures plan

This report focusses on activities and observations commencing from the formal closure of the site to the end of the defined post-injection monitoring period. It does not include:

- Post closure and decommissioning activities related to other legacy oil and gas infrastructure in the field.
- Commercial or proprietary technology details used in CO_2 capture unless previously disclosed.
- Comprehensive life-cycle carbon accounting for upstream or downstream activities outside the scope of the storage site.

While all efforts have been made to ensure data accuracy and completeness, the report is based on available information at the time of preparation. Future findings or regulatory updates may necessitate revisions or addenda.

2. Legislative Context

This PCP is designed to meet the regulatory requirements set out by the CCS Directive 2009/31/EC of the European Parliament and of the Council, Article 17, and to facilitate the final ‘Transfer of Responsibility’ for the storage site to the Competent Authority. The plan has been prepared with reference to Guidance Document 3: Criteria for Transfer of Responsibility to the Competent Authority.

Article 17 -

1. A storage site shall be closed:

(a) if the relevant conditions stated in the permit have been met;

(b) at the substantiated request of the operator, after authorisation of the competent authority; or

(c) if the competent authority so decides after the withdrawal of a storage permit pursuant to Article 11(3).

2. After a storage site has been closed pursuant to points (a)or (b) of paragraph 1, the operator remains responsible for monitoring, reporting and corrective measures, pursuant to the requirements laid down in this Directive, and for all obligations relating to the surrender of allowances in case of leakages pursuant to Directive 2003/87/EC and preventive and remedial actions pursuant to Articles 5 to 8 of Directive 2004/35/EC until the responsibility for the storage site is transferred to the competent authority pursuant to Article 18(1) to (5) of this Directive. The operator shall also be responsible for sealing the storage site and removing the injection facilities.

3. The obligations referred to in paragraph 2 shall be fulfilled on the basis of a post-closure plan designed by the operator based on best practice and in accordance with the requirements laid down in Annex II. A provisional post-closure plan shall be submitted to and approved by the competent authority pursuant to Article 7(8) and Article 9(7). Prior to the closure of a storage site pursuant to points (a) or (b) of paragraph 1 of this Article, the provisional post-closure plan shall be:

(a) updated as necessary, taking account of risk analysis, best practice and technological improvements;

(b) submitted to the competent authority for its approval; and

(c) approved by the competent authority as the definitive post-closure plan.

4. After a storage site has been closed pursuant to paragraph 1(c), the competent authority shall be responsible for monitoring and corrective measures pursuant to the requirements laid down in this Directive and for all obligations relating to the surrender of allowances in case of leakages pursuant to Directive2003/87/EC and preventive and remedial action pursuant to Articles 5(1) and 6(1) of Directive 2004/35/EC. The post-closure requirements pursuant to this Directive shall be fulfilled by the competent authority on the basis of the provisional post-closure plan referred to in paragraph 3 of this Article, which shall be updated as necessary.

5. The competent authority shall recover from the operator the costs incurred in relation to the measures referred to in paragraph 4, including by drawing on the financial security pursuant to Article 19.

3. Prinos Store and Complex Description

3.1 Prinos Field

3.1.1 Overview

The Prinos field is in the Gulf of Kavala, northern Aegean Sea, offshore Greece. It is an anticline-shaped structure with a reservoir of Miocene turbiditic sediments. This sour oil field has been produced since the early 1980s from three main stacked zones: A, B, and C. All reservoirs are characterised as multilayered since they are subdivided into thinner layers and have independent oil-water contacts (OWCs).

The Prinos field has depleted and is reaching the end of its life as an oil producer.

Figure 2: Prinos Complex

The Prinos Offshore Complex comprises:

- Two four-legged wellhead head platforms Prinos Alpha and Prinos Beta each with 12 wells linked to Prinos Delta via two 60 m bridges. The platforms are located in 28.5 m water depth.
- An eight-legged Prinos Delta platform that receives oil, gas, water and condensate produced from Prinos, Prinos North and South Kavala fields.
- Prinos Complex has no permanent accommodation due to high H_2S levels in the deposits and the potential risk in the event of a release.
- All staff are based onshore, transferring to the platforms by boat as dictated by their work shift. Production staff are split into 5 teams that cover a full 24-hour period in three shifts. Each team comprises 10 people.

The original Prinos exploration and appraisal wells, P-1, P-2, P-3, P-4, P-5 and P-6, were drilled from December 1973. Following on from these six wells the field was fully developed from 1979 to include two drilling platforms, Alpha and Beta. Both platforms contain twelve well slots and all 24 slots have been used to drill at least one wellbore since their installation. To date a total of 76 well bores have been drilled where 69 of these are from the 24 Platform slots, 24 mother bores and 45 sidetracks.

3.1.2 Carbon Storage Development Plan

EnEarth’s current development plans are to:

- **Development Scheme 1 (Phase 1):**
  - 4 wells: 2 injectors + 2 water producers, all sidetracks from the Prinos Beta platform, using existing water processing infrastructure
  - First years inject into B and C reservoirs, while the A reservoir continues to produce oil
  - 10 years later the A reservoir oil shuts down and the CO_2 is injected everywhere, including the A, B, and C reservoirs. These assumptions also apply to water production
  - Up to 1 MPTA capacity, averaging 0.5 MPTA per well, with a maximum of 0.7 MPTA per well
  - New pipeline + receiving terminal onshore
- **Development Scheme 2 (Full Scale Capacity Phase):**
  - 15 wells: 6 injectors and 9 water producers
  - All new wells to be drilled from a new platform
  - First years inject into B&C reservoirs, then addition of the A reservoir. Same for water production.
  - Up to 3MPTA, averaging at 0.5 MPTA per well, with a maximum of 0.7 MPTA per well

New additional platform for the new water processing infrastructure + new pipeline + receiving terminal onshore.

A phased approach will allow for geological data, gathered in the new wells, to be integrated into the store development plan to optimise or adjust it as required. The total CO_2 storage capacity for the Prinos CO_2 project is 18 MT. The targeted flow rates are an average injection rate of 0.55 MTPA and a maximum of 0.7 MTPA per well, with 9000 bpd of water production per well. Given the reservoir pressure and temperature conditions during injection, CO_2 will be in a supercritical state in the store.

During Phase 1 the existing Prinos oilfield infrastructure will be used as the host facility for CO_2 related wells. An offshore normally unmanned installation dedicated to hosting CO_2 offshore infrastructure is to be installed above the Prinos Storage Site for Phase 2.

CO_2 will be injected in locations downdip of the existing Prinos oilfield wells. Additionally, water will be produced from the reservoir to help manage pore pressure in the Storage Site and ensure operation within safe limits.

Formation water will be produced at via new producers drilled into the water leg downdip of the field’s crest to relieve pressure build up and ensure operation within safe limits to prevent geomechanical problems. Timing of the cessation of Prinos oil production will be decided by the operator of the oil development in synergy with the conversion to CO_2 Storage and enhanced oil recovery effects will be avoided.

4. Post Closure Timeline

An indicative timeline for the Prinos CO_2 Storage Project post closure activities has been prepared in support of the post-closure plan. As with the rest of this document, the schedule has been prepared in line with currently available technologies and decommissioning methodologies. The post closure timeline, especially those activities immediately after post-closure, will be largely influenced by the available technology at the time of facility closure, with a possible acceleration in many areas.

The timings shown are based on the store closure occurring after the completion of the intended injection period. In the event site closure occurs earlier than planned detailed de-commissioning planning and vessel contracting may not have been completed and therefore the period from closure to final seabed remediation could be longer.

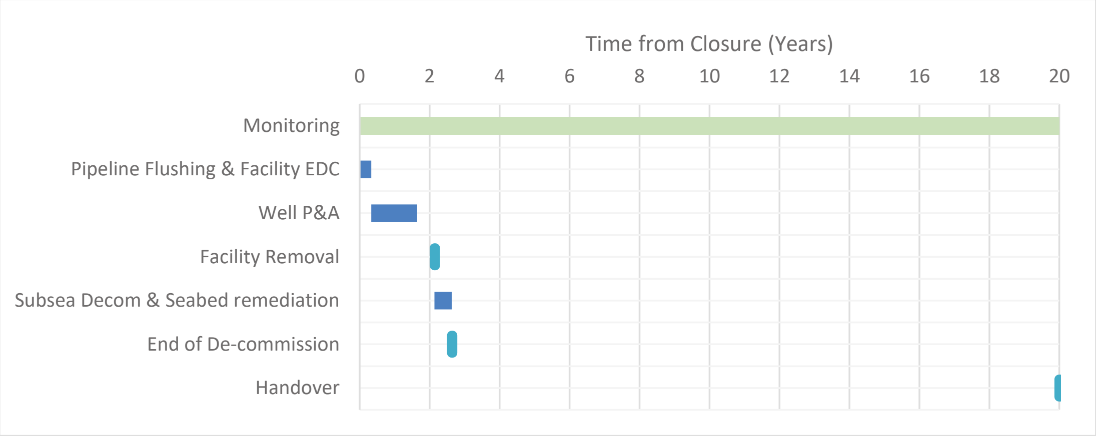


Figure 3: Projected Post Closure TimeLine

The timeline above shows expected windows of activity and, especially, for facility removals and subsea decommissioning, as shown below:

Activity	Expected Execution Duration
Subsea Pipeline Flushing	45 days
Facilities Engineer Down and Clean (EDC)	30 days
Well P&A	160 days
Disconnection of Pipelines from Facility	21 days
Facility Removal	14 days
Subsea Decommissioning	14 days
Seabed Remediation	45 days

Table 1: Prinos CO2 Storage Decommissioning Time Estimate

A number of assumptions were used in the preparation of the estimates shown:

- Only currently available and proven technologies are considered
- The platform topsides and jackets will be removed by a vessel suitable for removing them in line with the methodology described in Section 7.2.1. Piece small removal, at a significantly longer duration, is not covered above.

- The majority of the facilities will have been mothballed prior to closure and EDC activities will be limited. EDC can occur in parallel with P&A.
- Subsea pipelines will be decommissioned in-situ, with ends cut and remediated.
- All currently accessible wellbores will be abandoned to at least ABN1 standard, with reservoir isolation implemented in accordance with OEUK classification, prior to the anticipated arrival of the CO_2 plume at each respective wellbore.
- Approximately four wellbores will be slot recovered for use as CO_2 injectors or producers. In addition, a number of wells – yet to be determined – will be converted into monitoring wells and subsequently plugged and abandoned (P&A'd) following the injection phase.
- This high-level time and cost estimate for the Prinos CO_2 wells P&A campaign assumes 8 wells split between the Alpha and Beta platforms, with a most likely duration of 20 days per well (240 days total) and a cost of USD 5.8 million per well.

Well Type	No. Wells	Days per Well		Total Days	Cost Per Well (MM USD)		Total Cost (MM USD)
		Range	Most Likely		Range	Most Likely	
Monitor	4	18 - 26	20	80	3.4 – 6.5	5.8	23.2
Injection	2	18 - 26	20	40	3.4 – 6.5	5.8	11.6
Production	2	18 - 26	20	40	3.4 – 6.5	5.8	11.6

Table 2: CO2 Storage Wells P&A time and cost estimate

5. Post-Closure Decommissioning

Following closure of the facility, and in the absence of any viable lifetime extension opportunities or options for reuse of the facilities, decommissioning will be required. This will begin with Well P&A activities followed by facilities decommissioning aligned to the schedule shown in the section above.

The measures described are aligned to the current decommissioning landscape, both in terms of technical feasibility and regulatory expectations. In the coming years, this may change, and EnEarth will revise the final schedule of decommissioning works will be determined once the Closure Plan has been reviewed and revised prior to the end of the operational period, around two years prior to facility closure.

As the Prinos platform is located within the Thalassia Periochi Kavalas–Thasou marine protected area (Natura 2000 site code GR1150014), all closure and decommissioning activities will be subject to an Appropriate Assessment (AA) under Article 6(3) of the EU Habitats Directive (92/43/EEC) and local requirements. This assessment will evaluate the potential for significant effects on the site’s qualifying habitats and species, including marine mammals and Posidonia oceanica seagrass beds. The project will ensure that decommissioning methods and mitigation measures are designed to avoid adverse impacts on site integrity, considering cumulative and in-combination effects. The AA will be developed in consultation with HEREMA and the Hellenic Ministry of Environment and Energy, and its findings will guide the environmental management and permitting approach throughout the closure phase.

5.1 Description of Items to be Decommissioned

The facilities planned to support the Prinos CO_2 Storage Project are legacy gas platforms within the Gulf of Kavala, as described in Section 3.1. Beta will support core operations, with Alpha remaining for the purpose of hosting monitoring wells.

Figure 4: Alpha & Beta Platforms

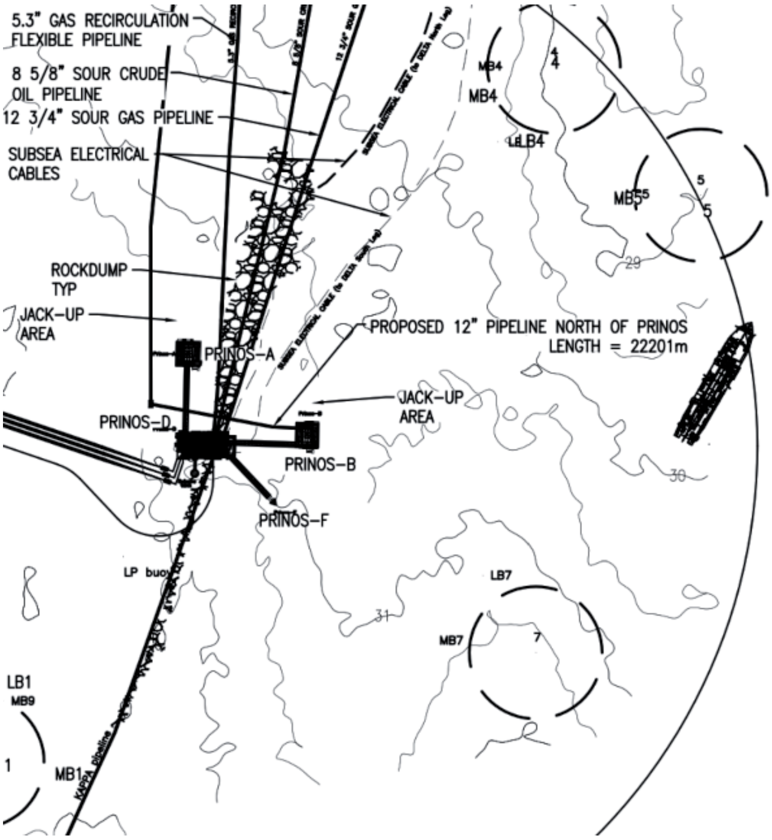


Figure 5: Prinos Field Layout Including proposed routing of 12” pipeline (Scale 1:3000)

The Prinos facilities are summarised in the following table:

Component	Description	Weight
Alpha Topsides	12-slot platform; 22.2 m x 20.2 m	500 t
Alpha Substructure	4-legged steel jacket	550 t
Beta Topsides	12-slot platform; 22.2 m x 20.2 m	500 t
Beta Substructure	4-legged steel jacket	550 t
Alpha-Delta 6” Pipeline	6” dia., 12 km long, dehydrated gas	229 t
Port of Prinos Terminal-Beta 12” Pipeline	12” dia., 18 km long, Carbon Dioxide	1290 t
Beta-Delta 6” Pipeline	6” dia., 12 km long, dehydrated gas	229 t
Alpha-Onshore Power Cable	Submarine power cable.	N/A
Alpha-Onshore Power Cable	Submarine power cable.	N/A

Table 3: Prinos facilities summary

The Delta, Kappa and Flare assets are out with the scope of this document and are covered by their own decommissioning commitments.

As all facilities discussed within this Post Closure Plan are pieces existing infrastructure, except the new pipeline transporting CO_2 from the onshore terminal to the Beta Platform, the plans for their decommissioning have not been changed by the Prinos CO_2 Storage Project. The outline below remains aligned to current expectations around decommissioning, with the transformation of the facilities to a CCS processing unit having no impact on how the infrastructure could be decommissioned.

The facilities decommissioning solutions proposed within this document have sought to adhere to the following key principles:

- Compliance with EU and Greek National Legislation as well as industry best practice and Natura 2000 regulations;
- Decisions backed by proportionality and justification where options exist;
- Consideration of the rights and needs of legitimate users of the sea;
- Safety of surface and subsurface navigation;
- Health, Safety and Environment (HSE) considerations with environmental restoration at the centre.

An overview of the decommissioning measures proposed, assuming no viable alternative use, is captured below.

The proposals have been developed through a holistic evaluation framework that integrates environmental, safety, technical, societal, and economic considerations, with the ultimate overall rationale described in the table below. This multidisciplinary approach ensures that long-term stewardship of the storage site is not only technically robust and compliant with regulatory requirements, but also environmentally sustainable, publicly acceptable, and economically feasible. Environmental risks, such as potential leakage pathways or ecosystem interactions, were assessed alongside technical criteria including reservoir performance, well integrity, and monitoring technologies. Together, these considerations have shaped a post-closure strategy that supports secure storage, minimises residual risk, and facilitates a smooth transition of responsibility to the Competent Authority.

Component	Proposed Decommissioning Measures	Rationale
Alpha Wells	P&A’d as described in Section 7.	Adequate P&A vital to long term storage security, proposals represent current best practice.
Beta Wells	P&A’d as described in Section 7.	
Alpha Topsides	Complete removal from site	Complete removal presents the best long-term solution; avoiding impacts to other users of the sea and minimising environmental impact. There are tried and tested options for their removal, and proposed methodology minimises potential harm to people during dismantling.
Alpha Substructure	Complete removal from site	
Beta Topsides	Complete removal from site	
Beta Substructure	Complete removal from site	
Alpha-Delta 6” Pipeline	Ends cut and remediated, remainder decommissioned in situ on the seabed	No environmental impact associated leaving buried cables in situ and considered a viable technical solution. Post decommissioning site monitoring will identify any cable exposure and required mitigation to ensure that safety risk is insignificant.
Beta-Delta 6” Pipeline	Ends cut and remediated, remainder decommissioned in situ on the seabed	
Port of Prinos Terminal-Beta 12” Pipeline	Ends cut and remediated, remainder decommissioned in situ on the seabed	
Alpha-Onshore Power Cable	Ends cut and decommissioned in situ on the seabed	
Alpha-Onshore Power Cable	Ends cut and decommissioned in situ on the seabed	

Table 4: Proposed Prinos decommissioning measures

During the period prior to facility closure, when the Closure Plan is reviewed and revised, site-specific studies, such as an Environmental Impact Assessment or Appropriate Assessment under the Habitats Directive, will be undertaken to further support the decommissioning proposals above.

6. Subsurface Isolation Requirements

6.1 Prinos Carbon Storage Site, Storage Complex and Monitoring Area Definitions

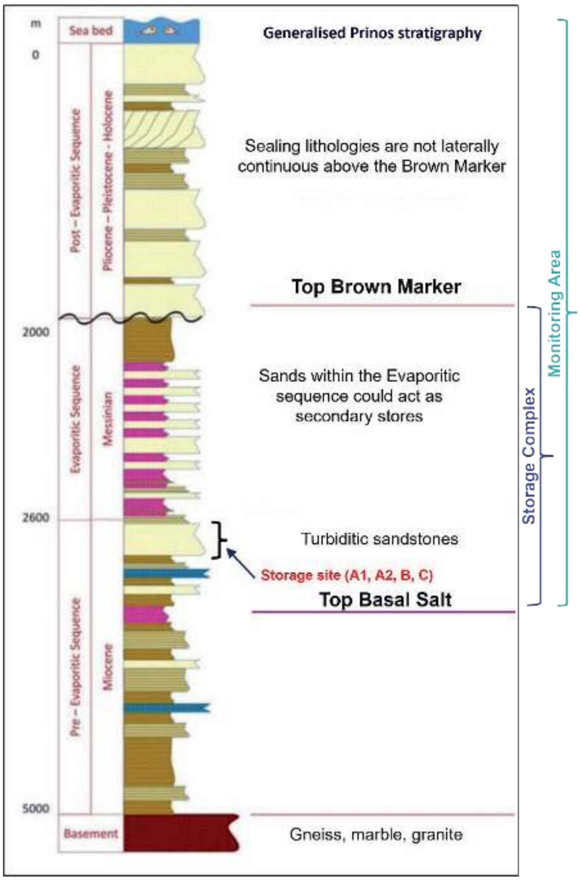


Figure 6: Generalized Prinos stratigraphy, and the vertical extents of the Prinos storage site, complex and monitoring area

Prinos Storage Reservoirs: CO_2 will be injected and stored within the Miocene Pre-Evaporitic sequence, specifically the turbiditic reservoirs known as A1, A2, B and C (Figure 6).

Storage Site: The Storage Site is a defined volume within a geological formation used for the geological storage of CO_2, and a defined area covering the associated surface and injection facilities (European Commission Guidance Document 1, 2024). The Prinos Storage Site consists of the Storage Reservoirs (Pre-Evaporitic Sequence A1, A2, B & C Miocene sands) and includes all wells and surface infrastructure within the red polygon shown in (Figure 7). The Storage Site boundaries have been agreed between HEREMA (Hellenic Hydrocarbons and Energy Resources Management Company) and EnEarth based on the maximum extent of the injected CO_2 plume in the reservoir throughout the project lifecycle, trap geometry, spill points, lithology changes and bounding faults.

Primary Caprock: A Caprock is a geological formation overlying the Storage Site or Complex that effectively restricts upward migration of CO_2 or charged CO_2 formation fluids. At Prinos the Primary Caprock this is defined as the lowermost section of the Messinian Evaporitic Sequence, consisting of a claystone approximately 20 m thick, overlain by the Lower Main Salt (LMS) (100 m thick).

Secondary Caprocks: Overlying the Primary Caprock, within the Storage Complex, a sequence of salts interbedded with clastics, capped by mudstone, belonging to the Evaporitic Sequence is present. Some of these salts and claystones form Secondary Caprocks, providing additional safeguards, in the event of migration from the Storage Site.

Storage Complex: The Storage Complex is defined stratigraphically as between the Top Basal Salt, below the storage reservoirs, to the top of the Brown Marker (Figure 6). It includes the Primary Caprock as well as the Secondary Store and caprocks above the storage site. Any permeable units within the storage complex could be additional secondary storage units, although they are not injection targets. The extent of the Prinos Storage Complex is highlighted by the blue polygon shown in (Figure 7). EnEarth have agreed the vertical and lateral extend of the storage complex with HEREMA.

Surrounding Area: This is the surface and subsurface area surrounding the Storage Complex where leakage or negative effects on the environment or human health are realistically possible. A risk assessment (EnEarth Prinos Risk Assessment, 2025) has been carried out to assess the significance of risks and inform on the extent of the Storage Complex and surrounding area.

Monitoring Area: The Storage Complex and Surrounding Area encompass the Monitoring Area. which includes the Epsilon field accumulation.

6.2 Zones of Flow Potential

6.2.1 Definition

In planning the plugging and abandonment of any well it is imperative that all formation zones capable of acting as a source of environmental contamination are taken into consideration. These zones are classed as “Zones of Flow Potential”, and are defined in OEUK Well Decommissioning Guidelines (2022) as follows:

Flow originates from formations with permeability *and a pressure differential with respect to other formations or the surface/subsea environment. The pressure differential needs to be sufficient to maintain flow once the well is filled with formation fluids. Formations with low (e.g. <0.1mD) matrix permeability, like shales and chalk, may also have flow potential (e.g. if fractured), in which case these may require isolation. Fractures may be natural or induced by operations (fracturing or other stimulation), injection or production.*

In the case of CCS developments, the impact of injection on both the formation fluids and formation pressure should be taken into account when identifying Zones of Flow Potential. The presence of CO_2 in the store may increase the likelihood of flow induced by buoyancy effects, and the increased pressure resulting from injection may extend for a significant distance beyond the CO_2 plume. Both of which can result in an increase in the number and size of Zones of Flow Potential present.

Where multiple Zones of Flow Potential in a well, these may be grouped together where they have of similar fluids and/or pressures. Provided that inter-zonal isolation has been assessed as not required, or where the consequences of cross flow are deemed acceptable within the broad principle of keeping leak risk ALARP.

6.2.2 Store

Storage Site

The Storage Site consists of four stacked Miocene sandstone packages; A1, A2, B and C (Figure 6). Core descriptions suggest that the reservoir sandstones consist of a series of stacked/amalgamated high to very high-energy turbidite flows, separated by low to very low-energy mud-dominated flows. The storage reservoirs consist of a mix of channel and distal fan turbidites, deposited during basin subsidence.

Petrographic interpretations show that reservoir A1 contains moderately well sorted, mostly medium grained sandstones. Reservoir A2 contains alternations of structureless, fine laminated sandstones with medium grained and moderately well sorted sandstones. Reservoir B is characterized by structureless sandstones with grain size typically being medium to coarse sand. As with A2, the B reservoir has several thin sandy claystones layers. The sandstones of the C reservoir are mainly poorly sorted, very coarse-grained with some conglomeratic intervals. Vertical connectivity is low between stratigraphic reservoirs with correlated horizontal barriers interpreted between A, B and C reservoirs.

The combined average thickness of the Storage Site reservoir is 285 m TVT. Depth to Storage Site crest is 2450 m TVDSS, with the deepest section of the Storage Site located at 3566 m TVDSS. Net to gross ranges from 69 to 76%, while net porosity ranges from 7-20% (average 14%). Permeability averages at 250 mD but can be up to 6000 mD (Table 5**:** Average Storage Site properties (Table 5).

The Prinos field produces an undersaturated, sour crude (27-29° API gravity) with high sulphur content (from 30% of the gas phase in the B and C reservoirs to 60% of the gas phase in the A reservoirs), wax, and asphaltene content. CO_2 is also present within the crude (2.02% at well PB-13). The B and C reservoirs are lower Net to Gross and more heterogenous than the A reservoirs. ~80% of the produced oil originated from the A reservoirs. Well P-1 on drill stem test (DST) flowed at 2950bopd, under restricted conditions.

The A, B and C reservoirs are separate and have three different OWCs (2711, 2751 and 2791 m TVDSS respectively), with sealing claystones between each of the reservoirs. There is no evidence for the three reservoir zones exhibiting vertical communication with several pieces of evidence supporting this: different depletion levels, varying oil qualities, different pressure gradients and three distinct oil-water contacts. Laterally there is also evidence of fault compartmentalization; the north-eastern section of the crest is isolated from the rest of the field (Figure 7). The Prinos reservoirs do not exhibit a well-developed and connected natural fracture system. However, there is some evidence of deformation bands which could work as baffles to flow.

The Prinos Field is partially depleted by production, indicating a lack of pressure support from the aquifer, and necessitating the use of water injection to remain above bubble point pressure and support oil production. A similar pressure response is shown at the Epsilon field, again indicating a closed system. This and seismic interpretation suggest that the oil field and aquifer system is closed.

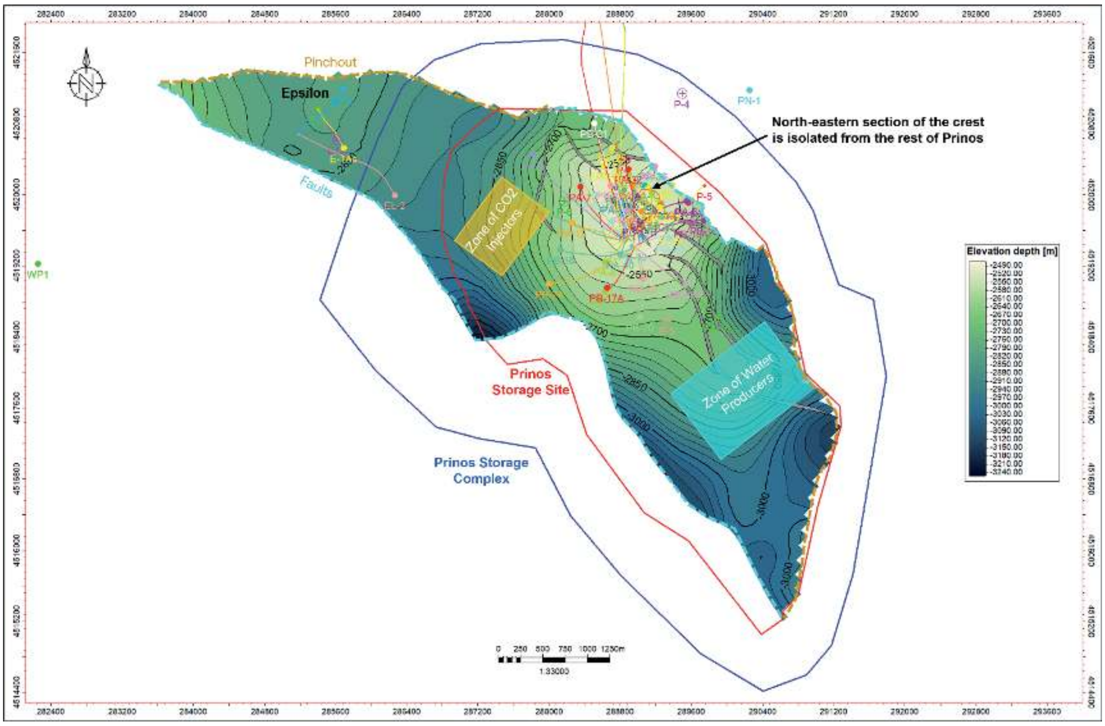


Figure 7: Top Reservoir A depth (m) map showing the extent of the Prinos aquifer and al. Boxes denote areas where CO_2 Injector and water producer wells are likely to be located

Reservoir	**Area**	**Average Gross Thickness (m TVT)**	**Depth Range (m TVDSS)**	**Average Porosity (PU)**	**Average Perm (mD)**	**Pressure at Injection Start, Crestal (psia)**	**Temperature at Injection Start, Crestal (˚C)**
A1	Storage Site	62	2482-3186	0.166	291	4083	110
A2	Storage Site	81	2553-3382	0.141	196	4269	115
B	Storage Site	42	2652-3457	0.13	106	5024	125
C	Storage Site	55	2714-3566	0.134	561	4867	130

Table 5: *Average Storage Site properties*

6.2.3 Clastic Formations in Evaporite Sequence

The Evaporite Sequence is characterized by a thick succession of over-pressured salts (halites and anhydrites) and interbeds of claystone, siltstone, and sandstone clastic rocks. The total thickness of this sequence is up to 800 m. To the north, the evaporites change laterally to thick anhydrites and limestones alternated with clastics, rich in marls.

Compared to the store, the amount of data available regarding the clastic intervals within the Evaporite Sequence is much lower; however, sufficient data (e.g. fluid losses during drilling several wells, kicks in Prinos-1 and PB-13, and cuttings descriptions) is available to indicate that there is permeability in at least some of the clastic formations. Due to lack of available data on the distribution of the permeability, it has been assumed that all clastic intervals do have at least some permeability. There is only a very small amount of direct evidence for over pressure in this interval (including the PB-13 kick), but when combined with the geomechanical modelling work and the potential for pressure increase resulting from CO_2 injection, it is reasonable to assume for well abandonment that these intervals are pressure communication with the store below.

The current storage development plan does not include any injection into the clastics in the evaporitic Sequence.

6.2.4 Formations Above Evaporite Sequence

The rocks above the Evaporitic Sequence are of Pliocene to Pleistocene age. The sequence appears to be predominately composed of sandstones, with subordinate claystones, anhydrites, limestones and a small number of conglomerates. It is likely (based on extensive drilling information) that the pore pressure throughout this interval is hydrostatic.

6.3 Potential Cap Rocks

6.3.1 Definition

In simple terms, any formation with suitably low permeability (including any secondary permeability) can act as a cap rock provided it is laterally extensive and of sufficient thickness to retain fluids below it. Where practicable the use of formations proven to retain fluids over geological time (e.g. directly above hydrocarbon reservoir or associated with changes in formation pressure regime) should be used.

6.3.2 Formations

The Primary Caprock consists of a claystone (approx. 20 m thick) overlain by a sequence of evaporites known as the Lower Main Salt (approx. 100 m thick), which is crosscut by relatively few faults. The Storage Site updip lateral seal (Figure 7) is provided by fault juxtaposition, reservoir against the lower Pre-Evaporitic sequence. This sequence consists of siltstones, claystones, thin limestones, and conglomerates. To the east the Storage Site is defined by stratigraphic pinchout, while to the south-west faults seal the Storage Site. The north-western boundary of the Storage Site is defined by the spill-point towards the Epsilon oilfield. Seismic mapping, drilling, and reservoir development data all suggest the Prinos aquifer is a closed pressure cell system, and not open-ended.

Oil production, pressure history and calibrated dynamic simulation suggest that the claystones between each of the four reservoir reservoirs can also be considered as sealing. However, Prinos oilfield experience demonstrates that there is some potential for crossflow between reservoirs through legacy wells with open perforations.

The Primary Caprock is overlain by claystones and impermeable, creeping salts within the Evaporitic Sequence (700-1000 m TVT) which could provide additional storage complex containment integrity. Above the Storage Complex limit, regional seals have not been identified.

The Prinos Evaporitic Sequence Sealing Potential study indicates that active creep in the Evaporitic Sequence, in particular across the Lower Main Salt is taking place, which is in line with field experience. The Lower Main Salt likely to be an excellent caprock because of its layer thickness, homogeneity and depth – which drives the closure stress at the cement interfaces. Halite has a closure stress approaching the overburden gradient, of the order of 2.1 SG.

6.3.3 Fracture Pressure

Although there is limited direct evidence of previous attempts to measure the actual fracture pressure (or minimum horizontal stress) in the formations above the Prinos reservoir, the available data offers a strong basis for developing a reliable estimate. In particular, FITs are a valuable resource, as they establish a clear lower bound for fracture pressure. Several FITs conducted in and around the Prinos field have already been compiled and provide meaningful insights into the stress regime. These results, presented in Figure 8, form a solid starting point for further evaluation and support a confident approach to assessing formation integrity.

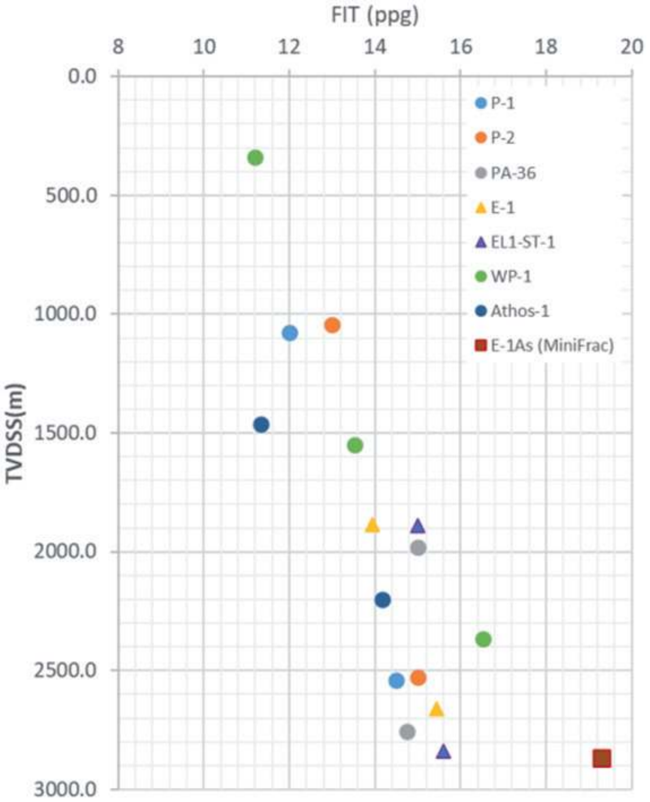


Figure 8: Prinos FITs versus depth (m TVDSS)

Three of the FITs are located close to the top of the storage complex (the Brown Marker at approximately 1900 – 2000 m TVDSS) and as a consequence probably the most important in this context Two of these tests showed no evidence of leak-off at 1.86 SG EMW indicating that the fracture pressure is higher than this value. Higher FITs have been recorded deeper in the sequence, with a Mini-frac in E-1A giving an actual fracture pressure in the storage formations (albeit at the Epsilon field location) of over 2.28 SG EMW. As there is no reliable method to quantify the where between the minimum (1.80 SG) and maximum (2.28 SG) the fracture pressure is a conservative fracture gradient of 1.80 SG EMW (2.56 psi/m) has been used.

It should be noted that this fracture gradient is unlikely to be applicable in the salt layers where, due to the plastic behaviour of the salt the fracture pressure is likely to be significantly higher than in the clastic layers and should be close to the lithostatic pressure (vertical stress) exerted by the overburden. This often results in salt layers having significantly higher fracture pressures than the clastic formations directly above and below them.

6.4 Isolation windows and cross flow events

6.4.1 Minimum Safe Abandonment Depth (MSAD)

The ability of any cap rock to act as a barrier to upwards flow from the zones of flow potential below it is limited by the pressure at which it is liable to fracture. In the context of CCS this includes the potential for CO_2 migrating upwards through either natural or manmade flow conduits. There is only a risk of formation fracture where the pressure in a flow conduit exceeds the fracture pressure. By extrapolating the maximum store pressure from the reservoir model upwards using the lowest possible fluid gradient (in this case CO_2 at storage conditions, density of 630 kg/m^3) on the same plot as the fracture pressure the cross over depth can be identified.

The MSAD can also be influenced by the presence of vertical permeability in the formation. Should there be the potential for a direct flow path to the environment (or a shallow zone requiring isolation from the store) the MSAD may be constrained by the formation properties.

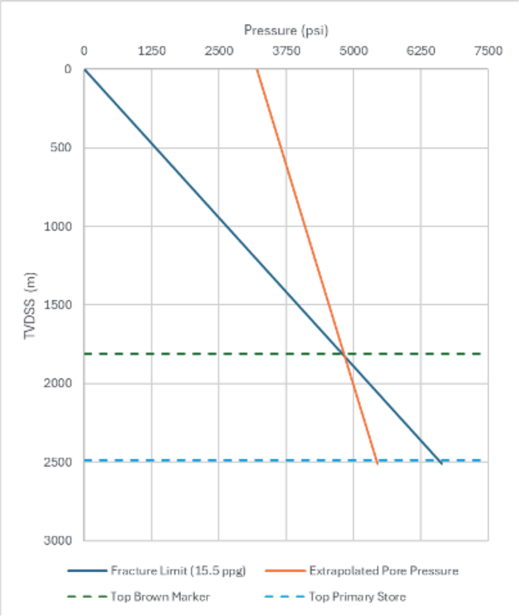


Figure 9: Prinos MSAD from store and fracture pressure

For Prinos, the MSAD based on fracture pressure / extrapolated pressure cross over, and the shallowest suitable formation give the Brown Marker Formation as shallowest depth for barrier setting, to ensure security of containment.

6.4.2 Grouping of Zones of Flow Potential

The grouping of Zones of Flow Potential, is done to reduce the number of barriers required. Typically zones that can be grouped are on the same pressure trend and contain similar fluids. In Prinos the primary and secondary storage (the reservoir/aquifer and the clastics within the Evaporitic Sequence) are likely to already be in pressure communication via wellbores, hence over time it is likely that the pressures will move towards equilibrium. The migration of CO_2 into the secondary storage does not appear to represent a significant increase in containment risk, with the potential for CO_2 to become trapped in the clastic intervals. Therefore, setting barriers below the secondary storage would be of limited value and it is proposed to group of all of the storage formations together for abandonment planning.

6.4.3 Minimum Isolation Requirements

Based on oil industry best practice (as set out in OEUK guidelines) it is anticipated that all wells existing and future which penetrate either the in situ hydrocarbons already present in the Prinos field or the injected CO_2 will require either two independent or a single combination barrier between the store and the environment. Similarly (due the anticipated over pressure from CO_2 injection) the water production well and any other aquifer wells will also require a similar barrier configuration. The most appropriate depth for barrier setting is the Brown Marker (with the option of extending barriers downwards into the upper part of the evaporites if required). These barriers should be “rock to rock” and be set on solid bases (e.g. mechanical plugs or similar) with appropriate verification after setting.

The inclusion of additional barriers either within the store itself or between the primary store and the evaporitic sequence are not required for safe abandonment but may be included in abandonment plans if required to limit the migration of CO_2 within the storage complex. The provision of shallow plugs (or environmental caps) is not strictly necessary as there is no evidence of over pressure in the over burden; however, it is considered good practice to include these in any abandonment.

7. Well decommissioning

7.1 Strategy

All of the currently accessible wellbores will be abandoned to at least AB1, reservoir isolation as per OEUK Guidelines before the CO_2 plume is expected to reach the respective wellbores.

The wellbores that are slot recovered for CO_2 injectors / producers and the monitoring wells will largely follow the same abandonment philosophy.

At present, PB-17A and PB-24 are planned to be slot-recovered for CO_2 injection wells and PB-22 and PB-23A slot-recovered for water production wells. The following wells are potential candidates for monitoring: PB-19A, PA-37, PA-38, PB-22 and EA-H3 ST1.

7.2 Currently Accessible Wells – P&A Focused Review

This section provides a high-level overview of the typical well construction, completion design, well status and associated risks with well re-entry and decommissioning for the currently accessible Prinos wells.

7.2.1 Well Construction

The typical casing and cement design used across the Prinos wells is as follows.

Table ***6:Typical casing and cement design at Prinos***

Casing	Setting Depth (m TVD BRT)	Cement	TOC
24” Conductor API5L GrB 0.75” Welded	100 m	Driven	N/A
18 5/8” K55 87.5# BTC	300 m	Class A 1.8-1.9 SG	Seabed/ Mudline
13 3/8” N80 68# BTC	1500 m	Lead Class A 1.5 SG Tail Class G 1.85 SG	Inside 18-5/8”
9 5/8” L80/ C95 47-53.5# BTC	2100 m (Brown Marker or First Stray Evaporite)	Lead Class G/ G+35% Silica 1.45-1.65 SG Tail Class G/ G+35% Silica 1.90-1.95 SG	Approx 150 m inside 13-3/8”
7” Liner L80/C75/P110 26-32# T3SB/ LTC	2700 m*	Class G/ G+35%Silica 1.90-1.95 SG	TOL
4 ½” or 5” Liner L80 18# BDS	2900 m*	Class G/ G+35%Silica 1.90-1.95 SG	TOL

*To avoid casing collapse across the evaporites, typically 7” 32 lb/ft L-80 casing has been placed across the upper/ lower salts and over pressure clays, which also allowed for a lower mud weight when drilling the reservoir section. The 5” 18 lb/ft L80 top of liner has typically been set above the upper main salt to “double skin” the most creeping salts.

7.2.2 Producing Wells Completion Design

The producing wells share a common gas lift completion design and utilise either 3-1/2” 9.2# L80 tubing throughout or 3-1/2” tubing crossed over to 2-7/8” 6.4# L80, positioned above or below the production packer.

Tubing connections predominantly consist of Tenaris TS Blue and VAM TOP, with additional use of Tenaris TDS, API EUE, and NV connections, particularly on the Beta platform.

All Alpha platform wells are equipped with tubing-retrievable, surface-controlled subsurface safety valves (SCSSVs) and associated control lines. In contrast, Beta platform wells are fitted with hydraulic landing nipples designed to accommodate wireline-retrievable safety valves; however, in most of the Beta platform wellbores the safety valves have been retrieved.

Alpha wells also include at least one chemical injection sub and associated control line located below the production packer. Beta wells lack downhole chemical injection capability, with the exception of PB-34, where a chemical injection sub is installed above the packer.

Each gas lift completion includes between two and four gas lift mandrels. Retrievable packers have been used consistently across all producing wells.

7.2.3 Injection Wells Completion Design

The water injectors follow a common completion design, utilising 3-1/2” 9.2# L80 tubing. However, a variety of tubing connections have been employed across the wells, including Tenaris (PH6, TSHB, NK3SB, TDS), Voestalpine (VAGT), VAM TOP, and API EUE.

Two wells are equipped with hydraulic landing nipples designed to accommodate a wireline-retrievable safety valve; however, no safety valves are currently installed. PB-19A is fitted with a tubing-retrievable safety valve and an associated control line. No downhole injection valves have been installed in any of the wells.

Expansion joints are present above the packer in all completions except for PB-19A. Retrievable packers have been used consistently across all injector wells.

7.2.4 Completion Design: Special Cases

Several of the Prinos wells deviate from the standard completion designs described above. These exceptions are stated below. While the overall reservoir isolation strategy remains unchanged, the Phase 0 well preparation steps will differ slightly for these wells.

Dual Completion/ Dual Hangers

Additional well barriers will be required to be set in these wells during well preparation for Xmas tree and completion recovery to address the dual string arrangement. These wells are as follows.

- Alpha - Slot 1 (PA-41) – Gas Lift Producer - Dual completion string
- Alpha - Slot 7 (PA-40) – Gas Lift Producer - Dual bore hanger
- Beta - Slot 6 (PB-22) – Gas Lift Producer - Dual bore hanger
- Beta - Slot 10 (PB-24 ST2) – Gas Lift Producer - Dual bore hanger
- Beta - Slot 12 (PB-16A) – Water Injector - Dual bore hanger

Kill Strings

These wells follow a very basic completion design and may present opportunities to streamline the phase 0 operations.

- Alpha - Slot 8 (PA-5) Kill String
- Beta - Slot 3 (PB-27) Kill String
- Beta- Slot 4 (PB-18) Kill String
- Beta - Slot 11 (PB-20) Kill String

7.2.5 Xmas Tree and Wellheads

There are multiple Xmas tree OEMs and configurations installed across the Prinos Alpha and Beta platforms. A summary of these has been provided in Table **7**.

*Table **7**: Prinos Xmas Trees*

Xmas Tree System		Platform	
OEM	**Xmas Style**	**Alpha**	**Beta**
Mc Evoy	Single Y-Block	1	4
	Dual	1	5
FMC	Single	1	0
	Dual	3	0
Cameron	Single	6	0
Weatherford	Single	0	1
Control Flow	Single	0	2

7.2.6 Well Access / Flow Assurance Issues

Severe scaling has been encountered in numerous Prinos wells, leading to significant flow assurance and well access issues. The scale deposits primarily consist of a mixed composition of Barium Sulphate ($BaSO_4$), Strontium Sulphate ($SrSO_4$), and Calcium Sulphate ($CaSO_4$). These scales are known for their low solubility and mechanical hardness, making them particularly difficult to remove using conventional methods.

The most affected wells are those producing from multilayered reservoirs, especially where water production is commingled from two or more formations (typically A and B, or A, B, and C reservoirs). The mixing of incompatible waters is believed to exacerbate the scaling tendency, promoting rapid precipitation and deposition within the tubing and near-wellbore area.

Efforts to remediate the scaling using chemical treatments have so far been unsuccessful. Multiple formulations have been trailed, but none have achieved meaningful scale dissolution or prevention.

Well access has become increasingly problematic due to scale-induced restrictions, with many interventions hampered by partial or total blockages. Coiled tubing operations aimed at mechanically cleaning the wells have delivered mixed results. While some interventions have temporarily restored flow, many have been prolonged due to complications such as stuck bottom hole assemblies (BHAs), ultimately resulting in fishing operations and extended downtime.

Asphaltenes are also common in Prinos. These are organic solids that precipitate from the crude oil system. Their chemistry is different and more complex than that of waxes, and they appear as black, coal-like deposits. Due to their complex and variable chemistry, they are toluene-soluble, normal (straight chain) and heptane-insoluble compounds. The deposits can be crumbly to very hard; unlike waxes, they do not melt once solidified. Unlike most other fields, the Prinos asphaltenes are unstable and precipitate in the tubing, causing severe restrictions. They are highly polar and comprise some of the heaviest components in crude oils, with molecular weights ranging from 500 to 1000 or above and densities of ~1.3 sg.

These issues represent a risk and high probability of occurrence for well P&A operations. A summary of the wells with known flow assurance issues is provided below in **Table 5**. This is not exhaustive and any well within Prinos could suffer varying degrees of well access challenges due to well deposits.

Active Wells	Reservoir Layers	Asphaltene	Scale	Iron Sulphide	General Corrosion	Formation Fine	Halite
PA-32	B-L7	X	X	X		X	
PA-33	L6-L5-L4	X					
PA-35A	L-1, L-3	X		X	X	X	
PA-36	C-B-L3-L4-L5	X					
PA-37	L-3,6,7			X	X		
PA-38	B-C	X					
PA-40	L1-L4	X					
PA-41S	L1-L3						
PA-41L	B-L-4,5,6,7	X		X	X	X	
PB-22	L1-L2	X	X				
PB-26	C-B-L-1,2,3,4,5,7	X	X				
PB-34	C-B-L5	X	X				
PNA-H4		X					X
EA-H3	L1-L3	X					

Table 8: Well Deposits at Prinos

7.2.7 Fishing Requirements

For each well with potential fishing requirements, a specific review will be conducted during the detailed engineering phase to assess available options. The primary operational changes for these wells relate to well preparation activities required to enable reservoir isolation.

PA-5

A deep fish (packer at 2476 m) remains in hole, with a kill string currently installed. This well can be abandoned above the fish in accordance with the standard abandonment philosophy detailed in section 7.4, as there is access to the upper main salt (UMS). Consequently, the likelihood of requiring additional operational steps is considered very low.

PA-33

Approximately 2500 m of 7/32" e-line cable and cutter tool string are left inside 3-1/2" tubing. The top of fish was located at 240 m after unsuccessful fishing attempts in May 2018. Given the size of the cable relative to the small completion tubing, accessing below the MSAD for reservoir isolation will require a detailed fishing programme, to be developed during the next phase of engineering.

PB-27

This well contains a short kill string and a 9-5/8" CX-10 retrievable bridge plug set at 203 m. An ESP completion fish is present, with the top of fish at 2104 m. Approximately 32 m of potentially sealing formation exists above the fish and below the MSAD, which may be used for isolation. During detailed engineering, the feasibility of extending operations to access a greater interval of potentially sealing formations will be evaluated.

PB-34

A coiled tubing fish remains in hole from operations in August/September 2019. Approximately 320 m of 1.5" (QT-800) coiled tubing, including a disconnected BHA (CT connector, MHA), is in place. The top of fish is at 1700 m, with three RCT anchors at 1995 m. A PDM and 2" Hurricane mill bit were lost in hole. Tubing was perforated at 1403 m, with an additional tubing fish at approximately 2020 m. To enable access below the MSAD for reservoir isolation, a detailed fishing programme will need to be developed in the next engineering phase.

7.2.8 Packer Removal

PA38

This well may require packer removal to access sufficient salts for annular isolation. The salt layers at PA38 location are particularly thin in the upper layers. If the packer remains in hole there is access to approximately 19 m of salt.

PA41

This well has a shallow set packer above MSAD which may require recovery for permanent barrier placement.

PB-27

This well may require packer removal to access sufficient salts for annular isolation. Completion packer is currently set above the first evaporite. There is potential access to 32 m of salts if the packer remains in hole.

7.3 New Water Producers and CO_2 Injection Wells – P&A Focused Review

As part of the field development some of the wells will be pre purposed as monitoring wells and new wells will be drilled for the purpose of CO_2 injection and water production.

7.3.1 Preliminary CO_2 Injectors

The preliminary casing and cement design for the CO_2 injection wells is anticipated to be as follows.

Table ***9:Typical casing and cement design for the water production wells***

Casing	Setting Depth (m TVD BRT)	Top of Cement
30”	100 m	N/A
20”	300 m	Seabed/ Mudline
13 3/8” L80 68# Vam-21	Brown Marker	Inside 20”
9 5/8” L80 53.5# Vam-21	2500 m	Inside 13-3/8”
9 7/8” L80 66.9# Vam-21	Base of Salts/ Cap Rock	
7” Liner TBC 32# Vam-21	3100-3400 m	TOL

The completion packers are anticipated to be set within the 7” liner.

7.3.2 Preliminary Water Producers

The preliminary casing and cement design for the water production wells is anticipated to be as follows.

Table ***10:Typical casing and cement design for the water production wells***

Casing	Setting Depth (m TVD BRT)	Top of Cement
30”	100 m	N/A
20”	300 m	Seabed/ Mudline
13 3/8” L80 68# Vam-21	Brown Marker	Inside 20”
10 3/4” TBC 65.7# Vam-21	2700 m	Inside 13-3/8”
10 3/4” TBC 85.3# Vam-HP	Base of Salts/ Cap Rock	
7” Liner TBC 32# Vam-21	3100-3400 m	TOL

The completion packers are anticipated to be set within the 7” liner.

7.4 P&A Philosophy

The Prinos wells will be decommissioned in accordance with good industry practices, e.g., OEUK Guidelines. Establishing this approach enables efficiencies to be realised across the field. Where significant deviations are necessary, bespoke well designs will be developed; however, such deviations will be minimised wherever possible.

Although the existing wells and new wells to be drilled have different casing designs across the salt sections, the concept for abandonment—specifically the placement of permanent barriers—remains largely the same.

- All zones assessed to have flow potential will be isolated from surface by a minimum of two permanent barriers.
- Zones which have flow potential, belong to different pressure regimes and cannot be combined will be separated by a minimum of one permanent barrier.
- Control lines and cables will be removed from the interval where any permanent well barriers are to be installed.
- Completion packers will be left downhole where possible and permanent barriers placed above, adjacent to competent cap rock.
- Annular fluids above the uppermost permanent barrier that cannot be legally discharged will be contained with an environmental cement cap before wellhead removal.
- Any remaining casing/ tubulars will be removed to a minimum of 10ft below seabed.

The following OEUK industry guidelines and prevailing good practices have been consulted for support and guidance on achieving a robust well decommissioning design where applicable.

- OEUK Well Decommissioning Guidelines, Issue 7, Nov 2022
- OEUK Well Decommissioning for CO_2 Storage Guidelines, Issue 1, Nov 2022

The minimum requirements for a single permanent barrier should be as follows.

Table *11: Permanent Barrier Requirements*

Material		CO_2 resistant cement or equivalent
Position		Be set above the zone with flow potential across a suitable cap rock
Strength		Have a formation fracture strength along the entire length of the barrier, in excess of the maximum anticipated pressure from the zone being isolated.
Internal	**Length**	100 ft (30 m) of good cement. In general, up to 500 ft (150 m) of cement may be required to ensure the minimum length requirements are achieved for a single permanent barrier. The final barrier length placed will be evaluated on a case-by-case basis, considering the ability to place quality cement.
	Verification	Tagged (at times with weight, 10-15 klbs) and/or Pressure Test >500 psi above fracture gradient at the base of the barrier.
Casing Annulus	**Length**	100 ft (30 m) of good cement or equivalent, if logged, adjacent to internal cement plug, or at least 1000 ft (300 m) of good cement, based on a desktop review, may be considered adequate for the equivalent of two barriers or a combination barrier.
	Verification	Cement evaluation log to verify 100 ft (30 m) of good cement or verification of at least 1000 ft (300 m) of annular cement if based on a desktop review.
Sealing Formations	**Length**	100 ft (30 m) of cumulative length
	Verification	Bond logging and hydraulic testing to be considered on a case-by-case basis.

The isolation strategy of non-compliant legacy wellbores, of which at the time of writing, 12 have been assessed as not having suitable barriers as per OEUK guidelines and prevailing good practices, are covered in the Containment Risk Assessment.

7.5 P&A Design

The proposed well decommissioning design for the accessible Prinos wells is as follows.

7.5.1 Phase 0 – Well Preparation

Where possible, the well preparation phase will be performed through batched wireline/ coiled tubing campaigns.

The following requirements have been assumed for the preparation of the wells for decommissioning.

- Establishment of well barriers will be required to facilitate rigging up of intervention equipment.
- Well access will have to be established, if not present, to enable wireline tools to be run to the required depths.
- In wells where access is challenging, coil tubing may be required as a contingency to perform a clean out operation.
- Prior to removing the Xmas tree, two verified barriers need to be in place. This may involve a combination of deep and shallow plug setting, and/or circulation of monitored kill weight fluid. To facilitate fluid circulation, communication between tubing and annulus will have to be established.
- A multi-finger caliper log may be run to assess tubing condition/ level of deposition prior to completion recovery and to assist with plug setting depths/ assessment of completion integrity for circulation of kill weight fluids.
- The completion tubing will be cut above the deep-set plug to facilitate completion recovery and may double up as a circulation path for kill weight fluid circulation.
- Where possible the production packer will be left downhole. In wells where the production packer has been set above MSAD, the packer will ultimately be pulled or milled to allow access for permanent barrier setting.
- A shallow set plug will then be set below the DHSV to isolate control lines and provide a secondary barrier. This may double up as a base to test the BOP.
- A pump open sub may be included below the shallow plug to remove the requirement for plug removal prior to completion recovery.

Step	Description
1.	**Skid Rig**
2.	**Establish Surface Barriers and Rig Up PCE**
2.1.	Verify Tree and Wellhead Isolations
2.2.	Bleed off Annulus Pressures and Top Up - where required
2.3.	Rig Up and Pressure Test Wireline PCE
3.	**Establish Well Access and Integrity**
3.1.	Establish Well Access - Run drifts and recover installed equipment where required
	Contingency: Coil Tubing
3.2.	Assess Completion Integrity – Multi-finger caliper log where required
4.	**Establish Downhole Barriers, Sever Completion and Rig Down PCE**
4.1.	Set and Pressure Test Deep-Set Plug
4.2.	Cut Tubing above Deep-Set Plug/ Completion Packer
4.3.	Displace Well to Kill Weight Fluid
4.4.	Set and Pressure Test Shallow Plug below DHSV c/w Pump Open Sub
4.5.	Rig Down Wireline and PCE

Table 12: Well Preparation Steps

7.5.2 Phase 1 – Reservoir/ CO_2 Store Isolation

After the Xmas tree is removed and the BOP installed, the shallow plug and tubing will be retrieved.

It may be planned to set a combination barrier cement plug 800 ft (250 m) in length inside the production casing to provide a 200 ft (60 m) isolation. The top of the barrier will be below the Minimum Safe Abandonment Depth (Base of Brown Marker) over an interval that contains 200 ft (60 m) of good annulus cement or equivalent formation seal.

Plugs will be set on tagged and pressure tested bases where possible, and a cement execution checklist performed. If the cement job execution is performed in line with the execution checklist without significant deviation, verification of the cement may not be required.

A suitable contingency method for annular remediation will be explored in the next phase of engineering maturity.

The following steps have been considered for the isolation of the primary reservoir / CO_2 storage site.

Step	Description
5.	**Skid Rig, Recover Tree and NU BOP**
5.1.	Skid rig over well slot & receive well handover from Production
5.2.	Remove tree and tubing head adaptor
5.3.	Nipple up 13 5/8" BOP and pressure test
6.	**Recover Completion**
6.1.	Pump open shallow plug.
6.2.	Retrieve completion tubing above production packer
	Contingency: Pull or Mill Packer
7.	**Set Reservoir Isolation**
7.1.	Set and pressure test bridge plug in casing

	Contingency: Perform cement evaluation logging
	Contingency: Casing clean out run.
	Contingency: Perf and Test
7.2.	Place combination cement barrier
	Contingency: Annular Remediation
	Contingency: Verify Cement

Table 13 Reservoir/ CO2 Store Isolation

7.5.3 Phase 2 – Overburden Isolation

Not required.

7.5.4 Phase 3 – Environmental Cap and Surface Casing/ Wellhead Removal

Environmental cap placement will be performed after all zones of flow potential have been isolated. The proposed way forward is described below, however additional options will be investigated at the time of implementation.

With the 9 5/8” cut and casing recovered; a cement retainer may be set within the 13 3/8” casing and a 200 ft (60 m) environmental cement cap may be placed. Once installed, the BOP will be nippled down.

The following steps have been assumed for environmental cap placement:

Table *14: Environmental Cap Placement*

Step	Description
8.	**Cut and Recover Production Casing (9-5/8”, 9-7/8” or 10-3/4”)**
8.1.	Set Bridge Plug on Cutter
8.2.	Cut production casing
8.3.	Circulate out casing annulus
8.4.	Recover production casing
9.	**Set Environmental Cap**
9.1.	Set 13 3/8" Casing Retainer
9.2.	Place environmental cement cap
10.	**ND BOP**

Surface casing and wellhead removal operations will be performed through a batched operation, where possible. The downhole and surface severance methods are yet to be evaluated and selected. It is anticipated that the surface casing and conductor will be recovered by drilling and pinning.

The casing and conductor will be cut 3 m below seabed and recovered to surface along with the wellhead, to fully decommission the well.

The following outline steps have been assumed for surface casing and wellhead removal:

Table *15: Surface Casing and Wellhead Removal*

Step	Description
11.	**Skid Rig**
12.	**Recover Surface Strings and Conductor**
12.1	Perform downhole severance of surface casing and conductor
12.2	Recover surface casing and conductor by drilling and pinning.

7.6 Proposed Final Status Schematics

An illustrative example of the proposed well decommissioning design for the Prinos existing wells, new water producers and CO_2 injectors are as follows.

For wells being prepared for slot recovery, only the reservoir isolation is required.

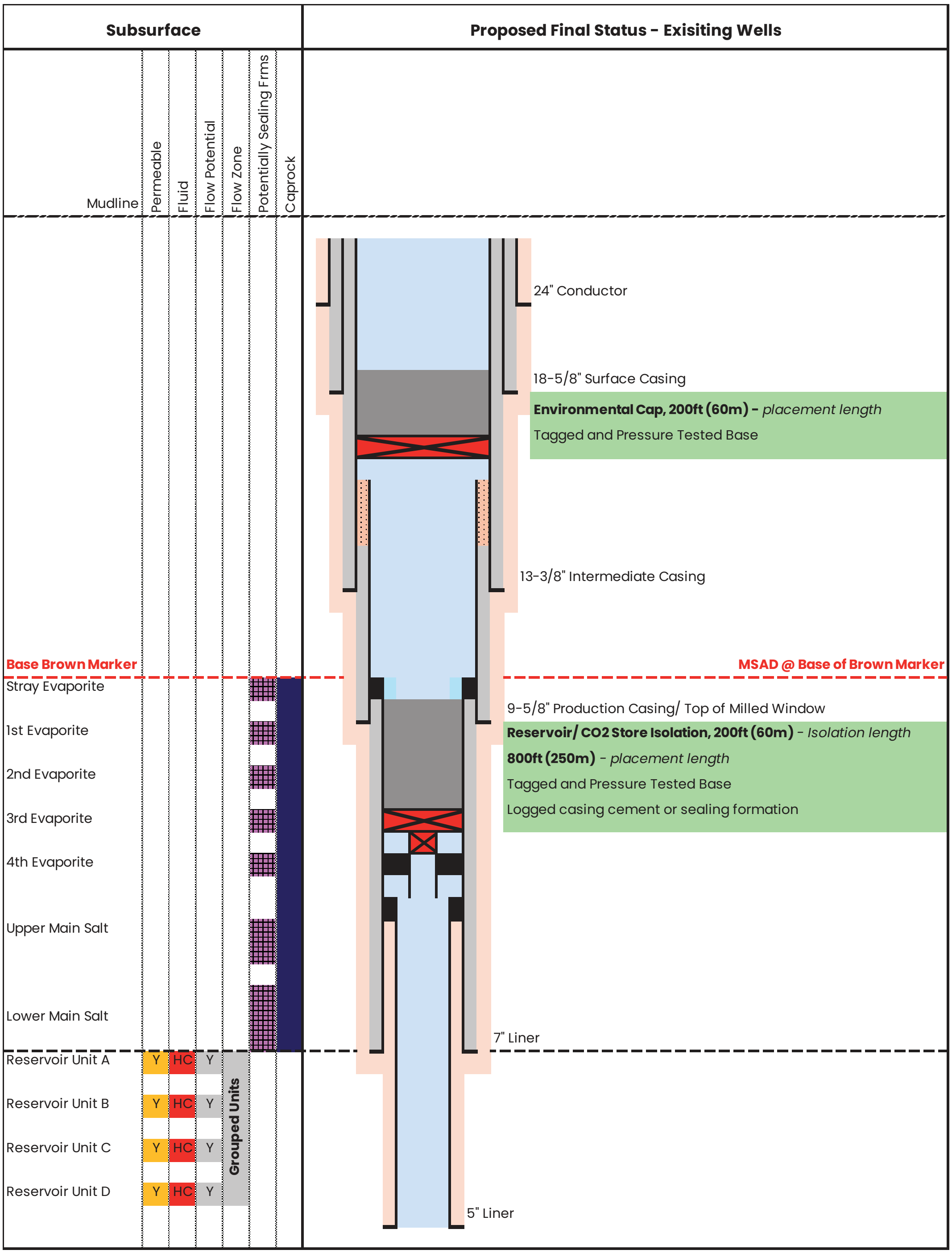


Figure 10: Proposed Final Well Status – Existing Wells

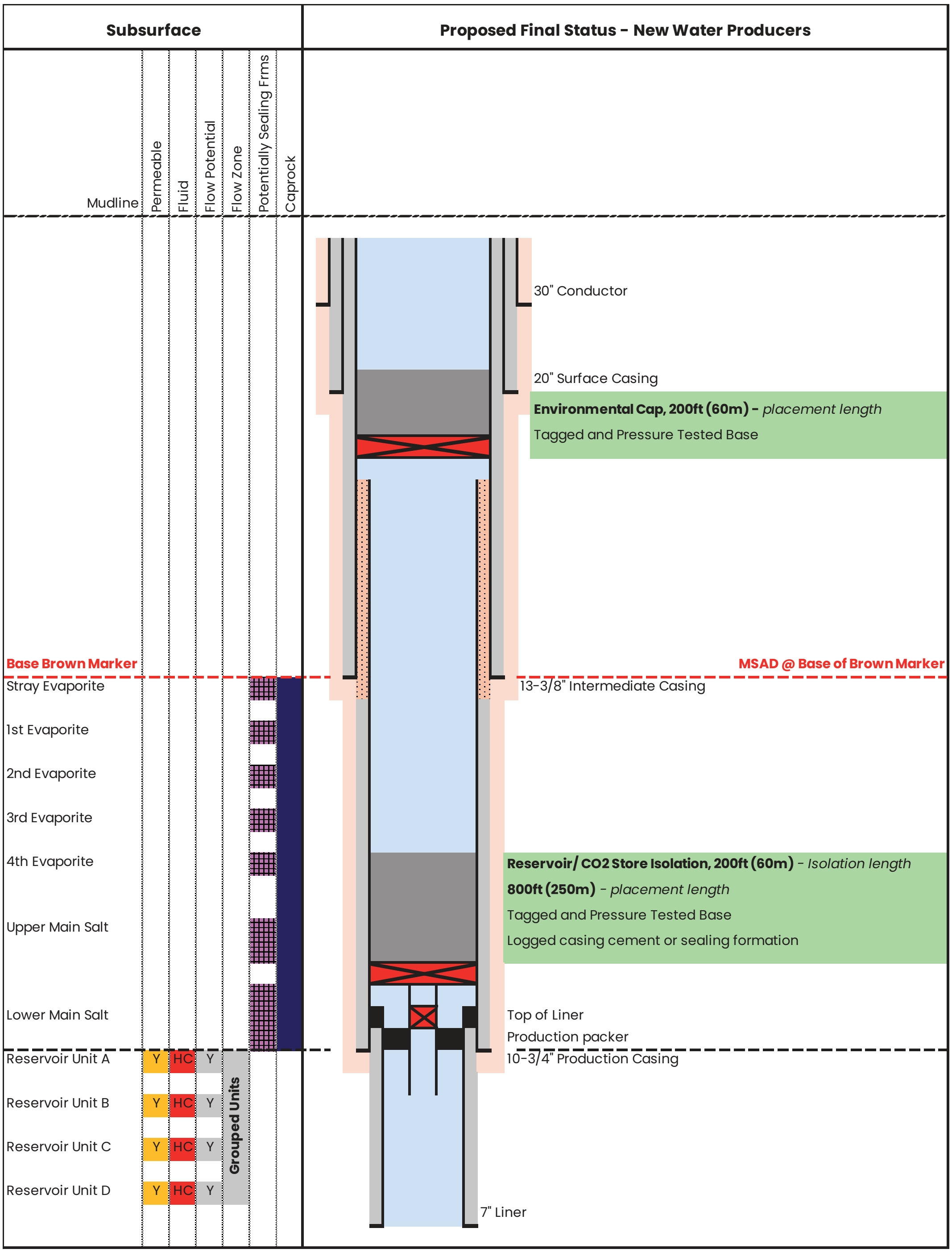


Figure 11: Proposed Final Well Status – New Water Producer Wells

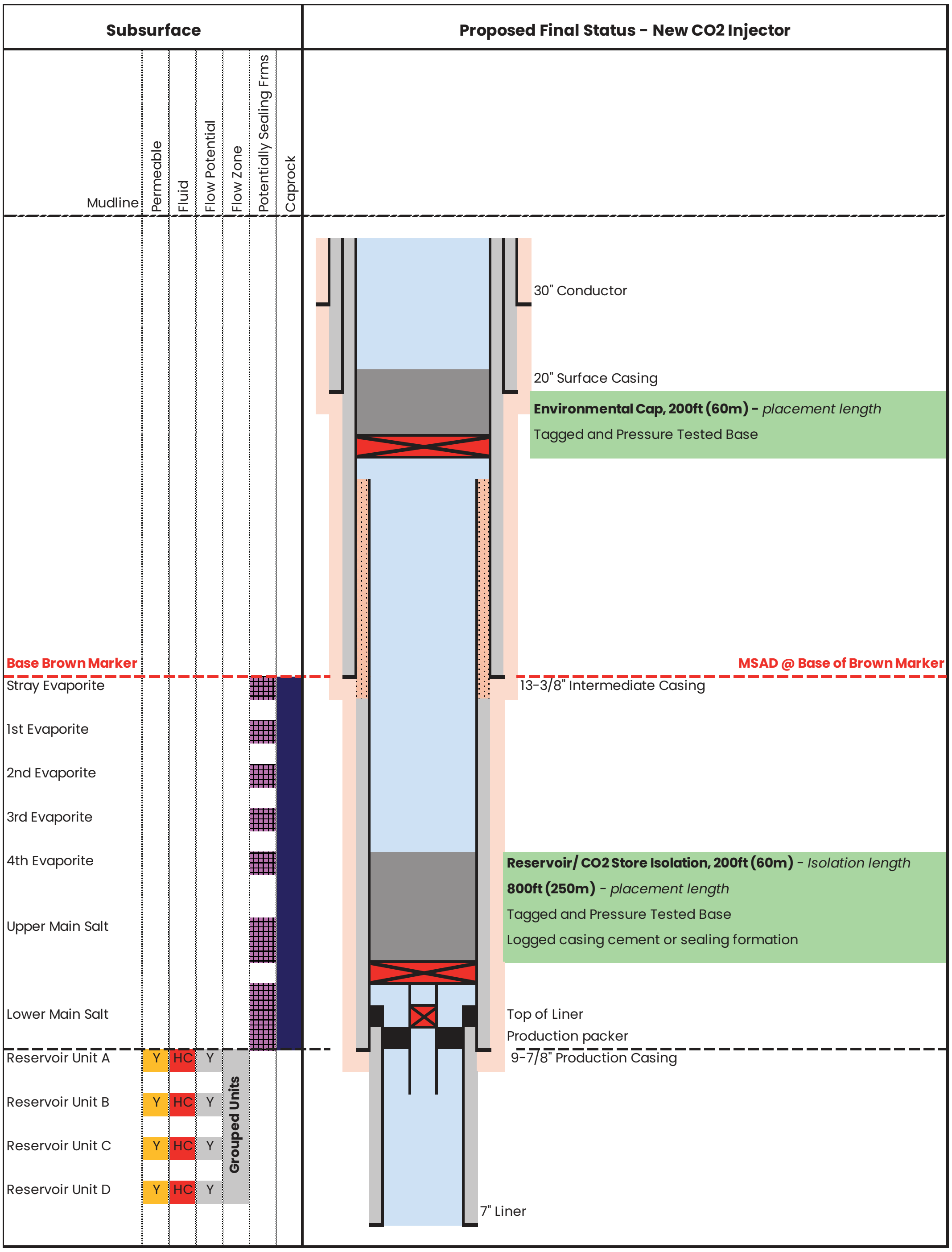


Figure 12: Proposed Final Well Status – New CO_2 Injector Wells

8. Topsides and Substructure

At facility closure, all systems will be drained, flushed, purged and vented. The two 6” Pipelines will then be flushed back to the Delta platform and routed down a suitable disposal well and the 12” CO_2 pipeline will have contents displaced either down a suitable disposal well on Beta or back to the terminal. All fluids resulting from these operations will be processed and disposed of depending on their contents, no overboard disposal is foreseen.

The proposed removal methodology for the Beta topside, is to separate the topsides from the jacket using suitable cutting tooling and then utilise heavy lift pad eyes located on the 4no. corners of the module. This mimics the installation method used during construction, thus avoiding major deviations in global load paths or stresses from original design intent. Inspection of existing pad eyes will be undertaken and installation of any new pad eyes identified undertaken as part of the decommissioning scope. It is likely that at the time of eventual decommissioning new pad eyes will be installed at all corners. Any items obstructing the sling path, such as the crane pedestals and communication towers, with also be destructed prior to the main lift. Suitable verification of global structural integrity and load path for lift conditions, set-down, onwards sea transit and onshore transfer will be required as part of the removals detailed design, to adequately understand current asset condition. Similarly, tasks including PDO sweeps, CoG envelope management and strategic de-weighting may be considered.

Lift configurations will likely utilise intermediate spreader beam systems, to mitigate racking loads during lift operations; subject to detailed assessments.

Given the size and distance from MSL, there is no challenge foreseen with the removal of these assets, shown below is the reach of the former Energean Force, a typically sized supply vessel, relative to the platform.

Figure 13: Mast being transferred to the top deck of Prinos Platform

Pre-lift, preparatory works will be required to air gap any caissons, risers or appurtenances from the jacket. Caissons and risers will be suitably restrained to allow air-gapping, most likely in the form of drilled & pinned dead weight support restraints which will bear on existing jacket guide annulus. Should the capacity or integrity of such prove insufficient, alternative engineered solutions (such as friction grip clamps or welded strengthening) will be considered. Localised removal of any tertiary equipment at jacket leg interfaces will also require clearing, to provide sufficient working space for any external cutting tooling. The topsides / jacket interface cut line may consider partial castellated cuts ahead of vessel arrival, subject to engineering assessment and scheduling / weather windows.

Once deemed safe to lift, the selected lifting vessel will remove the bridge to the Delta platform, connect rigging and lift the topsides before setting down on an adjacent transfer barge, using custom-made designed transit grillage structures. This structure will be designed to accommodate heavy lift set-down (such as bumpers / guides), sea transportation loading with accompanying sea-fastening and onwards land transfer at quayside using self-propelled modular transporters (SPMT’s) or similar.

Figure 14: Prinos A with Prinos B in the background to highlight scale

After removal of the topsides, a traditional sub-structure removal methodology of externally cutting the jacket legs directly above mudmat elevation; with subsequent retrieval of the mudmats and sub-surface pile sections may be required. Pile sections will be cut at a suitable depth below the seabed to avoid impact on other users of the sea, subject to agreement with the relevant authority at the time and review of environmental conditions. Both internal pile cutting tooling or localised external dredge / cut remain viable options to be further reviewed.

The jacket structure will be rigged up with Internal Lifting Tools (ILT’s) or similar to provide robust primary lifting points for vertical lift. Once rigged, 4no. subsea cuts can be performed using suitable cutting techniques such as diamond wire cutting (DWC) equipment. Proposed cut lines would aim to minimise the number of cuts sub-sea, with the optimal locations being below the lowest jacket horizontal chords and slightly above the mudmats. Lifting vessel metrics will likely dictate the strategic sectioning of the jacket structure for lifted removals.

Figure 15: Typical Jacket Lift using ILT’s

Should the jacket piles be internally driven within leg ID, supplementary restraint may be required to facilitate safe jacket sectional removal. If so, these will likely comprise of drilled holes and through pin restraints, providing suitable direct bearing restraint. These internal piles may require localised removal at the top of the jacket, to provide suitable insertion points for the ILT tooling and ensure the jacket tubulars are suitably engaged during lift. Should this prove problematic, welded jacket lift points can be considered.

Upon confirmation of internal pile retention, external cutting of the 4no. legs at the proposed cut lines below would then be complete, releasing the jacket from the mudline for safe vertical removal. In alignment with the topsides removals, opportunities exist to leverage efficiencies with HLV or lifting vessels across the field. The main intent with this removal approach is to minimise the time on station for a heavier capacity lifting vessel, focusing on commercial and schedule risk reduction. A smaller, more readily available CSV may then be utilised to complete the final retrieval campaign, recovering the mudmat structure and sections of the subsurface piles using internal cutting tooling.

The removal method for the Alpha platform is the same, and given the asset likeness the methodology for removal has not been duplicated within the report.

9. Subsea Decommissioning

9.1 Infrastructure Removal

Subsea infrastructure may be undertaken relatively autonomously from the platform removal, as long as the pipelines are physically disconnected from the jacket prior to its removal. Removal of any smaller items, such as concrete mattresses and grout bags, will be considered on a case-by-case basis during the decommissioning work plan development.

Once the pipelines have reached the agreed cleanliness criteria, they will be depressurised and flooded with inhibited seawater to ensure any remaining CO_2 has been removed and equalise the pressure of the lines with the external environment. At a suitable time within the overall decommissioning schedule but prior to jacket removal, the three pipelines and the power cables will then be disconnected from the risers using suitable cutting equipment – this operation may require diver intervention. Prior to physically cutting the pipelines all necessary controls will be in place to ensure a safe operation. Once cut, the pipeline and cable tie in sections will be cut and recovered at each platform location up to where the pipelines go into burial. The remaining pipelines and cables will be left in situ and remediated as required to ensure sufficient depth of burial.

The partial sections being removed will be cut into manageable lengths using a subsea shear and recovered to deck using a pipe grab or subsea basket. Should any section not be suitable for the pipe grab or a subsea basket, dedicated rigging will be installed subsea and used for recovery to the vessel. It is advised that a suitably sized Diamond Wire Saw (DWS) or similar tool is mobilised as a contingency cutting method to the shears.

Figure 16: Typical Pipeline Decommissioning Operations

Once pipeline sections are on deck, NORM checks will be carried out, bagging and tagging as necessary before being stored in deck corrals or baskets and sea fastened. Pipe sections will be pre-rigged on the vessel in preparation for offload in port for onwards disposal and cables will be pre bundled together or offloaded in a basket.

9.2 Seabed Remediation

Consistent with the decommissioning provisions detailed above, the key restoration activities for the CCS project will focus on ensuring that pipelines decommissioned in-situ and wellheads, jacket piles and associated subsea infrastructure do not present an obstruction to other users of the sea or an environmental hazard.

As the recommended decommissioning approach is to decommission the pipelines in situ, it may be needed that the cut ends or other exposed areas are remediated to avoid an ongoing hazard to other users of the sea. This can be done by either trenching and burying the line or carrying out spot remediation using graded rock. The most appropriate means of remediation will be dependent on the level of disturbance to the seabed and marine environment, the spans and volume of remediation required, and availability of suitable rock placement material - with trench and bury being more effective where larger spans are encountered but causing a greater seabed disturbance.

After the platform has been removed any remaining items of debris within the platform safety zone which have caused by the Prinos operations will also be recovered and transported to a waste processing facility.

Following completion of offshore decommissioning works, a detailed post-decommissioning seabed survey will be undertaken to verify that all temporary equipment and debris associated with the closure operations have been removed. This survey will identify and support the recovery of any remaining materials that could pose a hazard to navigation, fishing activity, or the marine environment. It is proposed that the survey be conducted by an independent and accredited marine survey contractor, with results submitted to HEREMA for review and shared with relevant stakeholders as agreed in advance.

The scope of the survey will be determined during the decommissioning phase, taking into account current industry best practice and stakeholder input. It is anticipated that survey efforts will focus on key infrastructure locations, including the injection well sites, monitoring station areas, and any associated pipelines or subsea equipment. Any anomalies of archaeological or ecological interest encountered during clearance will be reported to the appropriate authorities, and stakeholder consultation will be undertaken where required to determine appropriate action.

10. Waste Management

As part of the decommissioning of the site it is also important to consider a strategy for dealing with the decommissioned components. This will include recovered steel, copper and glass fibre composites. The proposed strategy will be to re-use and recycle as much material as possible.

After the operations described in Sections 7.2.1 and 7.2.2, transportation barges carrying the removed infrastructure will transit to an approved waste processing facility within the EU. The topsides and jacket will be dismantled and split into the appropriate waste fractions, with elements such as marine growth and WEEE separated from ferrous and non-ferrous materials, and recycled where possible.

All onward movements of these materials will be closely tracked to produce a final waste report in support of the decommissioning close out documentation.

Details of the anticipated materials generated by the decommissioning of the Prinos CO_2 Storage facilities are summarized below. An overarching waste hierarchy will be applied during this stage, with reuse being sought before any other options for processing.

As part of the decommissioning of the site it is also important to consider a strategy for dealing with the decommissioned components. This will include recovered steel, copper and glass fibre composites. The proposed strategy will be to re-use and recycle as much material as possible, with a likely target to achieve a 95% reuse and recycle rate.

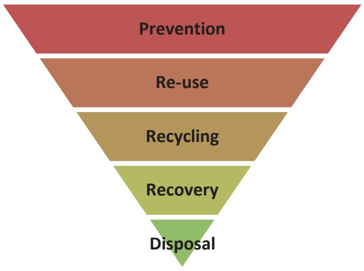
In order to properly manage the post-closure waste from Prinos, a bespoke closure waste management plan will be developed in the period immediately prior to closure which will be in line with the existing Waste Management Plan developed as part of the project’s EIA [ANNEX 16.3]. This will cover how waste generated during decommissioning will be managed, tracked, and disposed of in compliance with legislation, client policies, and best practice, specifically:

- Waste Classification and Characterisation
- Waste Handling & Segregation
- Waste Transfer & Transportation

- Project Specific Waste Treatment, Recycling & Disposal Routes
- Monitoring, Reporting & Record-Keeping
- Roles & Responsibilities

At this stage EnEarth, expect that this management plan will be in line with the existing Prinos Development Approved Environmental Terms, dated 24th April 2018, and adhere to the legislation and noted stakeholders within, including but not limited to:

- Specific emission limit values for pollutant loads and concentrations
- Law 4042/2012 – Greek Waste Framework Law
- Law 4964/2022 (Article 173)



As is best industry practice, waste will be managed, using a 5-tiered hierarchy which prioritises Prevention and Re-use and minimises disposal.

<u>Anticipated Materials</u>

Details of the anticipated materials generated by the removal of the Prinos CO_2 Storage facilities are summarized below. An overarching waste hierarchy will be applied during this stage, with reuse being sought before any other options for processing.

Component	Responsible Party	Materials Anticipated	EU Waste Codes
Alpha Wells	Energean	Iron and steel, NORM, drilling fluids incl. mud and cement.	17 04 05 01 05 xx 01 05 99
Beta Wells			
Alpha Topsides	HEREMA	Iron and steel, Steel with lead-based coating/hydrocarbons, Sludge from separators, Marine Growth, Concrete/Grout, Waste Electrical and Electronic Equipment (WEEE) and batteries	17 04 05 17 09 03 17 01 01 13 05 02 02 02 99 16 02 14 16 06 05
Alpha Substructure			
Beta Topsides			
Beta Substructure			
Alpha-Delta 6” Pipeline	HEREMA	Discharge water, used pipeline pigs, pipeline cleaning chemicals, concrete mattresses, miscellaneous debris	17 04 05 17 01 01 01 05 99 13 08 99
Beta-Delta 6” Pipeline	HEREMA		
Port of Prinos Terminal (Sigma Plant)-Beta 12” Pipeline	Energean		
Alpha-Onshore Power Cable	HEREMA	Plastic and ferrous cable coatings.	17 04 01 17 02 03
Alpha-Onshore Power Cable			

Waste Streams

The materials generated by the closure of the Prinos facilities should be processed using best practices at the time of closure. Current practices are captured below, and included as guidance, but changes may occur in the coming years, another reason why a waste management plan must be revised ahead of facility closure.

Material	Expected Processing
Carbon Steel	All metals will be separated onshore as far as is reasonably practicable using magnets and a combination of mechanical, physical, and sometimes manual separation techniques to ensure that materials can be recycled. Once separated, metals will enter their corresponding supply chain for recycling which will be closely monitored by Energean.
Stainless Steel	
Non-Ferrous Metal	
NORM	Any equipment identified as being NORM contaminated will be isolated, contained and processed and transported for long term storage as per Presidential Decree 91/2017 and under the direction of Greek Atomic Energy Commission (EEAE). NORM will be closely monitored during Well P&A offshore, at weigh bridges and at disposal facilities to minimise spread and only accredited facilities will process the Prinos topsides.
Concrete & Grout	Reuse opportunities for concrete mattresses will be sought, for example use as sacrificial quayside protection and erosion protection. Concrete and grout not suitable for reuse, for example if it is contaminated, will be disposed of accordingly.
Waste Water	Managed inline with existing waste water standards to Ministerial Decision E1b/221/65 “Wastewater Disposal”. This is foreseen as being in line with ANNEX 16.3 of the EIA (Waste Management Plan).
Waste Oils & Lubricants	Any waste oils and lubricants, for example residual diesel from generators or fluids from hydraulic systems, will be transported in suitable containers, with bunding, for onshore processing either via regeneration or energy recovery where possible.
Marine Growth	Marine growth will be separated from the material it is attached to onshore using high pressure jetting and processed accordingly depending on its cleanliness.
WEEE	WEEE will be managed in line with Waste Electrical and Electronic Equipment (WEEE) Regulations (2013) to maximising reuse, recycling, and safe

	treatment. It will be processed at an authorised treatment facility and manually dismantled or mechanical processing to ensure that only non-recyclable residuals pass for disposal.

Waste Processing Operations

After the operations described in Sections 7.2.1 and 7.2.2, transportation barges carrying the removed infrastructure will transit to an approved waste processing facility within the EU. The topsides and jacket will be dismantled and split into the appropriate waste fractions, with elements such as marine growth and WEEE separated from ferrous and non-ferrous materials, and recycled where possible.

After initial dismantling and separation, waste will be sent for further processing to specialist processors.

Waste management for in the region is currently supported by a number of providers, who hold all required certification depending on the waste being processed, and as part of the development of the eventual Waste Management Plan for the project similarly competent contractors will be engaged, audited and eventually selected for each type of waste noted above.

During waste processing, all onward movements of these materials will be closely tracked to produce a final waste report in support of the decommissioning close out documentation, as a complement to the requirements of EU criteria for transfer of responsibility (Guidance Document 3) and HEREMA Guidance & Good Practice.

11. Post Closure Monitoring

Monitoring requirements post closure should be directed towards proving that CO_2 remains contained. It is likely, although dependent on the store operational history, that during the post closure period monitoring will be reduced compared to the injection section of the project. Post closure monitoring includes:

- Verification of the location of the stored CO_2
- Determining whether the CO_2 mass is seeping into the environment
- Providing evidence that the system will behave as predicted in the future

Details of post closure monitoring timings and costs are contained within the Prinos Full Lifecycle Monitoring Schedule (2025), which details EnEarth’s commitment to a 20 year monitoring period post closure and are also detailed below with a summary shown in Figure 17 and Figure 18.

11.1 Environment

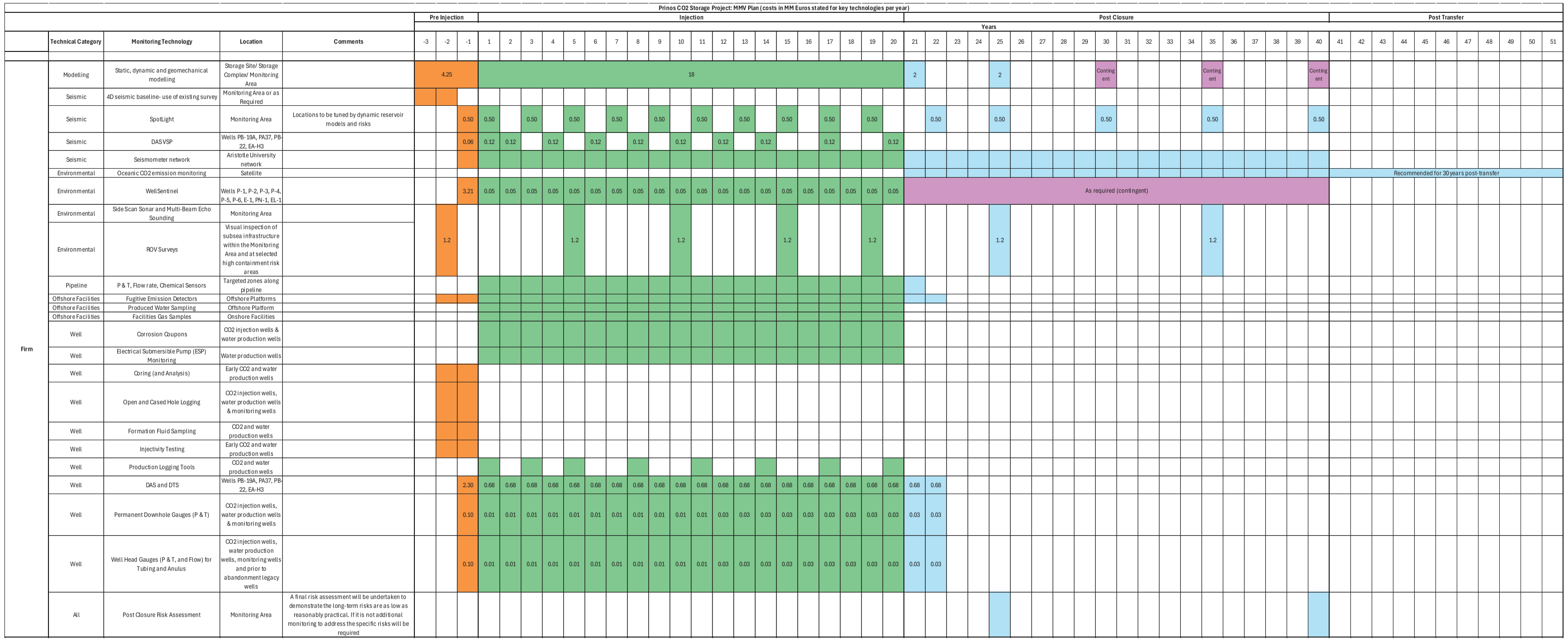
Environmental post closure risks: The Prinos CO_2 Storage project is located in mild and stable marine conditions. Water depths over the Monitoring Area averaging at 30 m, with shallow dips. Environmental monitoring is especially important at Prinos given the project is located within a European protected area (NATURA 2000 GR1150014, **Error! Reference source not found.**), which seeks to protect four species:

- Shag (Mediterranean subspecies) - Phalacrocorax Aristotelis Desmarestii
- Shad - Alosa Fallax
- Common Porpoise - Phocoena Phocoena
- Bottle-nosed Dolphin - Tursiops Truncatus

The Prinos CO_2 Storage project is located 8km west of the tourist destination Thasos. Other domains, pertinent to this MMV, which could be affected by the storage of CO_2 at Prinos include:

- Marine vessels
- CO_2 pipelines
- Offshore facilities:
- Prinos oilfield facilities
- Prinos CO_2 offshore facilities
- Seabed and seawater above potential leak paths

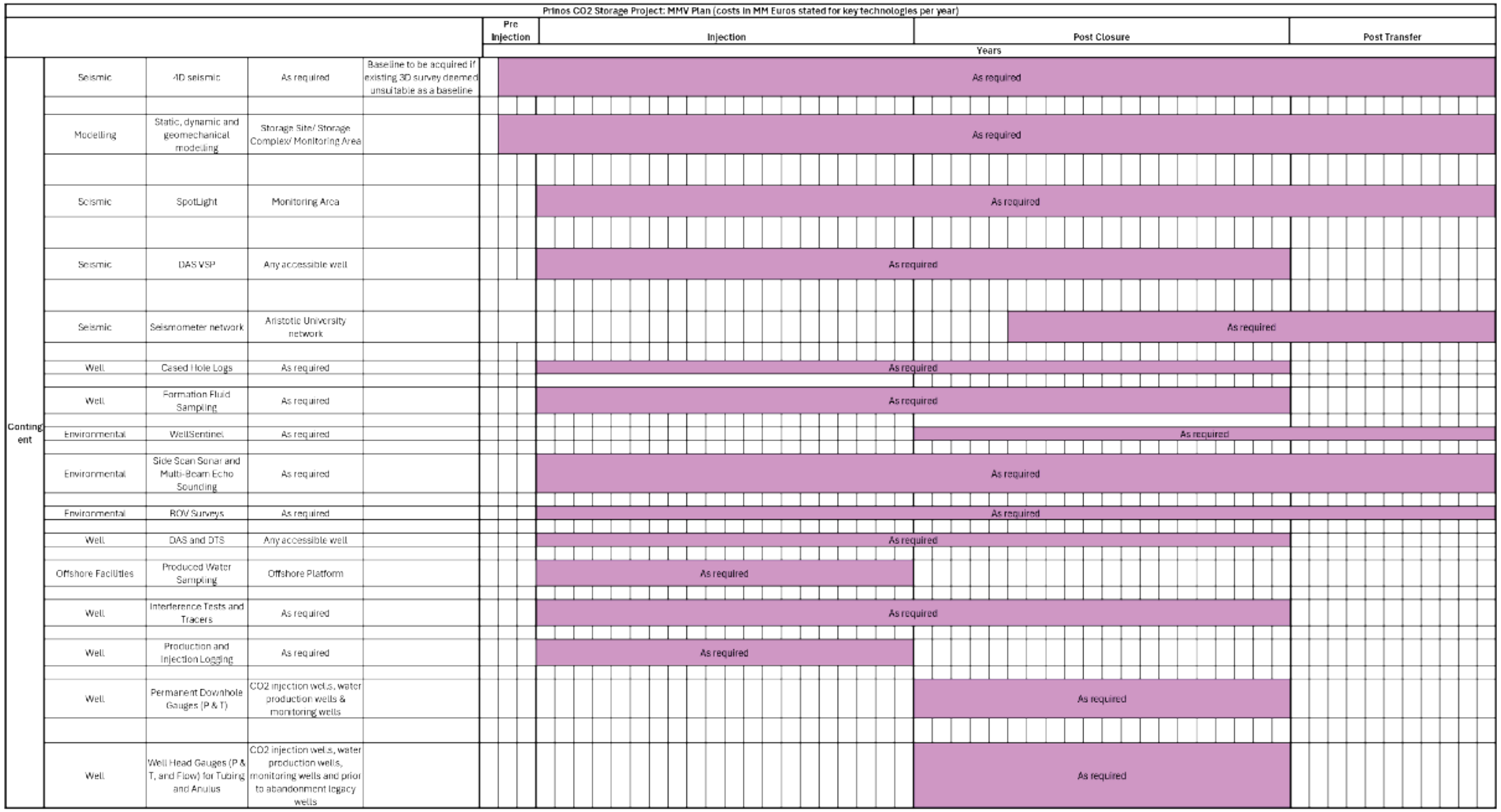
Post closure monitoring: Provided significant irregularities have not been identified by the base monitoring plan during injection operations environmental monitoring will be performed on years 5 and 15 after injection operations have ceased. MBES, SSS and sub-bottom profiling could be applied across the full monitoring area. Additional ROV surveys (including sediment and fluid sampling) will be undertaken at locations of the old exploration and appraisal wells, and any sites where anomalies have been detected during the injection period. These marine based methods will be complemented by satellite monitoring of sea surface and atmospheric conditions.



					Prinos CO2 Storage Project: MMV Plan (costs in MM Euros stated for key technologies per year)																						
					Pre Injection			Injection																			
					Years																						
	Technical Category	Monitoring Technology	Location	Comments	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Firm	Modelling	Static, dynamic and geomechanical modelling	Storage Site/ Storage Complex/ Monitoring Area		4.25			18																			
	Seismic	4D seismic baseline- use of existing survey	Monitoring Area or as Required		🟧	🟧																					
	Seismic	SpotLight	Monitoring Area	Locations to be tuned by dynamic reservoir models and risks			0.50	0.50		0.50		0.50		0.50		0.50		0.50		0.50		0.50		0.50		0.50	
	Seismic	DASVSP	Wells PB-19A, PA37, PB-22, EA-H3				0.06	0.12	0.12		0.12		0.12		0.12		0.12		0.12		0.12			0.12			0.12
	Seismic	Seismometer network	Aristotle University network				🟧	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Environmental	Oceanic CO2 emission monitoring	Satellite																								
	Environmental	WellSentinel	Wells P-1, P-2, P-3, P-4, P-5, P-6, E-1, PN-1, EL-1				3.21	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Environmental	Side Scan Sonar and Multi-Beam Echo Sounding	Monitoring Area			1.2						1.2					1.2					1.2				1.2	
	Environmental	ROV Surveys	Visual inspection of subsea infrastructure within the Monitoring Area and at selected high containment risk areas																								
	Pipeline	P & T, Flow rate, Chemical Sensors	Targeted zones along pipeline					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Offshore Facilities	Fugitive Emission Detectors	Offshore Platforms			🟧	🟧	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Offshore Facilities	Produced Water Sampling	Offshore Platform					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Offshore Facilities	Facilities Gas Samples	Onshore Facilities					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Well	Corrosion Coupons	CO2 injection wells & water production wells					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Well	Electrical Submersible Pump (ESP) Monitoring	Water production wells					🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Well	Coring (and Analysis)	Early CO2 and water production wells			🟧	🟧																				
	Well	Open and Cased Hole Logging	CO2 injection wells, water production wells & monitoring wells			🟧	🟧																				
	Well	Formation Fluid Sampling	CO2 and water production wells			🟧	🟧																				
	Well	Injectivity Testing	Early CO2 and water production wells			🟧	🟧																				
	Well	Production Logging Tools	CO2 and water production wells					🟩		🟩		🟩			🟩			🟩			🟩			🟩			🟩
	Well	DAS and DTS	Wells PB-19A, PA37, PB-22, EA-H3				2.30	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
	Well	Permanent Downhole Gauges (P & T)	CO2 injection wells, water production wells & monitoring wells				0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	Well	Well Head Gauges (P & T, and Flow) for Tubing and Anulus	CO2 injection wells, water production wells, monitoring wells and prior to abandonment legacy wells				0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	All	Post Closure Risk Assessment	Monitoring Area	A final risk assessment will be undertaken to demonstrate the long-term risks are as low as reasonably practical. If it is not additional monitoring to address the specific risks will be required																							

		Post Closure																				Post Transfer										
Technical Category	Monitoring Technology	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Modelling	Static, dynamic and geomechanical modelling	2				2					Contingent					Contingent					Contingent											
Seismic	4D seismic baseline- use of existing survey																															
Seismic	SpotLight		0.50			0.50					0.50					0.50					0.50											
Seismic	DASVSP																															
Seismic	Seismometer network	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦											
Environmental	Oceanic CO2 emission monitoring	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	Recommended for 30years post-transfer										
Environmental	WellSentinel	As required (contingent)																														
Environmental	Side Scan Sonar and Multi-Beam Echo Sounding					1.2										1.2																
Environmental	ROV Surveys																															
Pipeline	P & T, Flow rate, Chemical Sensors	🟦																														
Offshore Facilities	Fugitive Emission Detectors	🟦	🟦																													
Offshore Facilities	Produced Water Sampling																															
Offshore Facilities	Facilities Gas Samples																															
Well	Corrosion Coupons																															
Well	Electrical Submersible Pump (ESP) Monitoring																															
Well	Coring (and Analysis)																															
Well	Open and Cased Hole Logging																															
Well	Formation Fluid Sampling																															
Well	Injectivity Testing																															
Well	Production Logging Tools																															
Well	DAS and DTS	0.68	0.68																													
Well	Permanent Downhole Gauges (P & T)	0.03	0.03																													
Well	Well Head Gauges (P & T, and Flow) for Tubing and Anulus	0.03	0.03																													
All	Post Closure Risk Assessment					🟦															🟦											

Figure 17: Prinos MMV firm monitoring schedule



Prinos CO2 Storage Project: MMV Plan (costs in MM Euros stated for key technologies per year)

					Pre Injection	Injection	Post Closure	Post Transfer
					Years			
Contingent	Seismic	4D seismic	As required	Baseline to be acquired if existing 3D survey deemed unsuitable as a baseline	As required			
	Modelling	Static, dynamic and geomechanical modelling	Storage Site/ Storage Complex/ Monitoring Area		As required			
	Seismic	SpotLight	Monitoring Area			As required		
	Seismic	DAS VSP	Any accessible well			As required		
	Seismic	Seismometer network	Aristotle University network				As required	
	Well	Cased Hole Logs	As required			As required		
	Well	Formation Fluid Sampling	As required			As required		
	Environmental	WellSentinel	As required				As required	
	Environmental	Side Scan Sonar and Multi-Beam Echo Sounding	As required			As required		
	Environmental	ROV Surveys	As required			As required		
	Well	DAS and DTS	Any accessible well			As required		
	Offshore Facilities	Produced Water Sampling	Offshore Platform			As required		
	Well	Interference Tests and Tracers	As required			As required		
	Well	Production and Injection Logging	As required			As required		
	Well	Permanent Downhole Gauges (P & T)	CO2 injection wells, water production wells & monitoring wells				As required	
	Well	Well Head Gauges (P & T, and Flow) for Tubing and Anulus	CO2 injection wells, water production wells, monitoring wells and prior to abandonment legacy wells				As required	

Figure 18: Contingent monitoring schedule for the Prinos CO_2 Storage Project

11.2 Geosphere

Geological post closure risks: Several geology related leak pathways require monitoring as shown in Figure 19.

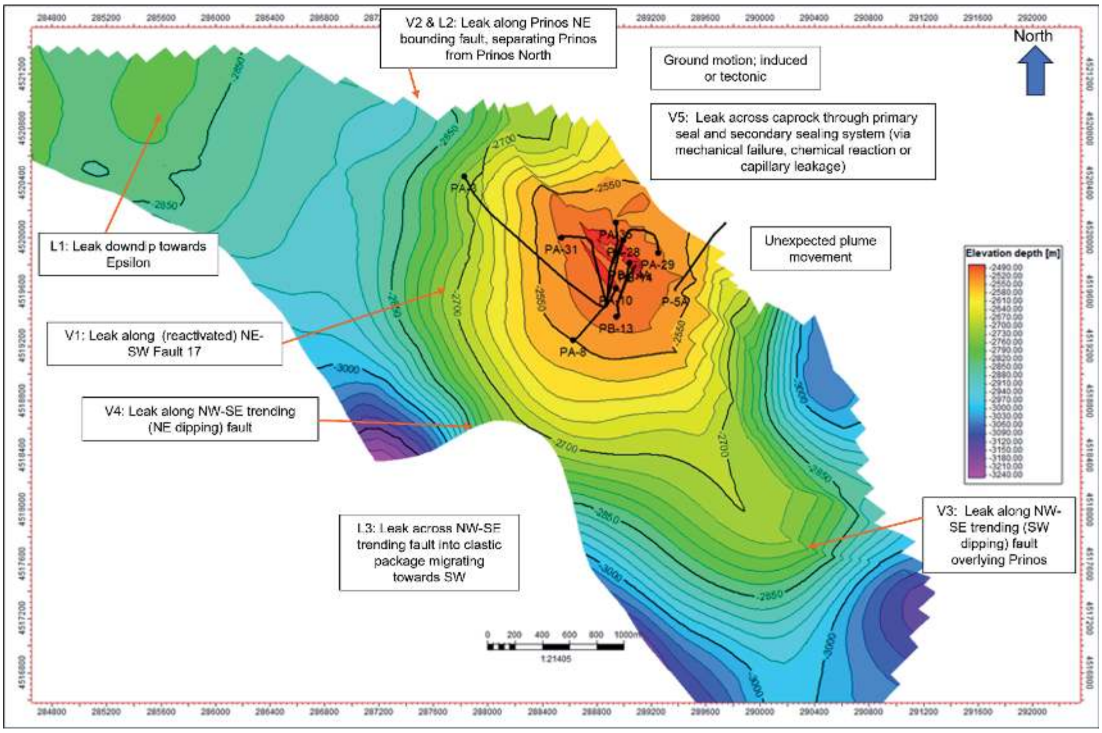


Figure 19: Top Prinos Reservoir A depth map with high risk well bores shown and key geological risks

Post-closure monitoring: Passive seismic observation will be carried out continuously to ensure storage site integrity. If irregularities have not been observed during the project, SpotLight seismic will be carried out through the post closure period at years 2, 5, 10, 15 and 20 as a check on containment and conformance. If irregularities are observed there is the option of using 4D seismic as a tool to help locate and quantify such. Geological, dynamic and geomechanical modelling will provide a relatively inexpensive means of providing assurance with regards to conformance and containment. Natural tectonic activity, which may post a containment threat, can be monitored post closure with access to a seismometer network such as that provided by Aristotle University.

11.3 Wells

Post closure risks:

- **Legacy oil production related wells:** Prinos has been a producing oil field since the early 1980s, and it has multiple penetrations through the caprocks. There are 76 man-made wells in the surrounding area, some of which can potentially create a leak pathway for stored CO_2 to migrate to shallower zones and/or the seabed. The legacy wells are distributed as follows:

a. 35 have or will have suitable barriers for CO_2, including the 23 currently active wells;

b. 29 have at least one verified barrier and are acceptable;

c. 12 are non-compliant and inaccessible, as each of these lacks a cement plug where it is needed to meet current CCS's plug and abandonment practices.

However, 8 of these 12 non-compliant wellbores have been recategorized as low risk. Only the non-compliant wells PA-3, PA-8, PA-10, and PB-13A are considered irregularities in Prinos. However, the historical well records and 40-years of field experience confirm that these wells are fully plugged by scales and asphaltenes. Thus, EnEarth does not consider that these four non-compliant wellbores are ‘significant’ irregularities. A detailed analysis of the legacy wells and its associated risks are described in the Containment Risk Assessment (ref. PRC-CCS-REP-DRI-0002).

CO2 Storage related wells:

- When any new well is drilled into a Storage Complex it disturbs the cap rock(s) and potentially creates a new leak path. Therefore, these wells will be designed, built, operated and abandoned in such a way that leakage risk is minimized. Despite this the potential for a leak to occur in the event of a well failure does remain.

Post Closure Wells Monitoring:

During the period between the end of operations and well abandonment, routine monitoring may continue (during injection, water production and monitoring wells). This may include passive monitoring of the DAS and DTS systems in specific wells, as well as recording the pressure and temperature, both at wellhead and downhole. If necessary, post closure, a contingent monitoring method could include acquisition of DAS VSPs.

The decommissioning schedule will take into account any requirements to utilise any of the downhole sensors (including DAS systems, formation fluid sampling, and cased hole logging) for post closure monitoring. If necessary, cased hole logging and formation fluid sampling can be undertaken prior to decommissioning. While the minimum monitoring period will only be defined based on the models available at the time of site closure, it is anticipated to be several years.

Once barriers have been placed in the wells to isolate the store it is likely that all of the instrumentation used to monitor the wells will cease to be available, although ongoing developments in terms of wireless data transmission and temporary fibre optic installations may allow some form of monitoring to continue. It is anticipated that a key indicator of conformance with the predicted plume behaviour will be a store wide decline in pressure; hence there may be a requirement to retain at least one pressure monitoring point for an extended time after site closure.

The WellSentinel devices that cap exploration and appraisal wells, will initially be left in place until such time as the risk of any releases has declined to a point that they are considered no longer to provide significant benefit.

11.4 Topsides, Substructure and Subsea Infrastructure

Post Closure Risks: Until removal Prinos CO_2 pipelines and offshore facilities could be potential leak paths allowing release of CO_2 into the environment. High pressures, and CO_2 contamination by impurities together with potential accidental damage from external activities and operational incidents are a few of the leakage mechanisms EnEarth have analysed. These must be carefully managed and mitigated to ensure safe CO_2 transportation.

Additional risks include human error, equipment failure, and natural disasters which can cause accidents during construction, operation, and maintenance. The release of CO_2 or other hazardous materials during an accident can pose immediate health risks through inhalation or contact.

Possible CO_2 leakage pathways can be identified along the pipeline via various exposure mechanisms. The high arrival pressure of CO_2 sources namely, combined with the risk of over-pressurization due to equipment failure, pipeline blockage due to impurities accumulation, or operational errors, is a concern, which can lead to pipeline rupture or burst, resulting in CO_2 leakage into the environment. Additionally, pipeline corrosion, can deteriorate the pipeline structure over time, increasing the probability of leaks while mechanical failures, such as material fatigue or weld defects can also contribute to this event by forming weak points in the pipeline that can fail under high pressure conditions.

Post Closure Monitoring

Commencing from the site closure, until the pipelines and other subsea infrastructure are no longer required to contain high pressure CO_2 (e.g. either de-pressurised or flooded) pressure monitoring will continue to enable detection of any anomaly. Similarly, monitoring of any releases from the platform (including any venting) will continue until high pressure CO_2 is no longer present either within the facility and all of the wells have been suitably plugged.

Environmental monitoring of the area in the post-closure phase while infrastructure is being removed will be in line with the existing plans for the decommissioning phase documented in *Environmental & Social Impact Assessment (ESIA) For Prinos Offshore Development Project (Chapter 2).*

Following decommissioning of the platform and removal of debris from the platform safety zone, surveys (sonar and/or ROV) will be carried out to demonstrate that the seabed is free of obstructions. Any subsea infrastructure decommissioned in situ will be monitored in line with any agreements made with the authority with jurisdiction at the time of closure and decommissioning planning.

11.5 Costs

MMV-1: Spotlight

Spotlight has conducted a feasibility study that confirms that the technology is fully applicable to the Prinos field. Based on their commercial proposal, the estimated cost for these services is 0.5 million euros per acquisition per year, inclusive of all associated expenses. Accordingly, one survey is planned for the baseline period, followed by ten surveys during the injection period, conducted every two years, and two additional surveys during the post closure period, scheduled for years 2 and 5.

MMV-2: Silixa DAS/DTS (4 wells)

Similar to Spotlight, Silixa conducted a feasibility study confirming that the DAS/DTS technology is suitable for the Prinos wells and the associated lithological formation. Based on their commercial offer, the installation cost for 4 monitoring wells is estimated at 1.62 million euros. In addition, Silixa charges 0.68 million euros per year for project management and monitoring package lease. Considering these parameters, the baseline OPEX includes one year of data acquisition, while during the injection phase, 20 years of DAS/DTS monitoring are anticipated. For the post closure phase, two years of additional data acquisition are assumed.

MMV-3: Well Sentinel (9 gathering systems)

The cost of each WellSentinel gathering system is €350,000 according to budgetary offers received from initial market assessments. This technology is well established for monitoring abandoned wells from the seabed and has proven to be highly reliable over the years. The above-mentioned value includes the installation fees. In addition, each gathering system carries an annual fee of €6,000 to cover satellite monitoring expenses. The systems will be installed during the baseline and will remain operational during the injection phases of the CO_2 project.

MMV-4: Silixa 4D DAS VSP

Silixa’s feasibility study for the Prinos project also included the application of DAS VSP technology in the monitoring wells to track the integrity of legacy wells. Based on Silixa’s commercial offer, the cost per DAS VSP acquisition is estimated at 0.06 million euros, assuming four monitoring wells. One acquisition is planned during the baseline phase, while 20 additional acquisitions are scheduled throughout the injection period (approximately two per two years), resulting in a total estimated cost of 1.2 million euros.

MMV-5: P/T gauges (facilities and downhole), slickline scope

The purchasing costs are estimated at approximately 0.2 million euros to be allocated prior to the injection phase. Operational costs during the injection period are projected to range between 0.02 and 0.06 million euros per year, consistent with current market benchmarks. Additionally, operational expenses of around 0.06 million euros per year are anticipated for two years following the injection phase. These estimates reflect a thorough assessment aligned with prevailing industry standards, providing a reliable basis for budgeting without committing to fixed figures at this stage.

MMV-6: Update of Subsurface Modelling

This refers to software / hardware and 3rd party expertise to perform updates on dynamic models and reliable forecasts, incorporating all available data. 4.25M€ are assumed to be the costs incorporating all baseline survey data, as well as well data acquired during drilling operations. Additional 1M€ is assumed per year during the injection period to update the models and prove predictability. During the post closure period we assume the dynamic models would be at a maturity level that updates would be sparsely required, thus 4M€ is assumed over the 20 years. The following gives a substantion to the subsurface costs in line with other industry scale projects and guidelines.

Baseline Model Update – Estimated Cost: EUR 4.25 million

Scope:

- Integration of baseline seismic survey and well data into a 3D static model.
- Full reservoir simulation calibration to pre-injection conditions.
- Uncertainty quantification and risk assessment reporting.

The cost basis is taken from benchmarking data from comparable CCS projects which show modelling update costs typically range from $3-5 million for large scale >1MTPA storage projects. Those would include software / hardware and specialized labour to perform updates on dynamic models and reliable forecasts, incorporating all available data. Those upfront costs will reflect and ensure high quality data integration and calibration costs before injection commences.

Operational Period (20 years) – Estimated Cost: EUR 18 million

Scope:

- Annual or biennial model updates incorporating new monitoring data (pressure, microseismic, plume migration, etc.).
- Continuous risk assessment, model recalibration, and regulatory reporting.
- Predictive simulations for plume migration and caprock integrity.

The cost basis for this phase is substantiated from industry benchmarks for monitoring and modelling. The IEAGHG / CLIMIT (2020) – Monitoring and Modelling of CO_2 Storage: The Potential for Cost Reductions is a review of global CCS projects (including Sleipner, Snøhvit, and Quest) and reports that annual monitoring and modelling costs for commercial-scale (~1 Mtpa) projects are typically in the range of USD 1–4 million per year, depending on monitoring intensity and technology mix. refxxx

Post-Closure Model Update – Estimated Cost: EUR 4 million

Scope:

- Integration of final post-injection monitoring data into the static and dynamic models.
- Long-term stabilization simulation and plume containment verification.
- Final reporting to support regulatory closure and transfer of liability.

In line with IEAGHG (2020) best-practice guidance, post-closure activities include at least one comprehensive model update, integration of final monitoring data, and preparation of closure documentation required for regulatory hand-over.

Benchmark analyses indicate that post-closure modelling and reporting typically account for 10–20 % of total MMV expenditures, corresponding to approximately USD 2–5 million for a commercial-scale storage site. The adopted estimate of EUR 4 million for post-closure model updates and documentation is therefore consistent with international CCS cost benchmarks and regulatory expectations under the EU CCS Directive.

MMV –7: Environmental Surveys

Environmental costs estimates were provided by an offer from Inosys. EnEarth plans a dense survey sampling over a 1km2 area, over the structural crest of the Prinos Storage Site with an estimated cost of ~ €600.000. These costs include vessel mobilization and demobilization, field operations (4 days approximately), and data interpretation and analysis. Away from this area, where the risk associated with legacy wells leaks is lower, a less dense sample interval is required. The total cost per environmental survey is estimated to be €1.200.000. One baseline survey is planned before the injection starts, additional surveys will be run on years 5, 10, 15 and 19 during the injection. During the post closure period 2 additional surveys will be done on years 5 and 15.

All the above costs include both the purchase or leasing of the required equipment and the external labour necessary to perform the corresponding services.

5.1.3. Sealing the storage site and removing injection facilities

Decommissioning and closure costs (DCC) of the wells consider all additional costs required to close the site in a CO2-proof manner.

In our initial approach to the development of Prinos CO2, as described in detail in our Environmental and Social Impact Assessment study submitted to the Greek authorities (Ministry of Energy) in August 2024, we foresaw new CO_2 injector and water producer wells l utilizing existing wellbores as donor wells. This is in line with the current standard drilling approach for the Prinos field. In such a context EnEarth holds no responsibility for dismantling, well abandonment, or closure operations associated with these donor wells. These obligations remain with the Greek State under the terms of the existing Prinos oil concession framework and thus all relevant cost is borne by the State. The same applies for monitoring wells where legacy wells will be repurposed as donors through workover operations. These wells will be equipped with all the necessary monitoring equipment to serve their new function. Importantly, the original well design will remain unchanged during this process. Consequently, no costs for P&A are borne by the Operator. Similarly, original planning was to utilize one of the existing well-head platforms (ALPHA or

BETA) to host the wells. Obligations for decommissioning as far as platforms are concerned also lie with the Greek State under the terms of the existing Prinos oil concession framework. At closure, existing platforms shall need to be removed or otherwise repurposed. No costs for platform decommissioning are borne by the Operator.

However, further extensive studies on well trajectories performed over the last year showed that it is preferable to drill the wells from new locations so as to reduce step-out distances and associated risks. Initially, the longest planned wells exceeded 5 km, whereas all wells are now limited to approximately 4 km. This reduction in well length enables the execution of open-hole logging and additional data acquisitions, which will further enhance reservoir evaluation. Discussions with the Ministry of Energy and its Environmental team has further indicated that it is also preferable to separate oil production facilities from the new CO2 project and to this end EnEarth has been encouraged to consider the installation of a new platform. It is expected that the approved environmental terms, when issued, will explicitly refer to a new platform and completely new well locations for drilling injectors and water producers. In such a case the cost for Wells Plugging & Abandonment (P&A) is borne by the EnEarth and is estimated at €21.09 million (4 wells: 2 CO_2 injectors, 2 water producers,; at $5.8 million per well over 23 days per operation, converted at FX rate of 1.1.). The costs presented herein are based on a recent plug and abandonment (P&A) campaign completed earlier this year in Italy. The P&A campaign in Italy was selected as a benchmark, as it closely resembles the planned operations in terms of well design and water depth. Accordingly, a similar type of drilling unit and services is expected to be used. The contingency already incorporated into the P&A costs is 20%. This level of contingency is considered standard practice for well operations, reflecting the typical range applied to account for operational uncertainties and potential variations in subsurface or equipment conditions.

Monitoring Wells will continue to be hosted at existing Prinos wells so that respective P&A are borne by the Greek State.

The decommissioning cost of the new platform under the name of Omega has been calculated as an average €11.81 million which are mainly subcontractor costs and include labour, equipment, materials, logistic services and specialist services. A contingency of 30% added to allow for unexpeced cost overuns and unknowns equates to a total cost €15.35 million The new OMEGA offshore platform will be a minimum facilities 15 slot piled 4 legged wellhead platform, designed in 32 m water depth located approximately 1 km south of the DELTA existing facility Its structural design will be almost identical to the existing ALPHA or BETA platforms, which also serve as wellhead platforms linked to the existing DELTA facility. Decommissioning costs for this type of structure have been based on ENERGEANS latest database costs which are based on current market estimates for project management, engineering, mobilization of heavy lift marine vessels, transport barges, cutting equipment and disposal. Breakdown of costs as follows: Project Management and Engineering 1.14 mil EUR Platform preparations for decommissioning and logistics €0.7 million, Mobilization and demobilization of a minimum 1500te capacity crane barge, €6 million, Cutting and Offshore lifting final surveys and transport operations, €2.97 million, based on an average daily rate of €200K per day, over approximately 15 days. Dismantling and cleanup is estimated as €1 million euros based on similar platforms costs registered in the ENERGEAN database for Italy assets.

The CO2 pipeline connecting the onshore and offshore facilities shall be also removed following the site closure along with all supporting facilities developed by the Operator specifically for Prinos CO2. The cost is estimated at €3.37 million which are mainly subcontractor costs and include labour, equipment, materials, logistic services. A contingency of 30% added to allow for unexpected cost overuns, and unknowns equates to a total cost of €4.38 million. The costs are founded on ENERGEANS database is split into 3 components. Onshore land section for the loading area assuming a pipe header removal, reinstatement of original conditions, 1.01 mil EUR. Pipeline pigging cleaning and chemicals, based on the pipeline remaining buried as per North Sea guidelines, 1.24 mil EUROS, and removal of piping and minor equipment from the existing facilities, 1.12 mil EUROS using a small workforce, and 100te crane barge at 28K per day for 28 days

In a future expansion of Prinos CO2 towards increased injection capacity with additional facilities and additional wells the cost of sealing and removing relevant facilities will be included in Table 3

MMV No	**Technology**	**Baseline** *[MM Euros]*		**Injection** *[MM Euros]*		**Post Closure** *[MM Euros]*	
		Opex	**Capex**	**Opex**	**Capex**	**Opex**	**Capex**
MMV-1	Spotlight	0.50		5.00		2.5	
MMV-2	Silixa DAS/DTS (4 wells)	0.68	1.62	13.56		1.36	
MMV-3	Well Sentinel (9 gathering systems)	0.05	3.16	1.05			
MMV-4	Silixa 4D DAS VSP	0.06		1.20			
MMV-5	P/T gauges (facilities and downhole), slickline scope	0.2		0.76		0.12	
MMV-6	Update of Subsurface Modelling	4.25		18.00		4	
MMV -7	Environmental Surveys	1.20		4.8		2.4	
MMV		6.94	4.78	44.37[1]	0	10.38[2]	
Total MMV cost including 30% contingency		**9.02**	**6.21**	**53.24**		**13.49**	

Table 16: Estimated costings, in millions of Euros, for key Prinos MMV technologies, assuming 20 years of injection. Costs provided by SpotLight, Silixa (DAS/DTS & DAS VSP), Elemental Energies (4D seismic), WellSentinel, and Inosys

A number of assumptions were used in the preparation of the estimates for decomissioning shown in Table 17:

- Only currently available and proven technologies are considered
- The platform topsides and jackets will be removed by a vessel suitable for removing them in line with the methodology described in Section 7.2.1. Piece small removal, at a significantly longer duration, is not covered above.

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[1] This cost refers to the full duration of the storage permit (20 years).

[2] This cost refers to the full duration of the post-closure period (20 years).

- The majority of the facilities will have been mothballed prior to closure and EDC activities will be limited. EDC can occur in parallel with P&A.
- Subsea pipelines will be decommissioned in-situ, with ends cut and remediated.
- All currently accessible wellbores will be abandoned to at least ABN1 standard, with reservoir isolation implemented in accordance with OEUK classification, prior to the anticipated arrival of the CO_2 plume at each respective wellbore.
- Approximately four wellbores will be slot recovered for use as CO_2 injectors or producers. In addition, a number of wells – yet to be determined – will be converted into monitoring wells and subsequently plugged and abandoned (P&A’d) following the injection phase.
- This high-level time and cost estimate for the Prinos CO_2 wells P&A campaign assumes 8 wells split between the Alpha and Beta platforms, with a most likely duration of 20 days per well (240 days total) and a cost of USD 5.8 million per well.

Well Type	No. Wells	Days per Well		Total Days	Cost Per Well (MM USD)		Total Cost (MM USD)
		Range	Most Likely		Range	Most Likely	
Monitor	4	18 - 26	20	80	3.4 – 6.5	5.8	23.2
Injection	2	18 - 26	20	40	3.4 – 6.5	5.8	11.6
Production	2	18 - 26	20	40	3.4 – 6.5	5.8	11.6

Table 17: CO2 Storage Wells P&A time and cost estimate

11.6 Post Closure Corrective Measures

Prior to abandonment of wells and infrastructure the corrective measures remain the same as those referred to in section 9 of the Corrective Measures Plan. After abandonment, when wells become inaccessible, the risks and corrective measures are as follows:

Geological/Subsurface: Vertical or Lateral Flow of CO_2 from the Storage Site

In the event the CO_2 plume behaviour shows a significant irregularity relative to that predicted by the dynamic model, resulting in an increased risk of migration out of the storage site, a number of actions could be taken:

- Carry out targeted data acquisition
- Update models, with latest data, to better understand the plume behaviour
- Update risk assessment
- Consider using unabandoned wells or drilling new wells to act as pressure sinks, to help control the migration of CO_2

In the event of migration out of the storage site, but remaining within the storage complex, a number of actions will be required:

- Update the modelling of plume migration
  - Investigate migration rate.
  - Assess potential for migration to extend outside the storage complex (e.g. become a leak).
  - If required, extend monitoring area to allow ongoing monitoring and verification.

Should there be a significant risk of CO_2 leaking laterally from the storage complex, a full assessment of available mitigations will be carried out.

Flow from Inaccessible Wells

Should there be any irregularity detected that could be indicative of a CO_2 flow in an inaccessible legacy well, a number of actions could be taken to understand the location and magnitude of the flow:

- Triggered monitoring – to understand the location of any flow, including
- Review and update leak rate modeling
- If necessary (e.g. for migration within the storage complex) update dynamic models to determine long term consequences

Once the rate, location and consequence of any flow are understood, select appropriate mitigations. If a significant leak is detected, it may be required to drill an intersect well. Consideration could also be given to using unabandoned wells or drilling new wells to act as pressure sinks to help control the migration of CO_2.

12. Transfer of Responsibility

By the time of the transfer of responsibility, the pressure within the store will be declining and all legacy and CCS wells. This will greatly reduce the possibility for migration or leaks. Assuming an absence of such flows, modelling shows that the risk profile for the store continues to decline as an increasing proportion of the CO_2 becomes permanently sequestered by dissolution and mineralisation.

At present no detailed plans for monitoring in the Post Transfer period have been made. However, should future monitoring be required, it is most likely to take the form of a small number (potentially only one) MBES/SSS survey(s) after several years to post hand-over. These surveys have the potential to detect small streams of leaks and are therefore well suited to confirming that the site is not releasing CO_2 into the environment. Both, the monitoring requirements and associated financial provisions will be reviewed and revised before hand-over to reflect any technological development that could lead to a more efficient and cost-effective solution.

The competent authority will be responsible for carrying out any post-transfer monitoring and verification. EnEarth will (if required) make an appropriate financial contribution to cover the direct cost of any such monitoring and verification for a period of up to 30 years after injection ceases.

12.1 Preparation

Article 18(1)(a), 18(1)(d) and 18(2)(a)-(c) of the Directive relate to the submission of a transfer report documenting that the following conditions have been met:

- All available evidence indicates that the stored CO2 will be completely and permanently contained.
- The storage site has been sealed and the injection facilities have been removed.
- The actual behavior of the injected CO2 conforms to the modelled behaviour.
- There is no detectable leakage.
- The storage site is evolving towards a situation of long-term stability.

Article 18(1)(b) of the Directive states that the post-closure, pre-transfer phase should be up to 20 years, unless the competent authority is convinced that all available evidence indicates that the stored CO2 will be completely and permanently contained before the end of that period.

The primary objective of the monitoring and modelling carried out post closure is to demonstrate permanent containment of the injected CO2 and meet the three conditions listed Article 18(2):

a) The actual behavior of the injected CO2 conforms to the modelled behavior.
b) There is no detectable leakage.
c) The storage site is evolving towards a situation of long-term stability.

12.2 Modelling

12.2.1 Description

During the period of injection operations several models of portions of the CO_2 injection system, the store and surrounding area will have been developed and tuned based on measured data. To ensure compliance with Article 18(2)(a), the competent authority will have been kept informed of any updates made to the models based on data acquired during the life of the store. Prior to site closure confirmation will be sought from the competent authority that the models to be used are considered valid to allow a full understanding of the containment performance of the storage complex. At the time of closure, each of the models will be used to generate a set of predictions regarding how the behaviour of CO_2 in the store will evolve over time and the potential impacts on the surrounding formations.

It is anticipated that as a minimum, the results of both a static geological model and a dynamic model of the storage complex will be maintained throughout the life of the store and kept under review throughout the period from cessation of injection to handover. Following the acquisition and processing of any new geological data or any large deviation from expected behaviour in the dynamic model, the static model will be reviewed and updated, if required. Should significant changes be required to the static model to reflect actual store behaviour (e.g. large changes to the connected pore volume) or reflect newly acquired data the dynamic model will be updated accordingly and a new history match will be generated.

In addition, any other subsurface models used in understanding or predicting the behaviour of the storage complex (e.g. geomechanical and geochemical) will as a minimum be reviewed directly after cessation of injection and again prior to final handover.

12.2.2 Evidence of Conformity

As part of the model review process in preparation for site closure, the conformance behavior to that of the store actual will be assessed. The acceptable margin of conformity between models and observations at the time of site closure will be defined in conjunction with the competent authority once the initial behaviour of the store is understood and key uncertainties better understood. The acceptable margin of conformity between models and observations may differ across the storage complex, with larger margins being applicable away from the CO2 plume. Provisions will also be made to revise the acceptable margins in the event other activities in the area (including any with potential hydraulic communication to the storage complex) are deemed to present a threat to conformance.

In a mature field like Prinos, the key parameters in the static model are clearly understood and are expected to remain significantly unchanged throughout the life of the store. However, larger changes to the model may be required in the aquifer where there is currently less data available. The data acquired during the construction and operation of the store should allow these parameters to be better understood, resulting in narrower ranges of uncertainty to be utilised.

A history matched dynamic model of the store (including historic hydrocarbon production data) will be available and have been tested by comparing to measured data under different scenarios. It is anticipated that large volumes of data will be available for history matching including pressure and rate data from all injection and production wells.

The validity of the model should be demonstrated by means of a combination of:

- Predictions from a range of start points to timesteps later in the store life.
- Backcast predictions from near the end of injection to several prior dates using the actual injected and produced volumes.
- The ability to match store behaviour without significant changes.

The changes made to the model and the resulting projections during the injection and post closure periods will be made available to the competent authority prior to the transfer to verify that the model has been able to match recent store behavior without significant changes to either the static geological model or the dynamic model derived from the static model.

Significant model changes can alter the understanding of the storage complex in terms of containment performance, plume development, geochemical or geomechanical behaviour in a way that could potentially invalidate previous risk assessments. This does not include the use of tuning parameters (including, but not limited to permeability, porosity, elastic properties or rock strength properties) in ways that do not substantially alter the understanding of the performance of the storage complex or its risk profile. Examples of significant changes could include introduction of previously unidentified leakage pathways or trapping mechanisms.

The need to recalibrate static and dynamic models to achieve an adequate history match should reduce over time as further data is acquired and the models become more mature. Ideally the need to re-calibrate should be eliminated or reduced to small changes to tuning parameters before site closure. GD#3 proposes that “the static geological model should remain significantly unchanged for 5 years prior to transfer”, with the 5 year period potentially starting before closure.

12.2.3 Model Projections

Modelling projections to demonstrate that the CO2 will remain within the storage complex throughout the modelled time period will be provided to HEREMA, these will be including evolution of the trapping mechanism (move towards mineralisation). If any of any of the model realizations run indicate a significant risk of future leakage further work will be done prior to transfer in order to further understand the source and cause of the projected leakage with a view to allowing these realizations can be rejected with confidence.

12.2.4 Model Documentation

Documentation in the form of periodic reports on the development and history matching of the models for the storage site will be maintained throughout the life of the project. These reports should incorporate an assessment of the predictive capability of the models and the impacts of model changes on the risk of leakage and the long-term stability of the store. These reports will include

- How monitoring data has been collected and interpreted, including measurement errors and confidence intervals for all monitored parameters
- How site-specific geological models and the associated geomechanical, geochemical and flow simulation models have been calibrated through history matching and other adjustments
- How site performance has evolved relative to the predictions, based on available monitoring data. This could include:
    - Injection pressures and volumes at each CO2 injection well.
    - Production pressures and volumes at each water production well.
    - Any production of CO2 or hydrocarbon associated with water wells.
    - Measured pressures throughout the storage complex (flowing and shut in).
    - Evolution of the CO2 plume.
    - Updates to the understanding of geochemical reactions in the storage complex.
    - Changes to processes within the storage complex that impact the security of storage.
    - Any observed earth deformation and seismicity.
    - Estimated fractions of injected CO2 trapped by the various mechanisms, i.e. structural buoyancy trapping, residual saturation trapping, dissolution, mineralisation and adsorption.
- Detailed assessment of any realization that suggests a risk of significant leakage, including any work done (e.g. additional modeling or monitoring) to demonstrate why the realization can be rejected

12.3 Absence of any Detectable Leakage

A key aspect of containment is that there is no detectable leakage from the storage complex, including leakage through geological or man-made pathways (as described in GD1). The rate of leakage that is considered to be ‘Detectable’ will be dependent on the leak path and the technologies deployed at the time, as per the Prinos Full Lifecyle Monitoring Schedule (2025, or later editions).

It is acknowledged that all monitoring technologies have limitations in terms of spatial and temporal resolution and sensitivity to changes. However, it is envisaged that technological improvements during the life of the store will improve the sensitivity of leak detection. Therefore, the post closure aspects of the monitoring plan should updated and approved as part of the site closure process in line with Article 17(3)(a) and (c).

While it is the objective of the monitoring and corrective measure plans to detect and stop any leaks from the store and the associated infrastructure, the potential for leakage post-closure exists. In the event any leakage is detected either during the injection period or post closure, prompt actions will be taken to remediate and prevent recurrence. As set out in GD3 there is anticipated to be a period of 10 years with no detected leakage before the time of transfer. The start of this period may be either the verification of the last corrective measure taken, or the start of injection (in the event no leaks are detected). In the former case EnEarth may present a case for a shorter in the event of a leakage event associated with a well, where it can be demonstrated that the likelihood of recurrence is suitably low

Specific metrics for determining the absence of leakage from the storage complex are set out below; pending approval by the competent authority, in consultation with other stakeholders (as appropriate).

Metrics applicable for the absence of detectable leakage:

- Well integrity (development and legacy wells):
    - All well abandonment activities completed.
    - No well integrity issues.
- Overburden monitoring – all formations above the storage complex:
    - No evidence of unexpected pressure.
    - No changes to seismic response.
    - No other changes in measured parameters associated with leaks from complex.
- Conformity monitoring:
    - No detection of CO_2 plume beyond the defined storage site.
    - Conformance with modeled behaviour.
- Biosphere monitoring:
    - No detection of CO_2 above expected natural levels a seabed.

The absence of leakage will be demonstrated based on a combination of pre-project baseline and data acquired throughout the injection period and the post closure period to final transfer. The area to be monitored, applicable techniques and monitoring frequencies are set out in the Monitoring Measurement and Verification Plan.

12.4 Evolution Towards Long-Term Stability

Evolution towards long-term stability of the stored CO2 as described in Article 18(2)(c) will be demonstrated by

- Modelling of continued evolution of the storage complex for an extended period (in excess of

1,000 years) does not show any significant risk of future leakage of CO2 or negative effects on human health or the environment. Modeling will take into consideration:

  - Dispersion of remaining CO2 plume.
  - Pressure influence from the storage project.
  - Geochemical reactions.

- Key monitored parameters being within predetermined ranges.
- A trend towards future stable values (as predicted by modelling).

Sensitivity studies exploring alternative model realizations will be performed, with appropriate checks made to ensure that any model realizations indicating possible leakage are improbable. This will include future evolution of the CO2 plume, with particular emphasis on locations that represent potential future leakage pathways (e.g. legacy wells without verified barriers) and geochemical reactions with wells or formations that might have a material impact on the risk of leakage. It is envisaged that pressure in the injection zone will generally be on a declining trend after injection has ceased, which implies a reducing leakage risk.

The key parameters for assessing evolution towards long-term stability based on the currently available technologies are:

- Pressure within the storage complex (while physical monitoring via wells is possible).
- Movement of the CO2 plume (as demonstrated by seismic and / or well monitoring).
- Long term integrity of materials used to construct or seal the wells (laboratory research).

If any leakage resulting in a requirement for corrective measures is detected during the life of the project, any potential impacts on long term stability will be assessed in terms of the possibility of recurrence and impacts on the long term status of the store after transfer.

12.5 Transfer Report

The likely requirements for the transfer report are set out in Table 1, of GD#3, with the documentation required to demonstrate “evidence for complete and permanent storage” as defined Article 18(1)(a) being defined in 3 categories (Table 18):

- The model compliance criteria (Section 12.2).
- No detectable leakage for over 10 years (Section 12.3).

Evolution towards long-term stability (Section 12.4).

In addition to the documentation listed in Table 18, the transfer report will provide a summary of the geological storage activities that have taken place in the storage complex. This is likely to include the following items (based on Chadwick et al., 2006 and ISO 27914):

- A narrative history of the storage site activities, including site characterisation, construction, operation, any corrective measures, and monitoring.
- A final storage complex characterisation report, including reference to the final static and dynamic models as transferred, and a description of historical storage performance relative to iterative predictions from modelling and simulations.
- Quantification of the modelled contribution of the various trapping mechanisms to deliver permanent containment.

- Final project risk database showing how risk scenarios have evolved throughout the project, including a description of the reasons for upgrading or downgrading risks;
- Summary of results and conclusions drawn from monitoring, modelling and risk assessments to help demonstrate that the criteria for transfer of responsibility have been met,
- Proof that wells have been abandoned appropriately and injection facilities removed.

Evidence for complete and permanent storage	**Expected Execution Duration**
Conformity with models	1. For at least a continuous 5-year period immediately before the transfer, there has been no need to significantly change the 3D static geological model assumptions for the characteristics of the storage complex during history matching exercises incorporating parameters monitored at regular intervals. 2. Demonstration that backcast and forecast predictions obtained using the final history-matched dynamic models are consistent with observed behaviour, where any observed discrepancies do not impact confidence in storage security
Absence of any detectable leakage	For at least a continuous 10-year period immediately before transfer, show that: • integrity of all wells (monitoring and injection) remains without any leaks or unexpected deterioration or damage; • monitoring data based on the approved monitoring plan indicates that there is no leakage.
Evolution towards long-term stability	The models project stability of any remaining CO2 plume within the storage complex. • Key monitored parameters are within a predetermined range of the future stable values.

Table 18: Required documentation in transfer report (from table 1, in GD#3)

12.6 Minimum Period for Post-Closure Monitoring

Article 18(1)(b) of the Directive states that the post-closure, pre-transfer phase should be at least 20 years, unless the competent authority is convinced that all available evidence indicates that the stored CO2 will be completely and permanently contained before the end of that period. By the application of careful planning and appropriately targeted monitoring, to demonstrate compliance with:

- The model compliance criteria (Section 12.2).
- No detectable leakage for over 10 years (Section 12.3).
- Evolution towards long-term stability (Section 12.4).

It is currently the intension of EnEarth to seek a shorter (but as yet undefined) post-closure, pre-transfer phase. The planned duration of this phase will be defined prior to site closure in conjunction with the competent authority taking into account the anticipated:

- Rate of the evolution of containment risk over time.
- The effect of modelling and monitoring on constraining any residual leakage risk.

A final risk assessment will be undertaken to demonstrate that the long-term risk to containment of the

CO_2 is as low as reasonably practical. As part of the same process the provisional post-closure plan will be reviewed in full prior to closure.

12.7 Site sealing and removal of injection facilities

The preparation of the final post-closure plan at the time of site closure should include a full review of the plans described in Sections 7, 8 and 9 to ensure that the storage site is sealed and injection facilities removed. On completion of the review the plan will the presented to the competent authority for approval prior to implementation. Following completion of the planned de-commissioning activities adherence to the plan will be used to demonstrate that the site has been properly sealed including:

- Any well under the responsibility of the operator which penetrates the storage complex, or which has been identified as a CO2 migration risk, is sealed using appropriate best practices and materials.
    - Permanent sealing of wells will include consideration of geochemical reactions and geomechanical effects that could have an impact on the integrity of well materials.
    - Legacy wells with either be permanently sealed or otherwise shown to present a negligible risk of leakage.
    - Wells to be used for post-transfer monitoring may be excluded from this requirement
- Removal of the injection facility:
    - Elements of the facility may be maintained in order to continue monitoring beyond transfer.
    - Facilities that will not be used post-transfer monitoring will be removed and the areas remediated.

Where any activities conducted are not as per the final plan or new information is recorded regarding the sealing of the site, these will be recorded in the transfer report.

12.8 Transfer of Data and Models

EnEarth will transfer a copy of all relevant data about the site and the models used in the post closure period to the competent authority. The full scope of the data transfer will be subject to agreement at the time, but is likely to include:

- Physical samples from throughout the life cycle of the project
    - Core
    - Cuttings
    - Construction materials (potentially to include those used in laboratory assessments)
- A selection raw data gathered during the construction and operation of the store
    - Seismic
    - Well logs
    - Pressure data
    - Injection / production data
    - Environmental monitoring

- A selection raw data gathered during the time period from site closure to transfer
    - Seismic
    - Well logs
    - Pressure data
    - Environmental monitoring
- All raw and processed data from a time period of at least 10 years prior to transfer pertinent to demonstrating the absence of any detectable leakage
- Reports
    - The transfer report (as described in Section 12.5)
    - Reports detailing all de-commissioning and remediation activities
    - Any reports pertinent to future monitoring or development close to the storage complex
- Models
    - Final full storage complex static model (including overburden)
    - Final full storage complex dynamic model
    - Any additional models used to demonstrate Evolution towards long-term stability (as described in Section 12.2)

It is recognized that some of the data in the proposed transfer may be duplicates of information provided to the regulator during the operation of the store. Where there is any ambiguity or uncertainty regarding the relevance of any data or model it will be included in the transfer. As part of the transfer report a clear statement will be provided of all changes to static geological model (whether deemed significant or not) for a continuous period of at least 5 years prior to handover. In addition, the models prior to the application of the changes will be made available to the regulator

At the present time there are no specific provisions on data retention and ownership in the CCS Directive or within Greek Statutes. Therefore, it is the intension of EnEarth to, as a minimum, retain data in accordance with existing Energean oil and gas policies; pending clarification of the requirements.

13. Plan Implementation and Reporting

All of the information presented regarding post closure activities is provisional, dependent on a number of conditions being met and the actual assets installed to support the CCS activities. In particular, that the storage of CO_2 in the Storage Site does not exhibit any significant anomalies at the time of closure or in the post closure monitoring period. Should any significant anomaly be detected during this period, additional contingency data acquisition may be required as set out in the Measurement, Monitoring and Verification Plan. Should such data indicate a significant leak, actions may proceed as described in the Corrective Measures Plan and actual conditions.

13.1 Store Status Plan

The activities set out in the plan are based on a set of boundary conditions as laid out below:

1. A total of not more than 57 Million tonnes of CO_2 storage capacity as per CPR 2024.
2. A maximum pressure in the store at the end of injection significantly below the estimated formation fracture pressure.
3. No significant irregularities detected either at the end of injection or during post closure monitoring:
    - CO_2 in the store behaving in accordance with dynamic models.
    - No leaks or unexpected migration paths are observed for CO_2.
    - No flow of brine into the environment from legacy wells.
4. No other storage takes place in the formations hydraulically connected with the store
5. Extraction of hydrocarbon in adjacent fields has ceased and all wells been de-commissioned
6. Access to the surface locations is maintained for
    - Monitoring methods described in the MMV.
    - Corrective measures.
    - De-commissioning activities.

13.2 Reporting

During the Post Closure period the reporting and data retention will continue as set out in the MMV. It is anticipated that a full set of models, processed data and resulting reports from throughout store life and the post closure period will be made available as part of the process required to facilitate responsibility for the store being transferred to the regulator. This may be in addition to (not in place of) any documentation required as part of the transfer process (e.g. the Transfer Report).

13.3 Updating the Plan

The Prinos CO_2 Storage Post Closure plan will be regularly updated to take account of changes to the store development plans. In addition, should significant changes be identified in assessed risks to the environment or human health; or improvements made in the best available technology. The Post Closure plan may also require updating if significant deviations from predicted behaviour of the injected CO_2 are identified.

13.4 Inspections

Inspections (both routine and non-routine) by the competent authority are required under Article 15 of the CCS Directive. It is anticipated that (as a minimum) such inspections will be carried out at least once a year until three years after closure, and every five years until transfer of responsibility to the competent authority has occurred. The purpose of these inspections is to check and promote compliance with the CCS Directive and to monitor the effects on the environment and on human health.

EnEarth will cooperate fully with all requests for inspection. Inspection activities may include site visits, auditing of record-keeping, evaluations of risk assessments, static and dynamic models, and monitoring plans to ascertain that there are no negative effects to the environment or human health.

13.5 Data Ownership

It anticipated that EnEarth will retain ownership of all data and models associated with the storage complex (and Permit) up to the time of transfer, However, where deemed appropriate to further the development of the carbon storage industry data may be shared either within the industry or more widely published in the period of time between site closure and the transfer of responsibility. Post transfer the ownership of the models and data will transfer to HEREMA, who will thereafter, become responsible for the ownership of any proprietary information in line with intellectual property and commercial competition rules.

13.6 Review

While it is the intention of EnEarth to proactively review and update the Post Closure plan it is recognized that HEREMA may seek updates to the plan at any time if they deem it necessary. The impact on post closure obligations of any changes to the legal framework or guidance documents (including, but not limited to those from HEREMA, the Greek government and the EU) will be assessed and the plan updated accordingly. Should no update be made for a period of five years a review will be conducted to ensure continued alignment with the storage development plans, MMV plan and Corrective Measures plan.

14. References

- DIRECTIVE 2009/31/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the geological storage of carbon dioxide
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- Prinos Full Lifecyle Monitoring Schedule. 2025. Excel spreadsheet detailing the MMV schedule, costs and monitoring parameter thresholds
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- Prinos CO_2 Storage Project Risk Assessment, 2025. Produced on behalf and with EnEarth, by Elemental Energies
- Wild Well Control. 20265. EnEarth_Prinos_ Intervention Well Feasibility Study_RevA_2025-135_12Jun25. Produced on behalf of EnEarth

15. Appendix 1 – Definitions

A list of general definitions which relate to wording used in this document are listed below.

Capacity the total mass (or equivalent volume at reference conditions) of CO_2 stored within a given site.

Caprock Geological formation(s) overlying the Storage Site or Complex that effectively restricts upward migration of CO_2 or charged CO_2 formation fluids. The caprock should have sufficiently low permeability to ensure ‘permanent containment’ of $CO_{2.}$

Closure means the definite cessation of CO_2 injection into that Storage Site.

Conformance refers to the consistency between the actual behaviour of injected CO_2 and the modelled forecast.

Containment Permanent containment means that injected CO_2 will be effectively trapped by trapping mechanisms in perpetuity, within the Storage Complex. describes the long-term security related to permanent CO_2 storage within a Storage Complex.

Corrective measures mean any actions, measures or activities taken to correct significant irregularities, or to close leakages in order to prevent or stop the release of CO_2 from the Storage Complex.

CO_2 plume means the dispersing volume of CO_2 within the Storage Complex.

Geological storage of CO_2 means permanent storage in underground geological formations.

Hydraulic reservoir means a hydraulically connected pore space where pressure communication can be measured by technical means and which is bordered by flow barriers, such as faults, salt domes, lithological boundaries, or by the wedging out or outcropping of formation.

Leakage means any release of CO_2 from the Storage Complex.

Migration means the movement of CO_2 within the Storage Complex.

Overburden The overburden is the lithostratigraphic volume of rock overlying the storage reservoir up to the surface or seabed.

Post-closure means the period after the closure of a Storage Site.

Seals In the context of geological storage this term is often used interchangeably with Caprock.

Significant irregularity means any irregularity in the injection or storage operations or in the condition of the Storage Complex itself, which implies the risk of a leakage or risk to the environment or human health.

Storage Complex means the Storage Site and surrounding geological domain which can influence overall storage integrity and security; that is secondary containment formations.

Storage Site means a defined volume area within a geological formation used for the geological storage of CO_2 and associated surface and injection facilities.

Surrounding area means the surface and subsurface area surrounding the Storage Complex where leakage or negative effects on the environment or human health are realistically possible.

16. Appendix 2 – Acronyms and Abbreviations

A list of general Acronyms and Abbreviations which relate to wording used in this document are listed below.

Term / Acronym / Abbreviation	Definition
DAS	Distributed acoustic sensing
DTS	Distributed temperature sensing
FIT	Formation Integrity Test
MBES	Multi beam echo sounder
MMV	Measurement Monitoring and Verification
MSAD	Minimum safe abandonment depth
OEUK	Offshore Energies UK
P&A	Plugging and abandonment
ROV	Remotely operated vehicle
SSS	Side scan sonar
TVDSS	True Vertical Depth Sub Sea

ANNEX IV

PRINOS CO_2 STORAGE

Corrective Measures Plan

EnEarth

10th October, 2025

Prinos CO_2 Corrective Measures Plan

Contents

1. Introduction

Corrective measures are actions, measures or activities taken to correct significant irregularities, e.g., close leakages to prevent or stop the release of CO_2 from the storage complex. Corrective measures are part of the overall risk management process that is intended to ensure the safety of geological storage and to manage the risks from leakage during the project life cycle. Corrective measures will be taken if a significant leak (or the potential for one developing) is identified (as defined in the Containment Risk Assessment, ref. PRC-CCS-REP-DRI-0002), but may not be required for other more minor irregularities.

The overall approach for corrective measures is closely linked to the risk management plan of the complex. Corrective measures within Prinos aim to be:

- Risk based; linked to identified risks from the site and complex characterisation (and risk assessment) and subject to the limitations of available technologies
- Specific to the storage site and complex
- Closely linked to monitoring plans and monitoring, including identifying triggers for use of corrective measures by identification of leakage or irregularities
- Suitable for use to address significant leaks from identified leakage pathways and specific leakage mechanisms out of the storage complex and any leakage to the surface
- Suitable for use when other types of significant irregularity are identified
- Ready to use at the start of injection

The Risk Management Plan, MMV, and the Corrective Measures Plan are interdependent. These documents are also supplemented by the Irregularly Response Plan. The deployment of corrective measures is required in the event of a significant leak and may be required for other significant irregularities, detected through monitoring results, the interpretation of monitoring data, or inspections.

Monitoring plans are designed to allow for early detection of CO_2 seepage or minor leaks so that additional monitoring can be triggered, if required, to better understand the situation and monitor any deterioration, and appropriate corrective measures applied if warranted by the situation. In addition, monitoring will be used to assess the effectiveness of corrective measures, and additional monitoring activities may be required in the event of any leakage or significant irregularities. The planned monitoring for the Prinos store is detailed in the MMV report (EnEarth Prinos CO_2 Storage MMV, 2025). The corrective measures are specific to the actual leakage or significant irregularity, taking account of the precise location, nature, and the specific situation and circumstances in which the leak occurred.

The interaction of the monitoring and the Corrective Measures Plan (CMP) is illustrated in Figure 1 below.

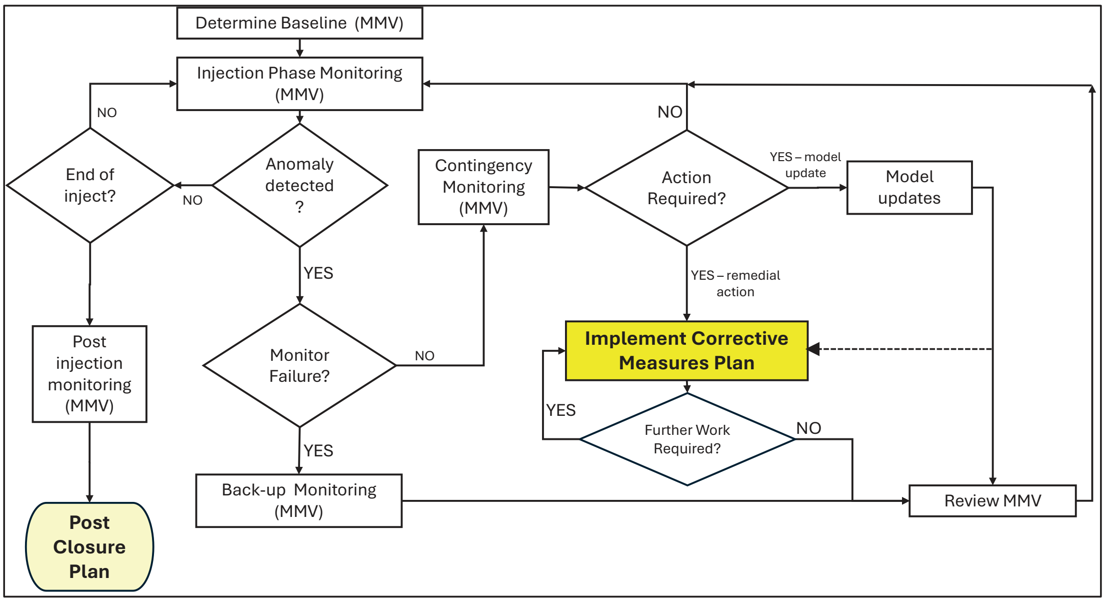


Figure 1: Interaction between monitoring process and corrective measures plan

This report documents EnEarth’s Corrective Measures Plan (CMP) for the Prinos Carbon Storage project.

2. Legislative Context

This CMP plan is designed to meet the regulatory requirements set out by the CCS Directive 2009/31/EC of the European Parliament and of the Council, Article 16:

1. Member States shall ensure that in the event of leakages or significant irregularities, the operator immediately notifies the competent authority, and takes the necessary corrective measures, including measures related to the protection of human health. In cases of leakages and significant irregularities which imply the risk of leakage, the operator shall also notify the competent authority pursuant to Directive 2003/87/EC.

2. The corrective measures referred to in paragraph 1 shall be taken as a minimum on the basis of a corrective measures plan submitted to and approved by the competent authority pursuant to Article 7(7) and Article 9(6).

3. The competent authority may at any time require the operator to take the necessary corrective measures, as well as measures related to the protection of human health. These may be additional to or different from those laid out in the corrective measures plan. The competent authority may also at any time take corrective measures itself.

4. If the operator fails to take the necessary corrective measures, the competent authority shall take the necessary corrective measures itself.

5. The competent authority shall recover the costs incurred in relation to the measures referred to in paragraphs 3 and 4 from the operator, including by drawing on the financial security pursuant to Article 19.

The plans should be updated, as appropriate, as part of the storage permit review required under Article 11 of the CCS Directive.

3. Prinos Store and Complex Description

3.1 Prinos Carbon Storage Development Summary

The Prinos CO_2 Storage project will use the partially depleted Prinos oilfield for CO_2 storage (Figure 2). The project is located within the Prinos-Kavala basin, in the northern Aegean Sea (in water depths of ~30 m), between the Greek mainland (18 km to the north) and the island of Thasos (8 km to the east).

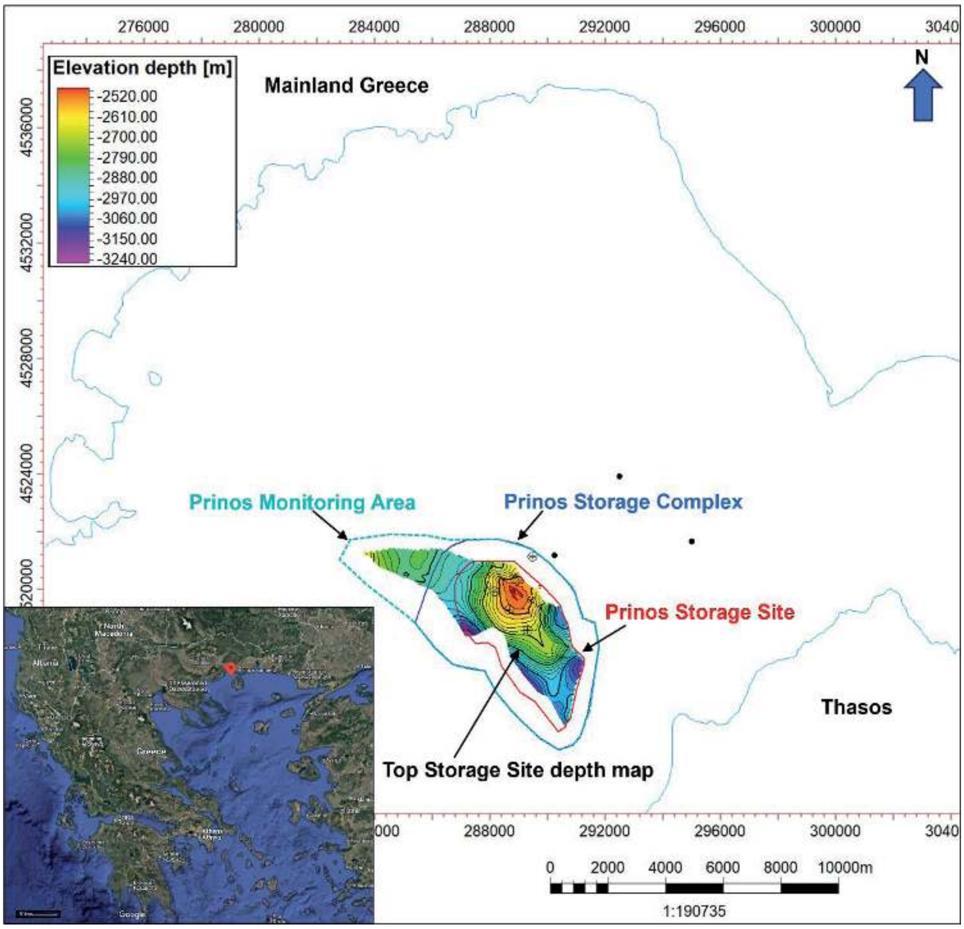


Figure 2: Prinos Carbon Storage development location map, with top storage site depth map (m) overlay

The Prinos oil field was discovered by the Prinos-1 well in 1973 and was appraised by 5 further wells between 1974 and 1977. Oil production started in 1981 and continues today. 76 well penetrations were drilled from the Prinos Alpha and Beta offshore platforms into the reservoirs which will be used for storage. Several smaller hydrocarbon accumulations located within 2 to 4km of the main Prinos field have also been discovered (Prinos North, Epsilon, Zeta, and Delta). Prinos North has been partially developed and Epsilon produces oil, via extended reach wells drilled from the Prinos platform infrastructure. The smaller Zeta and Delta discoveries have not been appraised following initial exploration well tests. The mapped Alpha prospect has yet to be drilled. The South Kavala depleted gas field lies ~12 km southwest of the Prinos oilfield.

Given the new injectors and water producing wells are currently planned in locations downdip of the Prinos oil field, data will be collected from these in-order to refine reservoir property estimates away from existing geological control points. Early CO_2 storage development wells should also acquire geological information in the Storage Site overburden to complete the existing dataset and improve monitoring.

EnEarth's current development plans are to:

- **Development Scheme 1 (Phase 1):**
  - 4 wells: 2 injectors + 2 water producers, all possible sidetracks from the Prinos Beta platform, using existing water processing infrastructure
  - First years inject into B and C reservoirs, while the A reservoir continues to produce oil
  - 10 years later the A reservoir oil shuts down and the CO_2 is injected everywhere, including the A, B, and C reservoirs. These assumptions also apply to water production
  - Up to 1MPTA capacity, averaging 0.5MPTA per well, with a maximum of 0.7MPTA per well
  - New pipeline + receiving terminal onshore
- **Development Scheme 2 (Full Scale Capacity Phase):**
  - 15 wells: 6 injectors and 9 water producers
  - All new wells to be drilled from a new platform
  - First years inject into B&C reservoirs, then addition of the A reservoir. Same for water production.
  - Up to 3 MPTA, averaging at 0.5 MPTA per well, with a maximum of 0.7 MPTA per well
  - New additional platform for the new water processing infrastructure + new pipeline + receiving terminal onshore.

A phased approach will allow for geological data, gathered in the new wells, to be integrated into the store development plan to optimise or adjust it as required. The total CO_2 storage capacity for the Prinos CO2 project is 18 MT. The targeted flow rates are an average injection rate of 0.55MTPA and a maximum of 0.7MTPA per well, with 9000 bpd of water production per well. Given the reservoir pressure and temperature conditions during injection, CO_2 will be in a supercritical state in the store.

During Phase 1 the existing Prinos oilfield infrastructure will be used as the host facility for CO_2 related wells. An offshore normally unmanned installation dedicated to hosting CO_2 offshore infrastructure is to be installed above the Prinos Storage Site for Phase 2.

CO_2 will be injected in locations downdip of the existing Prinos oilfield wells. Additionally, water will be produced from the reservoir to help manage pore pressure in the Storage Site and ensure operation within safe limits.

Formation water will be produced at via new producers drilled into the water leg downdip of the field's crest to relieve pressure build up and ensure operation within safe limits to prevent geomechanical problems. Timing of the cessation of Prinos oil production will be decided by the operator of the oil development in synergy with the conversion to CO_2 Storage and enhanced oil recovery effects will be avoided.

3.2 Prinos Carbon Storage Site, Storage Complex and Monitoring Area Definitions

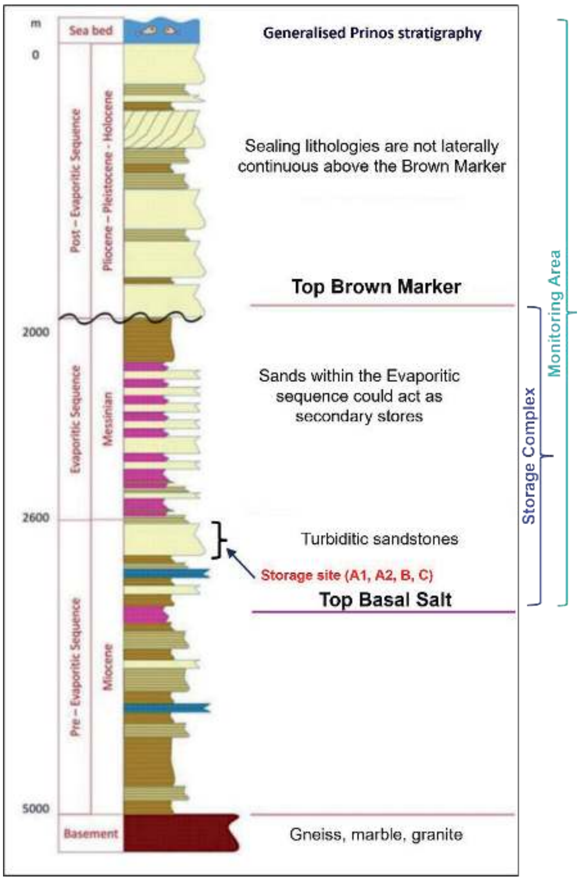


Figure 3: Generalized Prinos stratigraphy, and the vertical extents of the Prinos storage site, complex and monitoring area

Prinos Storage Reservoirs: CO_2 will be injected and stored within the Miocene Pre-Evaporitic sequence, specifically the turbiditic reservoirs known as A1, A2, B and C (Figure 3).

Storage Site: The Storage Site is a defined volume within a geological formation used for the geological storage of CO_2, and a defined area covering the associated surface and injection facilities (European Commission Guidance Document 1, 2024). The Prinos Storage Site consists of the Storage Reservoirs (Pre-Evaporitic Sequence A1, A2, B & C Miocene sands) and includes all wells and surface infrastructure within the red polygon shown in (Figure 2). The Storage Site boundaries have been agreed between HEREMA (Hellenic Hydrocarbons and Energy Resources Management Company) and EnEarth based on the maximum extent of the injected CO_2 plume in the reservoir throughout the project lifecycle, trap geometry, spill points, lithology changes and bounding faults.

Primary Caprock: A Caprock is a geological formation overlying the Storage Site or Complex that effectively restricts upward migration of CO_2 or charged CO_2 formation fluids. At Prinos the Primary Caprock this is defined as the lowermost section of the Messinian Evaporitic Sequence, consisting of a claystone approximately 20 m thick, overlain by the Lower Main Salt (LMS) (100 m thick).

Secondary Caprocks: Overlying the Primary Caprock, within the Storage Complex, a sequence of salts interbedded with clastics, capped by mudstone, belonging to the Evaporitic Sequence is present. Some of these salts and claystones form Secondary Caprocks, providing additional safeguards, in the event of migration from the Storage Site.

Storage Complex: The Storage Complex is defined stratigraphically as between the Top Basal Salt, below the storage reservoirs, to the top of the Brown Marker (Figure 3). It includes the Primary Caprock as well as the Secondary Store and caprocks above the storage site. Any permeable units within the storage complex could be additional secondary storage units, although they are not injection targets. The extent of the Prinos Storage Complex is highlighted by the blue polygon shown in (Figure 2). EnEarth have agreed the vertical and lateral extend of the storage complex with HEREMA.

Surrounding Area: This is the surface and subsurface area surrounding the Storage Complex where leakage or negative effects on the environment or human health are realistically possible. A risk assessment (EnEarth Prinos Risk Assessment, 2025) has been carried out to assess the significance of risks and inform on the extent of the Storage Complex and surrounding area.

Monitoring Area: The Storage Complex and Surrounding Area encompass the Monitoring Area. The extent of the Prinos Monitoring Area is highlighted by the dashed cyan polygon shown in (Figure 2), which includes the Epsilon field accumulation.

3.3 Geological Characterisation and Expected Plume Behaviour

3.3.1 Reservoirs

Storage Site

The Storage Site consists of four stacked Miocene sandstone packages; A1, A2, B and C (Figure 3). Core descriptions suggest that the reservoir sandstones consist of a series of stacked/amalgamated high to very high-energy turbidite flows, separated by low to very low-energy mud-dominated flows. The storage reservoirs consist of a mix of channel and distal fan turbidites, deposited during basin subsidence.

Petrographic interpretations show that reservoir A1 contains moderately well sorted, mostly medium grained sandstones. Reservoir A2 contains alternations of structureless, fine laminated sandstones with medium grained and moderately well sorted sandstones. Reservoir B is characterized by structureless sandstones with grain size typically being medium to coarse sand. As with A2, the B reservoir has several thin sandy claystones layers. The sandstones of the C reservoir are mainly poorly sorted, very coarse-grained with some conglomeratic intervals. Vertical connectivity is low between stratigraphic reservoirs with correlated horizontal barriers interpreted between A, B and C reservoirs.

The combined average thickness of the Storage Site reservoir is 285m TVT. Depth to Storage Site crest is 2450 m TVDSS, with the deepest section of the Storage Site located at 3566 m TVDSS. Net to gross ranges from 69 to 76%, while net porosity ranges from 7-20% (average 14%). Permeability averages at 250mD but can be up to 6000 mD (Table 1).

The Prinos field produces an undersaturated, sour crude (27-29° API gravity) with high sulphur content (from 30% of the gas phase in the B and C reservoirs to 60% of the gas phase in the A reservoirs), wax, and asphaltene content. CO_2 is also present within the crude (2.02% at well PB-13). The B and C reservoirs are lower Net to Gross and more heterogenous than the A reservoirs. ~80% of the produced oil originated from the A reservoirs. Well P-1 on drill stem test (DST) flowed at 2950bopd, under restricted conditions.

The A, B and C reservoirs are separate and have three different OWCs (2711, 2751 and 2791 m TVDSS respectively), with sealing claystones between each of the reservoirs. There is no evidence for the three reservoir zones exhibiting vertical communication with several pieces of evidence supporting this: different depletion levels, varying oil qualities, different pressure gradients and three distinct oil-water contacts. Laterally there is also evidence of fault compartmentalization; the north-eastern section of the crest is isolated from the rest of the field (Figure 4Error! Reference source not found.). The Prinos reservoirs do not exhibit a well-developed and connected natural fracture system. However, there is some evidence of deformation bands which could work as baffles to flow.

The Prinos Field is partially depleted by production, indicating a lack of pressure support from the aquifer, and necessitating the use of water injection to remain above bubble point pressure and support oil production. A similar pressure response is shown at the Epsilon field, again indicating a closed system. This and seismic interpretation suggest that the oil field and aquifer system is closed.

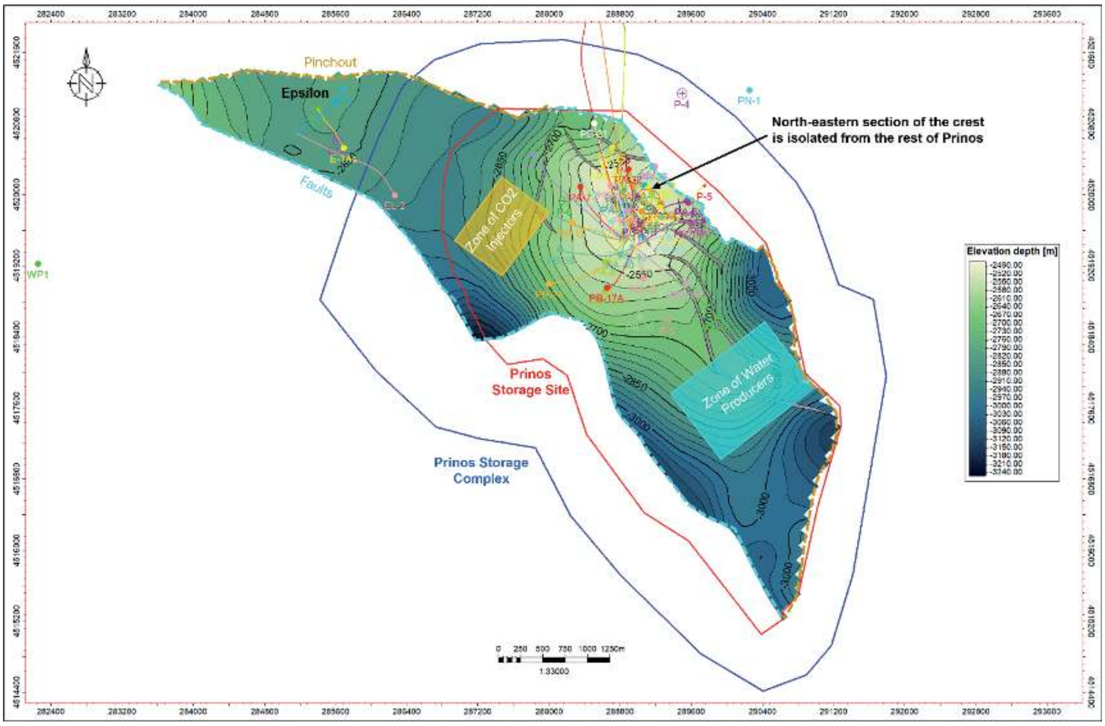


Figure 4: Top Reservoir A depth (m) map showing the extent of the Prinos aquifer and al. Boxes denote areas where CO_2 Injector and water producer wells are likely to be located

Reservoir	Area	Average Gross Thickness (m TVT)	Depth Range (m TVDSS)	Average Porosity (PU)	Average Perm (mD)	Pressure at Injection Start, Crestal (psia)	Temperature at Injection Start, Crestal (˚C)
A1	Storage Site	62	2482-3186	0.166	291	4083	110
A2	Storage Site	81	2553-3382	0.141	196	4269	115
B	Storage Site	42	2652-3457	0.13	106	5024	125
C	Storage Site	55	2714-3566	0.134	561	4867	130

Table 1: Average Storage Site properties

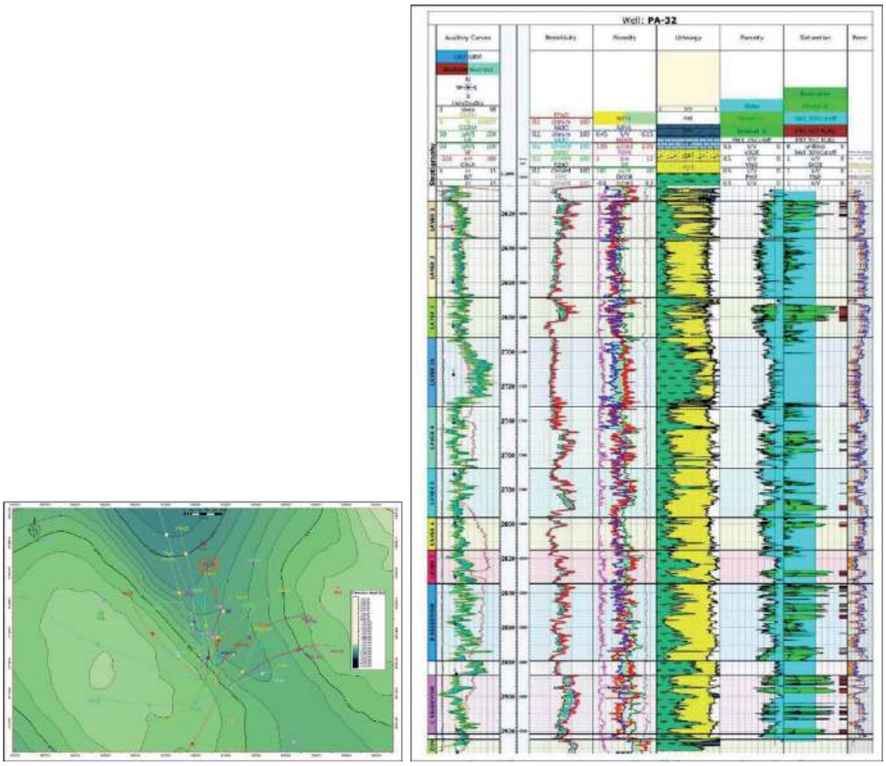


Figure 5: Example computer processed interpretation (CPI) from well PA-3. Well location shown inset on a map of Top Brown Marker depth.

Expected Plume Behaviour

CO_2 will be injected in the super-critical phase and remain in this phase while contained in the Storage Site. CO_2 will be in contact with oil, water, and rock. CO_2 will be stored, principally, under four trapping mechanisms:

- Structural and stratigraphic trapping
- Residual trapping due to relative permeability and capillary pressure imbibition-drainage hysteresis
- Solubility trapping – CO_2 will be trapped dissolved in reservoir fluids.
- Mineral trapping.

Injectors are currently planned to be located west of the Prinos field, while water producers will be to the south-east of the field (Figure 4). The exact number of CO_2 injection and water production wells will be defined during the post-FID detailed design phase.

During CO_2 injection some oil production from Prinos could be on-going. To mitigate against CO_2 leaks, CO_2 injection and oil production will not be from the same reservoirs with the CO2 Storage project being split into two phases:

- **Phase 1:** Simultaneous Oil Production (to be confirmed) and CO_2 Injection: To minimise the risk of CO_2 leaks, oil production should be restricted to the A Reservoir while CO_2 injection and storage will be limited to Reservoirs B and C. Crossflow through legacy wells should be monitored.

- **Phase 2:** Oil Production Cessation: CO_2 will be injected and stored within all Prinos A, B and C reservoirs.

Injection will commence in the water legs of reservoirs B and C. Simulations show that CO_2 will migrate updip towards the field’s crest following the roof of reservoirs B and C. These are stratigraphically isolated from each other although there is a risk of crossflow through legacy wells with open perforations. Once the CO_2 reaches the Prinos oilfield, the CO_2 front is likely to sweep oil and act as a solvent, stripping volatile hydrocarbon fractions and leaving behind low saturations of heavy residual oil.

In Phase 2 of the CO_2 Storage project additional perforations will be added to the CO_2 injectors in the A1 and A2 reservoirs. Simulations show that CO_2 will accumulate within the structural highs of each of the Prinos reservoirs, while some will dissolve slowly within the water leg as injection continuous.

Water production wells will extract water to the south-east to prevent excess reservoir pressure build-up and protect Storage Site seal integrity. The water offtake is likely to act as a pressure sink and spread towards the water production wells. CO_2 in the form of carbonic acid may eventually reach these water producers. This will be accounted for in the well design, monitoring, and management.

A narrow and depleted fault block located north of the field’s crest (Figure 3) is shielded from the CO_2 plume due to a fault acting as a barrier. Wells in this part of the Prinos field are unlikely to see the CO_2 plume.

The Epsilon oilfield wells will not be exposed to the CO_2 plume. The B and C reservoir units are not in communication between the two oil fields, while the A reservoir may have some hydraulic communication through the aquifer (uncertain), thus potentially an increase in pressure in the A zone of Epsilon field may be observed, as the Prinos structure is pressured up.

Epsilon currently produces oil through a single extended reach well (from the Prinos Alpha Platform). The Epsilon oil field reservoirs are within the upper Pre-Evaporitic Sequence, in the same interval as those of Prinos. The field has three oil reservoirs separated by claystones and each with individual OWCs. The total STOIIP is estimated to be 82MMbbls, with low recovery (<1%) to date. Epsilon produces lighter, compared to Prinos, undersaturated sour oil with 2-3% CO_2 and H_2S of 8-14% mole in gas. The Prinos North oilfield is currently still producing but is located updip of Prinos, in an isolated compartment and will not be affected by CO_2 storage activities.

Storage Complex

Emergence and shallowing, in association with the Messinian salinity crisis, occurred after the deposition of the Prinos Turbidites. The Storage Site is unconformably overlain by a thick succession of over-pressured salts (halites and anhydrites) and interbeds of claystone, siltstone, and sandstone clastic rocks, known as the Evaporitic Sequence. These clastics could form secondary storage intervals in the event of migration from the Storage Site.

The uppermost reservoir of the Evaporitic Sequence is known as the “Brown Marker”. This is a thick succession of tan-coloured, marls, sands, anhydrites, and claystones which represent a deepening and/or a renewed connection to the open Mediterranean at the end of the salinity crisis event. The top of the Brown-Marker is the upper limit of the Storage Complex and considered as the MSAD (Minimum Safe Abandonment Depth) at its shallowest depth.

The Storage Complex extends below the Storage Site down to the top of the Basal Salt. This under-burden section consists of interbeds of claystone, siltstone, limestone, and sandstone which will require monitoring for containment assurance.

Overburden

The Post-Evaporitic sequence (Figure 3) is of Pliocene to Pleistocene in age. This section contains permeable sands, with occasional silt and clay layers (which are difficult to correlate regionally). The lower Post-Evaporitic sequence is marine dominated while towards the top of the Post-Evaporitic interval sediments were deposited by a prograding delta that was fed by the palaeo Nestos River. A transgression led to the deposition of marine clastics above this sequence. There are no continuous seals or caprocks within this interval.

3.3.2 Trap

The Prinos CO_2 storage project makes use of the same trapping mechanism as the oilfield; three-way dip closure onto an updip fault. Depth to Storage Site crest is 2450 m TVDSS, while the deepest section of the Storage Site is located at 3566 m TVDSS. Within the tectonic setting of the Prinos basin, the Prinos and Epsilon fields are structural traps located in the hanging wall of an intra-sedimentary low angle listric fault, with flat-ramp-flat geometry, and were formed as submarine extensional wedges due to unstable sliding. The Storage Site is situated on the southerly, down-thrown side of a NNW-SSE listric fault. NW-SE trending normal faults crosscut the Storage Site (Figure 4**Error! Reference source not found.**). It is possible that sands within the Evaporitic Sequence could form secondary CO_2 stores in the event of migration from the Primary Store from the primary Prinos storage site.

3.3.3 Caprocks

The Primary Caprock consists of a claystone (approx. 20 m thick) overlain by a sequence of evaporites known as the Lower Main Salt (approx. 100 m thick), which is crosscut by relatively few faults. The Storage Site updip lateral seal (Figure 4) is provided by fault juxtaposition, reservoir against the lower Pre-Evaporitic sequence. This sequence consists of siltstones, claystones, thin limestones, and conglomerates. To the east the Storage Site is defined by stratigraphic pinch-out, while to the south-west faults seal the Storage Site. The north-western boundary of the Storage Site is defined by the spill-point towards the Epsilon oilfield. Seismic mapping, drilling, and reservoir development data all suggest the Prinos aquifer is a closed pressure cell system, and not open-ended.

Oil production, pressure history and calibrated dynamic simulation suggest that the claystones between each of the four reservoir reservoirs can also be considered as sealing. However, Prinos oilfield experience demonstrates that there is some potential for crossflow between reservoirs through legacy wells with open perforations.

The Primary Caprock is overlain by claystones and impermeable, creeping salts within the Evaporitic Sequence (700-1000 m TVT) which could provide additional storage complex containment integrity. Above the Storage Complex limit, regional seals have not been identified.

The Prinos Evaporitic Sequence Sealing Potential study indicates that active creep in the Evaporitic Sequence, in particular across the Lower Main Salt is taking place, which is in line with field experience. The Lower Main Salt likely to be an excellent caprock because of its layer thickness, homogeneity and depth – which drives the closure stress at the cement interfaces. Halite has a closure stress approaching the overburden gradient, of the order of 2.1 SG.

4. Wells in the Storage Complex

EnEarth (2024) has undertaken a hazard identification study on legacy, current wells, and future CO_2 injection wells. This evaluated the integrity status of each penetration within the Prinos field that could be exposed to CO_2 and pressure. The evaluation involved systematic analysis of historical records to identify barriers, placement, and verification practices. It is supplemented by a third-party report produced by Stag Geological Services (add reference), which indicates that the annulus pathways for most wells are sealed by the creeping movement of the overlying salt cap rock. Please refer to the Risk Management Plan – Containment (ref. PRC-CCS-REP-DRI-0002) for further details.

4.1.1 New Wells

The current storage development plan involves the drilling of new wells for both CO_2 injection and water production. The wells will have prolonged operating lives and be exposed to a combination of a corrosive environment and cyclical loading (temperature and pressure). While these wells will be designed to minimize any risk of downhole failures, leading to a leakage risk, it cannot be completely eliminated.

In addition to the risk of leakage, corrective measures may be required to repair or replace downhole components associated with monitoring or downhole safety valves. In the case of the water production wells the use of ESPs is likely to introduce an additional failure risk.

5. Loss of Containment and potential consequences

Prinos is a depleted oil field that is uniquely positioned for carbon storage. However, as with any Carbon storage complex, it is *not* improbable that CO_2 could seep out of the storage site. The mechanisms that could conceivably lead to migration or seepage, and ultimately leakage to the atmosphere, include uncontrolled injection, equipment failure (e.g., wells), fault activation due to pressurisation, or geochemical reactions between the CO_2 and the caprock.

If any significant leakage were to occur through any pathway, then the main advantage of geological storage (removal of the CO_2 from the atmosphere) would have been eroded. However, if it can be demonstrated that any seepage, which may result in leakage, can be simply and cost-effectively remediated, then the risk can be managed.

Corrective measures are part of the overall risk management process designed to ensure the safety of geological storage and to manage the risks from leakage during the project life cycle. The following subheadings outline the remediation options for the most likely leakage scenarios in the Prinos storage complex in the remote event that seepage of CO_2 occurs. It should be noted that in the unlikely event of a leakage or significant irregularities, the competent authority will be notified with the approved corrective measures plan and the obligation to implement the corrective measures plan. Please refer to the Risk Management Plan – Containment (ref. PRC-CCS-REP-DRI-0002) for further details.

5.1 Potential Seepage Paths

The potential subsurface seepage paths for CO_2 in Prinos are depicted in Figure 6**Error! Reference source not found.**, noting that the main failure mechanism that could conceivably lead to CO_2 seepage is equipment failure, specifically legacy wells - Path #4. Since the storage site is geologically stable and structurally confined, containment can be monitored, and any required remediation is feasible compared to other sites with no structural closure.

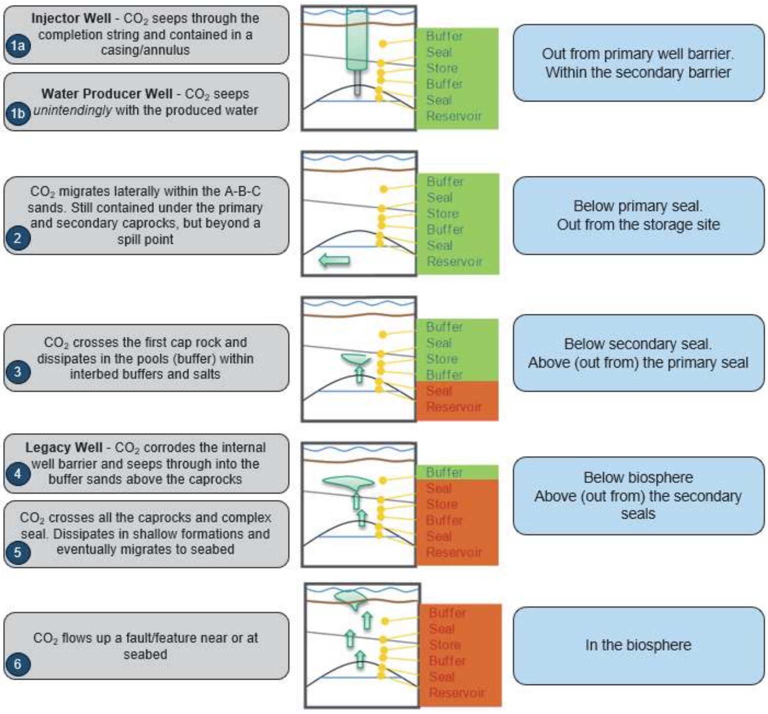


Figure 6: Potential CO_2 Seepage Paths

6. Summary of Site-Specific Corrective Measures

The corrective measures plan is closely linked to the risk assessment and monitoring plans for the Prinos storage complex. The results of the risk assessment can be found in the site risk assessment report (EnEarth –Containment Risk Assessment, ref. PRC-CCS-REP-DRI-0002). A summary of the risks and the associated level of risk is detailed in the following tables, with a list of the planned detection techniques and the relevant corrective measures. The corrective measure plans are included in more detail in section 8.

Containment Risks: Geological **Detection and Corrective Measure Summary**		**Initial Score**	**Post Evaluation Score**	**Corrective measure**
SS1	Vertical migration of CO2 out of storage site along Fault 17 (#V1)	2	2	Change injection/production strategy
SS2	Vertical leak of CO2 out of storage site along NE Prinos bounding fault (#V2)	2	2	Change injection/production strategy
SS3	Vertical leak of CO2 out of storage site along NW-SE trending fault (SW dipping) (#V3)	4	4	Change injection/production strategy
SS4	Vertical leak of CO2 out of storage site along NW-SE trending fault (NE dipping) (#V4)	2	2	Change injection/production strategy
SS5	Migration through site caprock - faults and fractures	2	1	Change injection/production strategy
SS6	Migration through site caprock -failure due to thermal effects	2	1	Change injection/production strategy
SS7	Migration through site caprock - due to fractures caused by drilling ECD	2	1	Change injection/production strategy
SS8	Structural spill out of the site across saddle towards Epsilon Field (#L1)	6	6	Change injection/production strategy
SS9	Lateral leak across NE bounding fault into Prinos North (#L2)	3	3	Change injection/production strategy
SS10	Lateral leak across NW-SE trending (SW dipping) (#L3)	4	4	Change injection/production strategy
SS11	Vertical CO2 leak out of secondary storage and complex	4	4	Change injection/production strategy
SS12	Lateral CO2 leak out of secondary storage and complex	6	6	Change injection/production strategy

Table 2: Summary of geological containment risk, irregularity detection methods and corrective measures

It is clear from the site characterization studies and risk assessment for the Prinos field that the risk of loss of containment of CO_2 from the store through a geological pathway is low. A monitoring plan has been designed to allow for early detection of any significant deviation from the planned site response so that early intervention can be taken through corrective measures to prevent escalation of the situation and reduce risks associated with leakage from the storage complex.

Containment Risks: Legacy Wells **Detection and Corrective Measure Summary**		**Initial Score**	**Post Evaluation Score**	**Last Resource Corrective measure**
W1	Barrier Degradation due CO2 on a Low-risk Inaccessible Legacy Wells	6	3	Drill intersect well and set new plug
W2	Barrier Degradation due CO2 on a Low-risk Accessible Legacy Wells	6	3	Workover well to set new barrier
W3	Barrier Degradation due CO2 on a Tolerable-risk Legacy Well	12	4	Drill intersect well and set new plug
W4	Barrier degradation on tolerable semi-accessible E&A wells	12	6	Re-entry to set new barrier
W5	Barrier degradation on non-compliant semi-accessible E&A wells P-5A	8	4	Re-entry to set new barrier
W6	Barrier degradation on non-compliant inaccessible wells PA-28 and PA-35	8	3	Re-entry child wellbore to set new barrier
W7	Barrier degradation on non-compliant inaccessible well PB-14 and PB-14A	8	3	Re-entry child wellbore to set new barrier
W8	Barrier degradation on non-compliant inaccessible well PA-29	8	3	Drill intersect well and set new plug
W9	Barrier degradation on non-compliant inaccessible well PA-31	8	6	Drill intersect well and set new plug
W10	Barrier degradation on non-compliant inaccessible well PB-13	8	6	Drill intersect well and set new plug
W11	Barrier degradation on non-compliant inaccessible wells PA-3, PA-8, PA-10, and PB-13A.	16	6	Drill intersect well and set new plug

W12	CO2 Seep with uncertain seeping source from an inaccessible wellbore	16	4	Drill intersect well and set new plug
W13	CO2 Seep with uncertain seeping source from an accessible wellbore	6	3	Workover well to set new barrier
W14	Ability to re-enter an inaccessible legacy well once a CO2 seep is identified	12	6	Drill intersect well and set new plug

Table 3: Summary of legacy well containment risk, irregularity detection methods and corrective measures

From the assessment of the integrity of the legacy wells in the Prinos field, it is evident that a risk of loss of containment of CO_2 from the store through the legacy wells exists, as it is the case in any CCS project with legacy wells. A monitoring plan has been designed to allow for early detection of any flow within the legacy wells so that additional data gathering and appropriate corrective measures can be undertaken to prevent escalation of the situation and reduce risks associated with leakage from the storage complex.

The new infrastructure required for carbon storage operations (e.g. facilities and wells) will be designed for CO_2 service, with the wells utilizing a minimum of two independent barrier envelopes. The design methodology to be employed will take service conditions into account throughout the design process, with a key objective being to minimize the risk of any loss of containment. In the case of the wells the design will include the provision to carry out remedial work on a compromised barrier, while maintaining the safe containment of the injected CO_2.

Continuous monitoring will be implemented throughout the new infrastructure to allow for early detection of any deviation from the predicted behaviour. In the event that any deviation is identified early intervention will be taken to prevent escalation of the situation and reduce risks associated with leakage from the storage complex.

7. Corrective Measures Feasibility Study

7.1 Drilling Intercept Wells

The feasibility of intercepting and subsequently safely plugging and abandoning the inaccessible legacy wells in Prinos as a corrective measure in the event of a significant leakage was investigated by Wild Well Control, who are a specialist and industry leader in the field.

This method relies on a relief-type well. Serious well integrity failures necessitating deep intersection wells are comparatively infrequent among the numerous wells drilled globally each year. However, its underlying method is 100% effective when a leak has developed, and it is a recognised corrective measure plan for source control.

A full feasibility report is available covering the planning, design, drilling and abandonment of an inaccessible legacy well using an intercept well. The report includes, but is not limited to:

- Well Trajectory Design
- Ranging Technology
    - Active Ranging - Downhole Current Injection
    - Active Ranging - Rotating Magnet Ranging
    - Passive Magnetic Ranging
- Milling Technologies
- Well Re-entry
- Barrier Placement

7.2 Feasibility Study

As part of the Storage Permit Application, Section 1.g, EnEarth systematically analysed the presence and condition of the natural and man-made pathways, including wells and boreholes, which could enable leakage pathways.

The legacy well integrity assessment identified 12 well bores that lacked the cement plugs needed to comply with current industry plug and abandonment practices for carbon storage

For the study, three intercept wells, were selected in order to ascertain the feasibility of the intercept well strategy. The wells were selected to demonstrate that even the most challenging wells were feasible, therefore the findings and recommendations will be applicable to all the twelve well bores that have been identified.

The following sections are extracts from the full feasibility report to demonstrate the methods and technologies that would be used in the low likelihood event that an intercept well would be required.

Inaccessible wells PB14 & PB14A have been used to demonstrate the process on how an intercept well would be planned, drilled, stop a leak and safely abandon the well.

7.2.1 Minimum Safe Abandonment Depth (MSAD)

The MSAD has been identified by the subsurface team as being the Brown Marker formation. Cement abandonment plugs set below this formation will be against cap rock formations with sufficient strength to contain the reservoir pressures post CO_2 injection.

7.2.2 Intercept Well Trajectory Design

The existing legacy well trajectories are reviewed in conjunction with the inaccessible well casing/tubing architecture and the optimal location for the intercept well to target is identified. After the target is known, the inaccessible well trajectory is then designed.

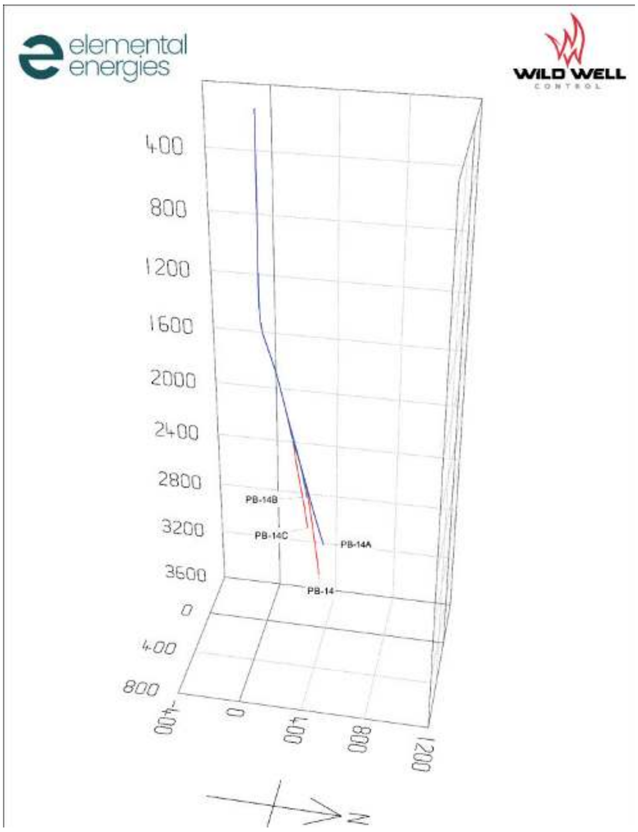


Figure 7: Prinos Beta slot 1 wellpaths

7.2.3 Modelling Distances

The planned intercept well path is inputted into the directional drilling software to identify the proximity to other legacy wells in the field. This information in conjunction with the available access to legacy wells is used to aid selection of the most suitable ranging technologies.

The graph below shows the proximity of the new intercept well path, along its length, to existing wells in the field that are close to the planned well path. These are shown as a “centre-to-centre separation” distance between the two wells and the “measured depth” is from the intercept well path.

In this example, the intercept well exits the legacy well at ~1650 m and re-enters deeper down at ~2100 m where access is possible.

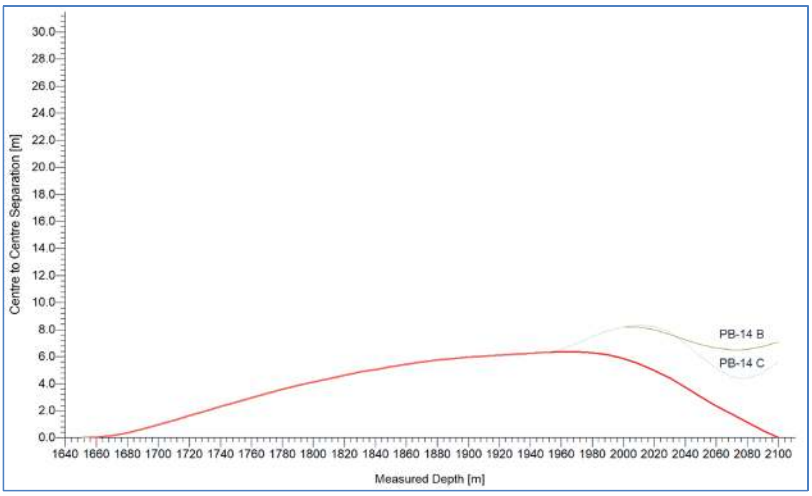


Figure 8: PB-14 / PB-14A Intersect Well Concept – Ladder Plot

7.2.4 Ranging Technologies

The most suitable forms of ranging technologies identified for the Prinos field legacy wells would most likely be active magnetic ranging and passive magnetic ranging techniques. Details on these technologies, and other possible techniques, are included in the feasibility study but as a summary:

Active Magnetic Ranging – Downhole Current Injection

Description

- The industry standard method for intercept wells, active magnetic ranging uses a downhole current injector and AC-sensitive magnetometers to detect conductive materials (e.g. casing) in the target well. Current injected into the formation collects on the casing, producing a detectable AC magnetic field.

Capabilities

- Under ideal conditions, detection ranges are claimed to be 50 m, though 15-20 m is more realistic due to well geometry and geological influences.
- Does not require access to the target well.

Deployment

- Typically deployed via wireline, with alternatives like conveyance inside a specialist drill string for challenging open hole conditions.

Limitations

- Ranging is limited to depths where conductive or ferrous materials (e.g. casing) are present, preventing detection in open hole sections.
- Detection is largely affected by highly resistive formations (e.g. salt)
- Unable to isolate one wellbore from another. If another well is within close proximity, the signal received is a vector sum of all, making ranging in congested environments problematic

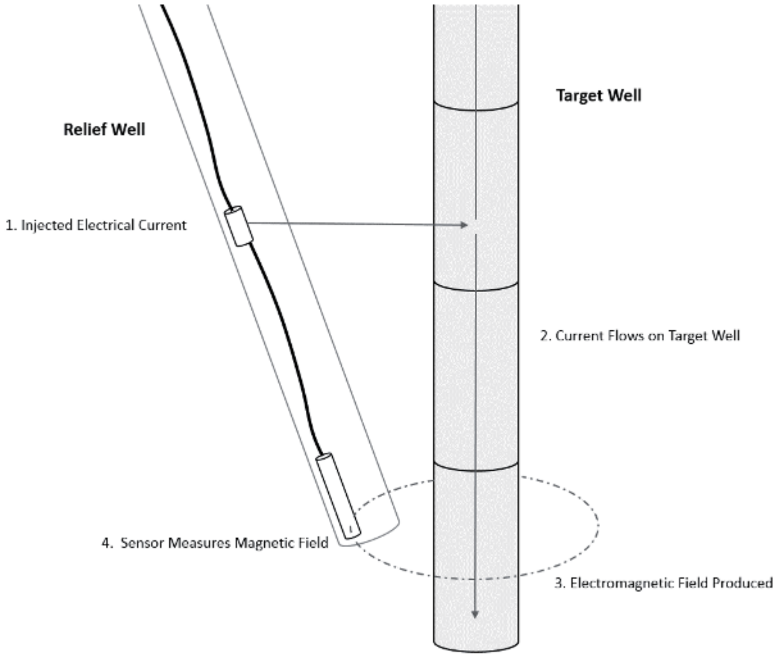


Figure 9: Active Ranging System Schematic

Passive Magnetic Ranging

Description

- A secondary method that uses the remnant magnetic field of the target well’s casing, detected by triaxial magnetometers.

Advantages

- Effective in resistive formation (e.g. salt) and requires no specialised tools beyond standard MWD or wireline survey instruments.

Limitations

- Ranging to well casing, generally has unknown magnetic pole strength and distribution in the target well which can lead to interpretive uncertainties, reducing reliability compared to active ranging
- Detection range is considerably less than active methods.

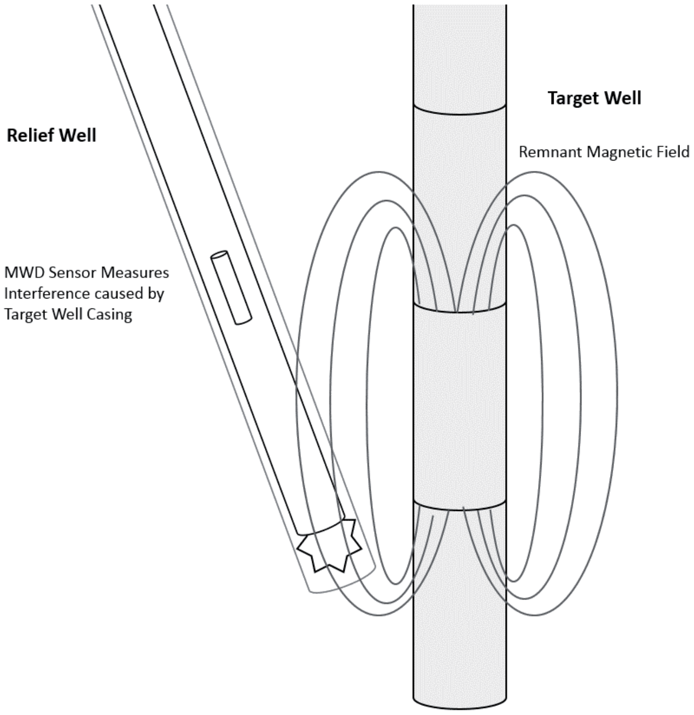


Figure 10: Passive Ranging System Schematic

7.2.5 Milling

Several mill types are available to cut windows in the target well when the intercept well is drilled, some examples and their use are:

Concave Slot Initiation Mills

- Dressed with crushed carbide, these mills are designed to initiate slots by cutting radially.

Bladed Mills with Junk Slots

- Featuring a concave face and an aggressive cutting structure, these “extension mills” excel at straight milling.

Dress Mills

- Used to refine the window cut, prevent hangups, or remove accumulated swarf, these include taper and watermelon mills and are typically run as an optional final step.

Figure 11: Crushed Carbide Slot Initiation – Concave Mill

Figure 12: Bladed Slot Mill

Figure 13: Milled Slot in text fixture, Crushed Carbide Mill, and milled coupling shown

7.2.6 Selection of Abandonment Methods

A review is done on the specific well to determine the best method to place a suitable barrier into the inaccessible well after a leak is stopped.

Three methods were reviewed in each well scenario

- Use the existing cemented annulus as the annulus barrier.
- If the annulus is unsuitable, mill the casing to restore a rock-to-rock barrier
- Use the natural sealing salt formation to form the annulus barrier

For the PB14 / 14A wells, (and in all the wells), the base plan would be to select an area where there is a sealing salt formation which would form an annulus seal and only require an internal cement plug to be set inside the production casing/liner to form a full lateral barrier in the well.

Option A – Intersect with 8 ½” Hole

- PB-14A: Tertiary Method Isolation:

After intersection, re-enter and utilise the adjacent salt formation as a natural seal. Place an internal barrier through the window using a cement stinger to set a balanced cement plug

- PB-14A and PB-14: Primary Method Isolation:

At the re-entry window, assess cement quality in the casing annulus via logging or review of historical cement job records. If the annulus barrier is verified, set an internal balanced cement plug through the window using a cement stinger.

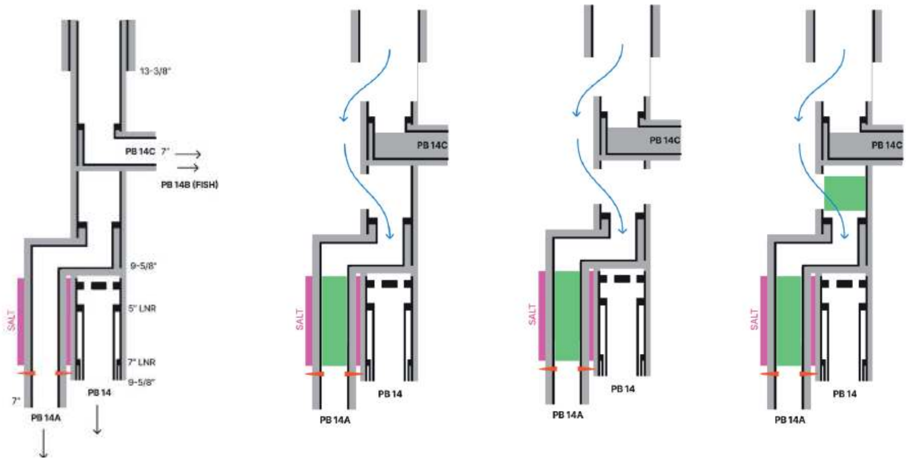


Figure 14: PB-14 and PB-14A (left to right) – current, PB-14A tertiary isolation, Mill 9 5/8”, PB-14A and PB-14 primary isolation

7.3 Feasibility Study Conclusions

The Feasibility Report shows that all three of the intercept wells selected are feasible to drill and these results can be inferred to show that this as an acceptable plan for any of the wells in the field, given they were selected to be representative of the issues which may be encountered on all other wells.

There are two questions to be answered for the intercept well feasibility plan.

1. Are the wells feasible to drill and can they be used to kill / stop any leaks?

Yes, the wells are feasible to drill, and all inaccessible wells could have the leaks stopped by conventional relief well techniques and using kill weight fluids.

2. In the event of a leak, can the intercept wells gain access to the inaccessible target wells to allow suitable abandoned barriers to be set in the target well which could be acceptable to meet recommended guidelines for carbon storage developments?

Yes, intercept wells are feasible to allow the setting of acceptable abandonment barriers.

For the plug & abandonment of the inaccessible wells in the event of a significant leak, the base plan for the wells would be to use what is classed as the “tertiary” abandonment plan in the WWC report, which is to use the sealing salt formations as the annulus barrier with only the requirement to set an internal cement plug in the existing production casing or liners to restore a full lateral barrier.

The suitability of the salts for use as the annulus seal has been shown in the independent experts Stag Geological Services, report ref DCS-CR-24-F-01 and it is planned to validate/verify this engineering study during future well operations which will only consolidate this concept.

However, there are design challenges where further engineering work will be required to ensure that the concept for abandonment of the high-risk wells with non-standard operations is achievable in all cases with a good level of confidence.

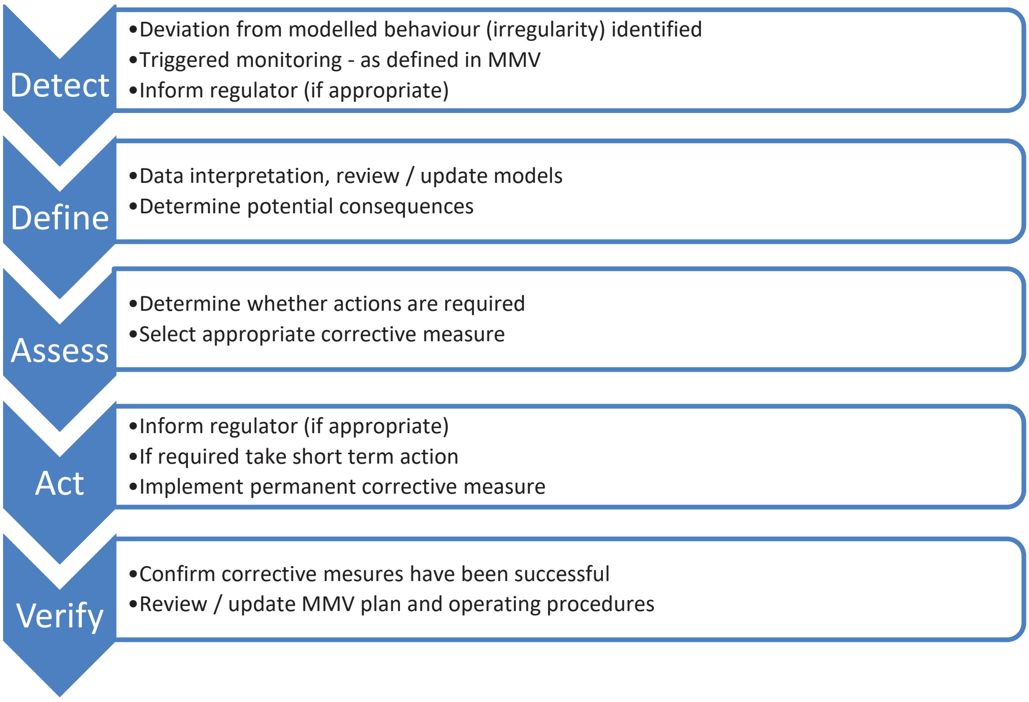
8. Corrective Measures Plan

Where possible, corrective measures will be implemented as quickly as reasonably practicable. The requirement for corrective action may be based on irregularities detected by the ongoing MMV plan, or under the direction of the competent authority.

In scenarios where long term corrective measures cannot be implemented quickly (e.g. it is necessary to mobilise a rig), short term actions will be taken to minimise any volume of leakage or potential for further failures to occur. Measures to be taken to facilitate rapid corrective actions are likely to include maintaining an inventory of critical spare parts and potentially contracts with key suppliers.

In all instances where there is a requirement to implement any of the corrective measures set out below, all the appropriate competent authority (and other stakeholders if required) will be notified immediately. If required updates will be provided on a regular basis regarding while corrective measures are ongoing, and on successful completion of the work (and any associated verification) further notifications will be made.

The application of corrective measures will be based on a structured approach starting from the initial detection of an anomaly or irregularity during routine operation, through the acquisition and interpretation of additional data, and the implementation and verification of the appropriate corrective measure has been including actions to minimize the probability of recurrence.



Detect
- Deviation from modelled behaviour (irregularity) identified
- Triggered monitoring - as defined in MMV
- Inform regulator (if appropriate)

Define
- Data interpretation, review / update models
- Determine potential consequences

Assess
- Determine whether actions are required
- Select appropriate corrective measure

Act
- Inform regulator (if appropriate)
- If required take short term action
- Implement permanent corrective measure

Verify
- Confirm corrective mesures have been successful
- Review / update MMV plan and operating procedures

Figure 15: General corrective measures implementation sequence

The definitions of what constitute an anomaly or departure from expected behavior of sufficient size and / or severity to trigger additional monitoring and / or corrective measures are set out in the Prinos Full Lifecyle Monitoring Schedule (2025).

Anomalies may occur resulting in triggered monitoring and hence a call for corrective actions at any location in the CO_2 storage system from the surface facilities to the storage formation; and at any time from the initiation of injection to the final handover of the competent authority on completion of the required post closure activities.

The level of maturity of the detailed corrective measures required to achieve the overall goals of the corrective measure plan vary across the planned development, in alignment with the differing maturity of the design. Where risks relate to geology or legacy wells (both pre-existing), the corrective measures are relatively mature; however, where the risks relate to elements of the design that are yet to be finalized the risks (and hence corrective measures) are similarly yet to be finalized.

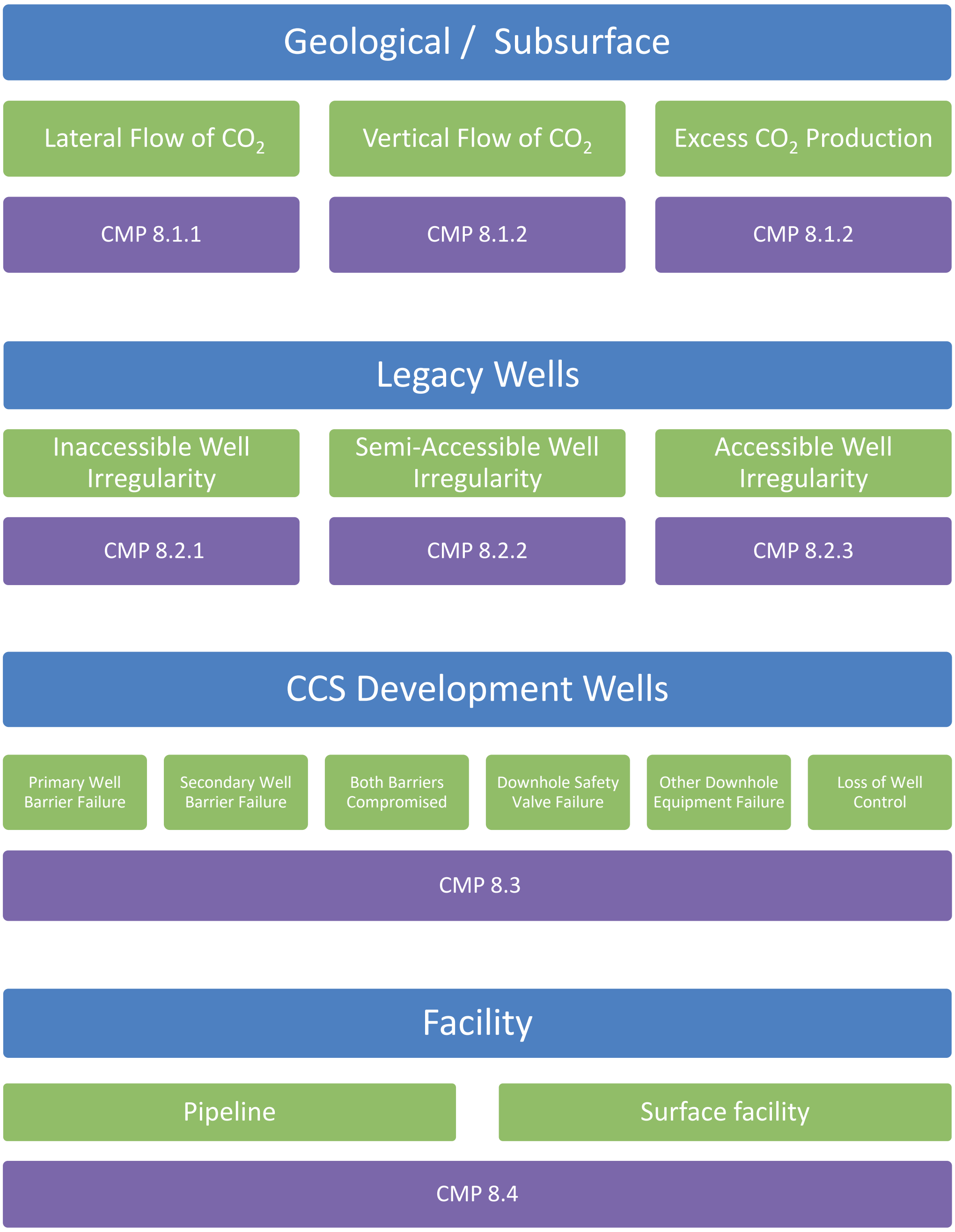


Figure 16: Corrective measures summary. Purple boxes refer to the key risks and the following chapter headings

8.1 Geological / Subsurface

8.1.1 Lateral Flow of CO_2, from the Storage Site

In the event that the CO_2 plume behaviour shows a significant irregularity relative to that predicted by the dynamic model, resulting in an increased risk of lateral migration out of the storage site (risk references: SS8, SS9, SS10 and SS12) a number of actions could be taken.

- If practicable reduce injection rate (or pause injection) in wells closest to the potential migration location
- Consider increasing water production to influence plume behaviour (and reduce store pressure)
- Carry out targeted data acquisition
- Update models to better understand the plume behaviour
- Based on revised model, update injection / production strategy including
    - Review store injection / production rates
    - Review individual well injection / production rates
    - Consider requirements for additional CO_2 injection and/or water production wells (new locations)

In the event that lateral migration out of the storage site, but remaining within the storage complex is identified a number of additional actions will be required:

- Pause injection in wells closest to the migration location and consider pausing injection to store
- Update the modelling of plume migration
    - Investigate migration rate.
    - Assess potential for migration to extend outside the storage complex (e.g. become a leak)
- If required extend monitoring area to allow ongoing monitoring and verification
- If lateral migration cannot be mitigated by other means consideration may be given to using CO_2 injection wells to produce a small quantity of the injected CO_2 to aid plume management and prevent a leak

Should there be a significant risk of CO_2 leaking laterally from the storage complex, injection operations may stop, and a full assessment of available mitigations will be carried out.

8.1.2 Vertical Flow of CO_2, from the Storage Site (Away from Wells)

In the event that the CO_2 plume behaviour shows a significant irregularity relative to that predicted by the dynamic model, indicating in an increased risk of vertical migration out of the storage site, not associated with a well (risk references: SS1 – SS7 and SS11) a number of actions should be taken.

- If practicable, reduce the injection rate (or pause injection) in wells closest to the potential migration site
- Consider increasing water production to influence plume behaviour (and reduce store pressure)
- Carry out targeted data acquisition

- Update models to better understand the plume behaviour
- Based on revised model, update injection / production strategy including
  - Review store injection / production rates
  - Review individual well injection / production rates
  - Consider requirements for additional CO_2 injection and/or water production wells (new locations)

In the event that vertical migration out of the storage site (not associated with a well), but remaining within the storage complex is identified a number of additional actions will be required:

- Pause injection in wells closest to the migration site and consider pausing injection to store
- Carry out modelling of migration
  - Investigate migration rate
  - Assess potential for migration to extend outside the storage complex (e.g. become a leak)

Should there be a significant risk of CO_2 leaking vertically from the storage complex (or a leak be detected), injection operations may stop, and a full assessment of available mitigations will be carried out. The mitigation actions available will depend on the characteristics of the potential leak site.

- Use of CO_2 injection wells to produce a small quantity of the injected CO_2 to aid plume management.
- Converting one or more wells (injection, production or monitoring) to allow production of CO_2 from within the Evaporitic Sequence.

Injection of cement or other materials to reduce formation permeability (in particular the sealing of faults of fractures), may be applicable for a point source, but is regarded as having a very low probability of success.

Water production will be used to manage the pressure in the hydraulic unit containing the store. This introduces the risk of injected CO_2 being produced with formation water. Should any increase in CO_2 content be identified in the produced water a number of actions should be taken.

- Carry out sampling to confirm the source of the CO_2
- Compare rate and source of CO_2 produced to model predictions
- If a significant irregularity is identified between modelled and actual behaviour
  - Carry out targeted data acquisition
  - Update models to better understand the CO_2 flow to the production well
- Based on revised model, update injection / production strategy including
  - Review store injection / production rates
  - Review individual well injection / production rates
  - Assess requirement to close in or carry out zonal isolation in wells producing CO_2
- Verify compliance with new model

8.2 Legacy wells

8.2.1 Inaccessible Wells

Should there be any irregularity detected that could be indicative of a CO_2 flow in an inaccessible legacy well (risk references: W1, W3, W8 -W14), the actions to be taken are described in the Management of Irregularities in Legacy Wells (ref: PRC-CCS-REP-DRI-00004) and summarized below.

Initial actions to understand the location and magnitude of the flow.

- Triggered monitoring – to understand the location of any flow, including
  - Interventions into accessible wells
  - DTS / DAS data
  - Potentially triggered seismic (e.g. DAS VSP, Spotlight) acquisition
- Review and update leak rate modeling
- If necessary (e.g. for migration within the storage complex) update dynamic models to determine long term consequences

Once the rate, location and consequence of any flow are understood, select appropriate mitigations. If a significant leak is detected drill an intersect well (as described below). For flow within the complex (migration) or a leak that is not considered to be significant, mitigations will be aimed at the prevention of a significant leak in the future and will include reviews of:

- Injection / production strategy
- MMV plan

As set out in Section 7, the drilling of an intersect well is considered to be the most appropriate technique to reliably stop a significant leak associated with an inaccessible well,. The exact sequence of operations will vary from well to well, depending on the configuration of both the well to be plugged and the donor well to be used for the intercept well drilling.

The key steps in the drilling of an intersect well will include:

- Locate rig over correct well slot for intersect well drilling
- Carry out slot recovery (if required) – recover tubing, place an internal barrier (e.g. cement plug) and recover casing, if required.
- Initiate sidetrack
- Drill and case appropriate hole sections to approach intersection point
- Intersect using active & passive magnetic ranging techniques, or other techniques.
- Mill window in legacy well to allow a cement stinger to be run, if required
- Set abandonment plug(s) in legacy well (and verify if practicable)

The intersect well above the intersection point will be retained for ongoing monitoring purposes, which may include the installation of monitoring equipment, in effect creating an additional monitoring well. The final plugging and abandonment of the upper sections of the intersect well will not be undertaken until after site closure as per the post closure plan.

8.2.2 Semi-Accessible E+A Wells

Should there be any irregularity detected that could be indicative of a CO_2 flow irregularity in an semi accessible legacy well (risk references W4 and W5) a number of actions will be taken:

- Triggered monitoring – to understand the location of any flow, including
    - ROV / sonar survey for well location
    - Potentially triggered seismic (e.g. DAS VSP, Spotlight) acquisition
    - DTS / DAS data
- Review and update leak rate modeling
- If necessary (e.g. for migration within the storage complex) update dynamic models to determine long term consequences

Once the rate, location and consequence of any flow are understood, select appropriate mitigations. If a significant leak is detected a new barrier will be set (as described below). For flow within the complex (migration) or a leak that is not considered to be significant, mitigations will be aimed at the prevention of a significant leak in the future and will include reviews of:

- injection / production strategy
- MMV plan

Where a significant leak is identified in an accessible legacy well. Action will be taken to stop the leak and set a new barrier to ensure containment is restored:

- Locate rig over leaking well
- Re-entry well from above
- Gain access to required for new barrier setting
- Set new barrier and verify

8.2.3 Accessible Wells

Should there be any irregularity detected that could be indicative of a CO_2 flow irregularity in an accessible legacy well (risk references W2and W13) a number of actions will be taken:

- Triggered monitoring – to understand the location of any flow, including
    - Wireline logging (or temporary fiber optic deployment) to understand the location and magnitude of any flow
    - DTS / DAS data
- Review and update leak rate modeling
- If necessary (e.g. for migration within the storage complex) update dynamic models to determine long term consequences

Once the rate, location and consequence of any flow are understood, select appropriate mitigations. If a significant leak is detected a new barrier will be set (as described below). For flow within the complex (migration) or a leak that is not considered to be significant, mitigations will be aimed at the prevention of a significant leak in the future and will include reviews of:

- injection / production strategy
- MMV plan

Where a significant leak is identified in an accessible legacy well. Action will be taken to stop the leak and set a new barrier to ensure containment is restored:

- Kill well (if required)
- If required, locate rig over leaking well
- Remove tree
- Pull tubing (if required)
- Set new barrier and verify

8.3 Development wells

8.3.1 Primary Well Barrier Failure

In the event a pressure anomaly is detected in the A-annulus of a production or injection well suggesting the presence of tubing to annulus communication, but no leak beyond the secondary barrier. The key actions to be taken can be summarized as:

- Stop production / injection in the well
- Investigate
    - Confirm existence of tubing to annulus communication
    - Using logging, DTS or temporary fiber optic determine the location of the site of tubing to annulus communication
    - Assess the likelihood of success of any repair. If low probability of success, consider workover of well
- Apply corrective measure (one or more of)
    - Tubing patch / straddle
    - Use of sealant
    - Workover

8.3.2 Secondary Well Barrier Failure

In the event a pressure anomaly is detected in the A-annulus of a production or injection well suggesting the presence of pressure communication from the annulus to the formation (above the store). The key actions to be taken can be summarized as:

- Stop production / injection in the well
- Investigate
    - Confirm existence of annulus to formation communication (pressure test)
    - Check integrity of wellhead seals – conduct repairs if required

- If casing leak is confirmed
    - Kill well
    - Locate Work Over unit or a rig over well
    - Remove tree and pull tubing
    - Carry out wireline logging to confirm location of failure and confirm condition of casing
    - Reinstate casing integrity (e.g. install casing patch, scab liner, tie back casing, etc.) if practical to do so. If repair is not considered practical, consider P&A or sidetrack
    - Reinstate tubing and tree – if well to be returned to service
- All new barriers to be verified prior to well being returned to service

8.3.3 Both Barriers Compromised

While simultaneous failure of both primary and secondary barrier envelopes is highly unlikely to occur, there may be the potential for a cascade failure whereby the failure of one barrier leads directly to the failure of a second. Should this occur the key actions to be taken can be summarized as:

- Initiate emergency response plan
- Stop production / injection in the store
- Kill the well / set deep plug
- Investigate the cause of the dual failure to understand the root cause and ensure a similar failure will not occur in other wells
    - Locate Work Over unit or a rig over well
    - Using logging, DTS or temporary fiber optic determines the location of the site of tubing to annulus communication (if safe to do so)
    - Remove tree and pull tubing
    - Carry out wireline logging to confirm location of failure and determine condition of casing
- Once the failures are understood, and using a revised design if required
    - Reinstate casing / wellhead integrity (e.g. install casing patch, scab liner, tie back casing, repair wellhead, etc.) if practical to do so. If repair is not considered practical, consider P&A or sidetrack
    - Replace tubing and tree – if well to be returned to service

8.3.4 Downhole Safety Valve Failure

The downhole safety valves in the injection and production wells are an integral part of the primary barrier envelope. Should a safety valve fail in such a way that it is no longer able to provide a barrier to flow or cannot be opened to allow flow key actions to be taken can be summarized as:

- Stop production / injection in the well
- Investigate location of failure (valve or control line)

- If valve has failed (good control line integrity) – install wireline retrievable insert valve, if possible.
- If control line has failed – workover well
    - Locate Work Over unit or a rig over well
    - Remove tree and pull tubing
    - Consider data gathering (e.g. check casing condition)
    - Reinstate tubing and tree
- All new barriers to be verified prior to well returning to service

8.3.5 Other Downhole Equipment Failure

Should any component in a new well completion fail, and the barrier envelop is not compromised, an assessment of whether a repair is required will be carried out. Provided the integrity of the well barriers can still be monitored there may not be a requirement to shut in the well pending corrective actions.

Items most likely to require replacement include the ESP systems in the water production wells and monitoring equipment.

- In the case of a failure that only compromises data acquisition (e.g. a downhole sensor failure) consideration will be given, including a risk assessment to select the most appropriate course of action. Options are likely to include
    - Continuing to operate with the monitoring equipment in a failed state
    - Installation of temporary equipment (e.g. wireless gauges)
    - Workover of the well
- Where a failure results in a loss of pumping capability, it is likely to be necessary to carry out remedial work
    - Shut in well
    - Based on electrical properties determine whether it is a cable fault or ESP fault
    - Actions required to replace cable and/or ESP will be dependent on well configuration
- If any well barrier elements are impacted by the remedial action, repair should be verified prior to the well returning to service

8.3.6 Loss of Well Control

After injection has commenced, there is the theoretical potential for an uncontrolled flow to surface in the form of a CO_2 blowout during well operations. Detailed preventative and corrective measures for this event should be contained in the safety case for the operation being carried out, taking into account the hazards associated with high pressure CO_2. At a store level, actions should include:

- Initiate emergency response plan
- Stop production / injection in the store – until blowout well is killed
- Investigate cause of blowout and update plans for future wells based on lessons learnt.

8.4 Facilities

8.4.1 Pipeline

The offshore pipeline design will incorporate remote monitoring and a suitable emergency shutdown system, to isolate the pipeline from the onshore facilities and platform as required. This should limit the volume of CO_2 released (hence consequences) of any pipeline leak. In the event of a pipeline anomaly indicative of a leak being detected a number of actions should be taken.

- Isolate the pipeline (and depressurize if appropriate)
- Attempt to locate the leak site
    - Pipeline survey (ROV or sonar)
    - Potential to utilize any available fibre optic cable for DAS / DTS
- Investigate the cause of the leak and condition of remaining pipeline
- Carryout remedial work to re-store integrity – technique to be used will depend on nature of the failure
- Pressure test pipeline to ensure remedial action has been successful
    - Requirements for additional verification of successful remedial action may be defendant on remedial action taken
- Re-commission the pipeline
- Update pipeline operating envelope if required

8.4.2 Surface Facilities

The corrective measures required for any facilities irregularity will be dependent on the facility design and as such cannot be predicted at present. The design of the facilities will take into account as part of the FEED, the need to carry out corrective measures (e.g. repairs) in a timely and cost-effective manner while protecting human health and minimizing any harm to the environment.

9. Plan Implementation, Reporting and Performance Management

9.1 Reporting and documentation

Any remedial work performed under the corrective measures plan will be fully documented to ensure that any change to the status of the facility, wells or store is captured. This information will be retained to allow any trends to be identified and lessons learnt to aid in planning and implementation of subsequent corrective actions. Where appropriate reviews and updates of the MMV plan and store operating strategy will be carried out

It is possible that reporting on changes to well or store status to HEREMA (or other stakeholders) will be required. This may include notifications relating to the detection of irregularities and implementation of triggered monitoring. Where necessary (e.g. in the event of a significant leak being detected) appropriate notifications will be sent to inform the relevant government agencies as soon as practicable. In addition, any statutory reporting requirements relating to the EU Emissions Trading Scheme (or similar) will be met.

Where deemed appropriate, elements of the corrective actions taken and their outcomes may be made publicly available by EnEarth or other stakeholders. Should any stakeholder wish to make data public, this must balance EnEarth’s rights to retain proprietary data while respecting the public need for transparency and openness about results and the social value of pooling data across sites. The public value of data access should also be factored in, especially given the need to rapidly accelerate and disseminate learning about such an important topic as carbon storage, in the context of the wider CCS industry.

9.2 Interpreting Corrective Measure Outcomes

Should any corrective measure be applied to mitigate a leak or other significant irregularity the routine and contingent monitoring data from before and after the application of the corrective measure should be collated and interpreted. The changes in behaviour before and after the application of the corrective should be used to determine the impact of the corrective measure both on the irregularity being corrected and the wider store. It may be necessary to assess the changes in the context of the predicted in dynamic behaviour of the store.

Where the impact of a corrective measure is confined to a single well and not intended to impact on the behaviour of the wider store (e.g. a repair to a single well barrier, direct replacement of a failed component, etc.) a period of increased monitoring on the well may be appropriate to demonstrate that the well has returned to its baseline condition.

9.3 Updating the Plan

The Prinos CO_2 Corrective Measures Plan is not static and will be regularly updated to take account of changes to the assessed risks, to the environment and human health, new scientific knowledge, and improvements in the best available technology. Any updates to the plan will be guided by revised risk assessments (as per the Risk Management Plan) to ensure that risks are maintained ALARP.

9.4 Review

While it is the intention of EnEarth to proactively review and update the Corrective Measures Plan it is recognized that HEREMA may seek updates to the plan at any time if they deem it necessary.

In the event of a significant change to any of the key documents listed below, the potential impact on the Corrective Measures Plan should be identified and the Plan revised if necessary:

- Store Development Plan
- Risk Management Plan
- Risk Assessment / Risk Register
- Monitoring Measurements and Verification Plan
- Post Closure Plan

Should no update be made to the Plan for a period of five years, a review will be conducted to ensure that it complies with the latest legislation and incorporates industry best practice and the best available technology. Following the implementation of any corrective measures, or changes to the corrective measures plan impacts on the documents listed above need to be understood and updated as required.

10. References

- DIRECTIVE 2009/31/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the geological storage of carbon dioxide
- EnEarth. 2024. Prinos CO_2 Storage Permit Application Deliverables. Step 1: Data Collection: g: Presence and condition of natural and man-made pathways, including wells and boreholes which could provide leakage pathways
- European Commission. 2024. Guidance document 1 CO_2 storage life cycle and risk management framework
- European Commission. 2024. Guidance document 2: Characterization of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures
- Halliburton. 2024. Prinos Containment Risk Assessment & Conceptual Monitoring, Measurement, and Verification (MMV) plan. Produced on behalf of EnEarth
- International Association of Oil & Gas Producers. 2022. Recommended practices for measurement, monitoring, and verification plans associated with geologic storage of carbon dioxide
- Prinos Full Lifecyle Monitoring Schedule. 2025. Excel spreadsheet detailing the MMV schedule, costs and monitoring parameter thresholds
- Prinos Measurement Monitoring and Verification Plan. 2025. Carried out by Elemental Energies on behalf of EnEarth
- Prinos CO2 Storage - Containment Risk Assessment.
- Wild Well Control. 2025. EnEarth_Prinos_ Intervention Well Feasibility Study_RevA_2025-135_12Jun25. Produced on behalf of EnEarth

11. Appendix 1 – Definitions

A list of general definitions which relate to wording used in this document are listed below.

Capacity the total mass (or equivalent volume at reference conditions) of CO_2 stored within a given site.

Caprock Geological formation(s) overlying the Storage Site or Complex that effectively restricts upward migration of CO_2 or charged CO_2 formation fluids. The caprock should have sufficiently low permeability to ensure ‘permanent containment’ of $CO_{2.}$

Closure means the definite cessation of CO_2 injection into that Storage Site.

Conformance refers to the consistency between the actual behaviour of injected CO_2 and the modelled forecast.

Containment Permanent containment means that injected CO_2 will be effectively trapped by trapping mechanisms in perpetuity, within the Storage Complex. describes the long-term security related to permanent CO_2 storage within a Storage Complex.

Corrective measures mean any actions, measures or activities taken to correct significant irregularities, or to close leakages in order to prevent or stop the release of CO_2 from the Storage Complex.

CO_2 plume means the dispersing volume of CO_2 within the Storage Complex.

Geological storage of CO_2 means permanent storage in underground geological formations.

Hydraulic reservoir means a hydraulically connected pore space where pressure communication can be measured by technical means and which is bordered by flow barriers, such as faults, salt domes, lithological boundaries, or by the wedging out or outcropping of formation.

Leakage means any release of CO_2 from the Storage Complex.

Migration means the movement of CO_2 within the Storage Complex.

Overburden The overburden is the lithostratigraphic volume of rock overlying the storage reservoir up to the surface or seabed.

Post-closure means the period after the closure of a Storage Site.

Seals In the context of geological storage this term is often used interchangeably with Caprock.

Significant irregularity means any irregularity in the injection or storage operations or in the condition of the Storage Complex itself, which implies the risk of a leakage or risk to the environment or human health.

Storage Complex means the Storage Site and surrounding geological domain which can influence overall storage integrity and security; that is secondary containment formations.

Storage Site means a defined volume area within a geological formation used for the geological storage of CO_2 and associated surface and injection facilities.

Surrounding area means the surface and subsurface area surrounding the Storage Complex where leakage or negative effects on the environment or human health are realistically possible.

12. Appendix 2 – Acronyms and Abbreviations

A list of general Acronyms and Abbreviations which relate to wording used in this document are listed below.

Term / Acronym / Abbreviation	Definition
ALARP	As Low As Reasonably Practicable
CMP	Corrective Measures Plan
DAS	Distributed acoustic sensing
DTS	Distributed temperature sensing
ESP	Electric Submersible Pump
MBES	Multi beam echo sounder
MMV	Measurement Monitoring and Verification
MSAD	Minimum safe abandonment depth
OEUK	Offshore Energies UK
P&A	Plugging and abandonment
PP&A	Permanent Plugging and abandonment
ROV	Remotely operated vehicle
SSS	Side scan sonar
TVDSS	True Vertical Depth Sub Sea
TVT	True Vertical Thickness
WWC	Wild Well Control

ANNEX V

Annex V

PERMIT REQUIREMENTS AND SPECIAL CONDITIONS FOR CO2 WELL OPERATIONS AT PRINOS

The Prinos reservoir is depleted and hydrocarbon-bearing. This suggests that any well activities for the purposes of CO2 injection or water production in the area of this reservoir are subject to all potential risks applicable to any typical well operation for hydrocarbons exploration and exploitation. It is imperative therefore that such well activities be subject to the mandates and requirements of Hellenic Law 4409/2016, which defines the framework for safety in offshore hydrocarbons exploration and exploitation in Greece. No CCS well operations are to commence before the Competent Authority of Law 4409/2016 has assessed the required safety documentation and issued all necessary approvals as mandated in the aforementioned Law.

More specifically, the following documentation must be submitted to the Competent Authority of Law 4409/2016 at least three months[i] prior to the commencement of any CCS well operations:

1. Report on Major Hazards for a non-production installation as specified in Law 4409/2016 Art. 13.
2. Notification of Well Operations for each well to be drilled or worked over, as specified in Law 4409/2016 Art. 15.
3. Weekly operations reports during the execution of well operations, as described in Law 4409/2016 Art. 15 par. 4.

In case of combined operations as defined in Law 4409/2016 Art.2 par. 26, in addition to the above, the Operator is required to submit to the Competent Authority a Notification of Combined Operations according to Law 4409/2016 Art. 16 six weeks prior to the commencement of such work.

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[i] Ministerial Decision ΥΠΕΝ/ΔΥΔΡ/28404/776 of 16/03/2023, https://herema.gr/wp-content/uploads/2023/03/RegDocF.pdf

ANNEX VI

Parent Company Guarantee

This Parent Company Guarantee (“**Guarantee**”) is given on [•] by:

Energean plc, a public limited company incorporated under the laws of England and Wales with company number 10758801, having its registered seat at Accurist House, 44 Baker Street, London W1U 7AL, United Kingdom (“**Guarantor**”)

in favour of:

Hellenic Hydrocarbons and Energy Resources Management Company (HEREMA), the competent authority for geological storage of CO_2 in Greece pursuant to Law 4920/2022, acting for and on behalf of the Hellenic Republic (“**Beneficiary**” or “**Authority**”).

1. Background

EnEarth Greece Single Member S.A., a company incorporated under the laws of Greece with registration no. 177955001000, having its registered seat at 32 Kifissias Avenue, 15100 Amaroussion, Greece, being a subsidiary of the Guarantor (“**EnEarth**” or “**Operator**”), holds a storage permit for the Prinos CO_2 storage project, a carbon dioxide storage facility located in northern Greece (“**Storage Permit**”).

In accordance with applicable law [art. 24 L. 5261/2025 FEK 231A, Article 173 of Law 4964/2022 and Article 19 of Directive 2009/31], the Operator is required to provide financial security to ensure that all obligations arising under the Storage Permit are met.

The Guarantor, being the ultimate parent company of the Operator, has agreed to provide this Guarantee in relation to the Operator’s payment obligations under the Storage Permit, solely for the following specific obligations defined as “*Certain Elements*” under the list included in Article [15.2] of the Storage Permit, namely the: (i) risk management plan and updates in accordance with Article [11] of the Storage Permit; (ii) monitoring costs during CO_2 injection as specified in Article [8] of the Storage Permit, including obligations for periodic updates every five (5) years in accordance with [Article 8.5] of the Storage Permit; (iii) sealing the storage site and removal of injection facilities based on [Article 10] of the Storage Permit unless otherwise provided by the applicable legislation; (iv) reporting in accordance with Article [8] of the Storage Permit; and (v) updates to the provisional post-closure plan in accordance with Article [10] of the Storage Permit (collectively, the “**Guaranteed Obligations**”), excluding for the avoidance of doubt any other obligations and the “Uncertain Elements” under the list included in Article [15.2] of the Storage Permit).

2. Guarantee

The Guarantor hereby irrevocably and unconditionally guarantees to the Beneficiary, as a principal obligor, in favor of the Operator the Guaranteed Obligations that are due and payable by the Operator, subject to the terms and limitations set out in this Guarantee.

Words and expressions defined in the Storage Permit shall, unless otherwise stated herein, have the same meaning when used in this Guarantee.

The Guarantor undertakes that, if the Operator fails to pay any amount in respect of the Guaranteed Obligations when due and payable, the Guarantor shall, upon first written demand by the Beneficiary, pay any and all such amount as if it were the principal obligor, provided that such demand is made in accordance with clause 2.2 (*Demands and payment*).

2.1 Maximum liability and adjustment

In no event shall this Guarantee create any greater monetary obligation for the Guarantor in respect of the Guaranteed Obligations than that assumed by the Operator under the Certain Elements of the Storage Permit, and in any case the Guarantor’s annual aggregate liability hereunder shall not exceed the maximum amount undertaken in respect of the Certain Elements on an annual basis, namely EUR [•] (“**Maximum Annual Guaranteed Amount**”). The Beneficiary may make multiple requests to the Guarantor by virtue of this Guarantee, in the event of a payment default by the Operator in respect of the Guaranteed Obligations, provided that the total amount requested by the Beneficiary annually pursuant to any such requests shall not exceed the Maximum Annual Guaranteed Amount. The amount available for payment each calendar year by virtue of this Guarantee, and up to the Maximum Annual Guaranteed Amount, shall be automatically reduced by the amounts of any request that are paid by virtue of this Guarantee within such year.

The Maximum Annual Guaranteed Amount shall be reviewed and readjusted at least every five (5) years, or on an extraordinary basis, following a request by the Operator, in the event of material changes in the estimated cost of the Guaranteed Obligations, according to art. 15 par. 8 of the Storage Permit and in any event up to the maximum annual guaranteed amount as each time readjusted. In case of readjustment of the Maximum Annual Guaranteed Amount, a new guarantee replacing this Guarantee, according to Article 2.6, shall be provided reflecting readjusted Maximum Annual Guaranteed Amount.

2.2 Demands and payment

Any demand by the Beneficiary under this Guarantee shall: (a) be in writing and signed by an authorised representative of the Beneficiary; (b) state that the Operator has failed to pay one or more Guaranteed Obligations when due and payable; and (c) specify the amount demanded and state that such amount is due, payable and remains unpaid by the Operator.

The Guarantor shall pay any amount up to the Maximum Guaranteed Amount validly demanded under this Guarantee within five (5) business days following receipt of the demand, in immediately available funds, without any set-off, counterclaim or withholding, and free and clear of any present or future taxes, levies, imposts, duties, charges or deductions of any nature, provided that such demand is made in accordance with this clause 2.2 (*Demands and payment*).

2.3 Waivers

The Guarantor expressly and unconditionally waives the right of article 855 of the Greek Civil Code, i.e. to refuse payment before the Beneficiary has first requested such payment from the Operator (*enstasi dizisseos*), and the right of article 853 of the Greek Civil Code, i.e. to invoke against the Beneficiary the objections of the Operator as well as the right of article 856 of the Greek Civil Code, i.e. to invoke compulsory enforcement firstly against the movable property of the Operator at the place of the Operator’s domicile or residence. Additionally, the Guarantor waives to the benefit of the Beneficiary the right to raise claims, objections, set-off or retention rights against the Operator (including recourse against the Operator for any payment under the Guarantee), as long as there is an outstanding claim of the Beneficiary under this Guarantee.

The Guarantor waives to the benefit of the Beneficiary the right of substitution in the Beneficiary’s rights *in personam* or *in rem*, even if the claims of the Beneficiary arising out of this Guarantee have been fully paid by that Guarantor. The Guarantor shall not be released from its obligations, even if the payment of the Beneficiary’s claims is impossible, for any reason, irrespective of whether the Beneficiary is liable or not (article 862 of the Greek Civil Code).

The Guarantor herewith waives its right to be released from this Guarantee where there is no claim against the Operator (article 864 of the Greek Civil Code) until the Expiry Date.

Any delay or negligence as to the undertaking or the continuation by the Beneficiary of legal proceedings against the Operator (articles 866-868 of the Greek Civil Code) shall not release the Guarantor.

2.4 Assignment and Substitution

This Guarantee may only be assigned or transferred with Guarantor’s prior written consent, such consent not to be unreasonably withheld or delayed. No Guarantor’s consent will be required to an assignment to any public authority successor of the Beneficiary having substantially the same regulatory role as the Beneficiary.

The Guarantor may not be substituted under this Guarantee, unless agreed in writing by the Beneficiary.

2.5 Representations and warranties

The Guarantor represents and warrants on the date of this Guarantee that:

(a) it is a company duly incorporated, validly existing and in good standing under the laws of its country of incorporation;

(b) it has full power and authority to lawfully enter into and perform this Guarantee and its Guaranteed Obligations hereunder and has taken all necessary actions to authorise its execution;

(c) the Guaranteed Obligations expressed to be assumed by it in this Guarantee are legal, valid, binding and enforceable in accordance with their terms, subject only to mandatory provisions of applicable law relating to insolvency or the enforcement;

(d) the execution and performance by it of this Guarantee and its Guaranteed Obligations hereunder do not conflict with: (i) any law or regulation applicable to it; (ii) its constitutional documents; or (iii) any judgment, award, administrative or regulatory order or other similar instrument binding upon it or any of its assets, in each case in any manner that would prevent it from performing its Guaranteed Obligations under this Guarantee;

(e) it meets the financial strength criteria required to perform its obligations hereunder and maintains sufficient financial resources to satisfy the Maximum Annual Guaranteed Amount in full as applicable; and

(f) the representations and warranties thereof are true, binding and complete and the Guarantor undertakes that the present representations and warranties shall remain true, binding and complete throughout the term of this Guarantee and shall inform the Beneficiary otherwise.

2.6 Term and expiration

This Guarantee shall become effective on the date it is duly signed and shall expire on the earlier of: (a) the date on which all Guaranteed Obligations have been fulfilled and upon the Beneficiary’s written confirmation; or (b) five (5) years from the date of issuance of this Guarantee, provided that a replacement guarantee has been delivered to the Beneficiary according to clause 2.1 hereof at least one (1) month prior to this Guarantee’s expiry date; or (c) the Beneficiary returning this Guarantee to the Guarantor for invalidation or replacement in case of readjustment of the Maximum Annual Guaranteed Amount according to clause 2.1 of this Guarantee (each the “**Expiry Date**”). For the purposes of paragraph (b) above, if the replacement guarantee is not delivered to the Beneficiary at least one (1) month prior to the Expiry Date, the term of this Guarantee shall be automatically extended until the date on which such replacement guarantee is duly delivered to the Beneficiary. Upon the occurrence of the Expiry Date, this Guarantee shall terminate automatically and irrevocably and the Guarantor shall have no further liability or obligation of any kind hereunder. No claim or demand may be made under this Guarantee after the Expiry Date and any demand made after such date shall be null and void.

The Beneficiary shall, upon the Expiry Date of the Guarantee and upon request of the Guarantor, return the original of this Guarantee and issue a written confirmation of the cancellation of this Guarantee and the expiry of any of the Guarantor’s obligations hereunder.

2.7 Miscellaneous

Amendments to this Guarantee are only valid if in writing and signed by the Guarantor and agreed by the Beneficiary.

The Guarantor hereby expressly acknowledges the terms of the Storage Permit and the Guaranteed Obligations as depicted thereunder.

If any provision of this Guarantee is or becomes invalid, illegal or unenforceable, the remaining provisions shall continue in full force and effect, provided that such invalidity, illegality or unenforceability does not materially increase the Guarantor’s obligations hereunder.

This Guarantee is issued for the sole benefit of the Beneficiary (and any permitted assignee or transferee) and no other person shall have any rights hereunder nor shall any third party be entitled to enforce any term of this Guarantee.

Any notice to the Guarantor must be addressed to [•], and any payment request must be submitted to [•].

Additionally, pursuant to article 142 par. 4 of the Greek Code of Civil Procedure, the Guarantor hereby irrevocably appoints [•], residing at [•] street, [•], Athens (email: [•]) as process agent (*antiklitos*), to whom the Beneficiary may, at its discretion, validly (and binding for the Guarantor) serve any extrajudicial or judicial document relating to this Guarantee, and is addressed to, notified to, or communicated to the Guarantor, including documents concerning the initiation of legal proceedings.

2.8 Governing law and jurisdiction

This Guarantee and all rights and obligations arising therefrom shall be governed by and construed in accordance with the laws of Greece. Any dispute arising out of or in connection with this Guarantee shall be submitted to the exclusive jurisdiction of the courts of Athens, Greece.

For and on behalf of
Energean plc

Name: ________________________
Title: ________________________
Place: ________________________
Date: ________________________

(Authorised Signatory)

ANNEX VII

ENEARTH

To:
Hellenic Hydrocarbons and Energy Resources
Management Company S.A.
18, Dimitriou Margari, 115 25, Athens
Att. Mr. Aristofanis Stefatos, CEO

Marousi, 17 November 2025

Re: Prinos CO2 Storage - Confirmation of Insurance Coverage for Uncertain Elements of the Financial Security

Dear Mr. Stefatos,

We, EnEarth Greece, refer to our Financial Security (FS) proposal submitted on 15.10.2025 in the context of our application for the issuance of the storage permit for Prinos CO2 Storage project.

We hereby confirm that the uncertain elements identified in our FS proposal, i.e. obligations that are not certain to occur and are unlikely to occur, as same are defined in the FS proposal, will be fully covered through insurance, in line with the structure, methodology, and approach already submitted and described therein.

As set out in the FS proposal, these uncertain elements will be addressed through an insurance policy designed to cover, inter alia:

- Corrective measures as required under Article 16 of the Directive 2009/31/EC (the “CCS Directive”), including any updates to the corrective measures plan;
- Costs associated with the surrender of EU Allowances (EUAs) pursuant to Directive 2023/959/EC for any tonne of CO_2 leaked; and
- Costs borne by the competent authority in the event of temporary site operation following withdrawal of the operator’s storage permit in accordance with Article 11(4) of the CCS Directive, including CO_2 acceptance procedures, registration of CO_2 streams, and monitoring.

EnEarth Greece has been working with leading international insurance brokers with extensive experience in both oil & gas and CCS-related risks. Consistent with our FS proposal, the envisaged insurance structure comprises five coverage sections (Property Damage, Operator’s Extra Expense/Control of Well, Third Party Liability, Loss of Production Income, and Indemnity for unexpected CO_2 migration or leakage costs), ensuring comprehensive coverage of all relevant uncertain elements.

Furthermore, EnEarth Greece confirms that the insurance policies covering these uncertain elements will be concluded and fully effective before the Commercial Operations Date (COD) as defined in the FS proposal.

We remain at your disposal for any further clarifications or additional documentation you may require.

For EnEarth Greece

AIKATERINI SARDI Digitally signed by AIKATERINI SARDI
Date: 2025.11.17 20:50:48 +02'00'

Katerina Sardi

Managing Director

ANNEX VIII

ΠΑΡΑΡΤΗΜΑ VIII

Συμπληρωματική Τεκμηρίωση επί της Χρηματικής Εγγυήσεως (Financial Security) και της Χρηματοοικονομικής Ικανότητας/Επάρκειας (Financial Capability/Adequacy) του Αιτούντος

Πίνακας Περιεχομένων

1. Γλωσσάριο – Ορισμοί / Ακρωνύμια

- **ΑΑ:** Αδειοδοτούσα Αρχή, ήτοι η **Ελληνική Διαχειριστική Εταιρεία Υδρογονανθράκων και Ενεργειακών Πόρων / ΕΔΕΥΕΠ (Hellenic Hydrocarbons and Energy Resources Management Company / HEREMA στην Αγγλική)**, η οποία έχει ορισθεί ως η αδειοδοτούσα αρχή για την γεωλογική αποθήκευση CO_2 στην Ελλάδα.
- **Οδηγία CCS ή CCS Directive:** Αναφέρεται στην **Οδηγία 2009/31/ΕΚ** του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου, η οποία θεσπίζει το νομικό πλαίσιο για τη Δέσμευση και Γεωλογική Αποθήκευση Διοξειδίου του Άνθρακα (Carbon Capture and Storage/CCS) στην Ευρωπαϊκή Ένωση (ΕΕ) και τον Ενιαίο Οικονομικό Χώρο (ΕΟΧ).
- **DAS/DTS** (**Distributed Acoustic Sensing / Distributed Temperature Sensing**): τεχνολογίες που χρησιμοποιούνται για την παρακολούθηση των συνθηκών του υπεδάφους, μέσω συνεχούς μέτρησης ακουστικών και θερμοκρασιακών μεταβολών κατά μήκος οπτικών ινών.
- **DCC (Decommissioning and Closure Costs): Κόστη παροπλισμού και παύσης λειτουργίας (κλεισίματος)**, συμπεριλαμβανομένης της σφράγισης του τόπου αποθήκευσης, καθώς και της απομάκρυνσης των εγκαταστάσεων έγχυσης.
- **Οδηγία ETS / ETS Directive:** Η **Οδηγία 2003/87/ΕΚ**, όπως τροποποιήθηκε από την **Οδηγία 2023/959/ΕΕ**, η οποία θεσπίζει το σύστημα εμπορίας δικαιωμάτων εκπομπών αερίων θερμοκηπίου στην ΕΕ.
- **EU ETS: Ευρωπαϊκό Σύστημα Εμπορίας Δικαιωμάτων Εκπομπών CO_2 (EU ETS)** - η αγορά άνθρακα της ΕΕ για τη διαπραγμάτευση δικαιωμάτων εκπομπής.
- **EUA (European Union Allowance): Δικαίωμα Εκπομπής CO_2 της ΕΕ**, το οποίο επιτρέπει την εκπομπή ενός τόνου CO_2 στο πλαίσιο του EU ETS.
- **ΧΕ (Χρηματική Εγγύηση) / FS (Financial Security):** Νομικώς δεσμευτική ρύθμιση, σύμφωνα με το ισχύον ρυθμιστικό πλαίσιο, η οποία διασφαλίζει ότι ο φορέας εκμετάλλευσης είναι σε θέση να εκπληρώσει όλες τις υποχρεώσεις που απορρέουν από την Άδεια Αποθήκευσης CO_2.
- **Κατευθυντήριο Έγγραφο υπ' αριθμόν 4 ή στην Αγγλική Guidance Document 4 (GD4):** Το κατευθυντήριο έγγραφο της ΕΕ που αφορά συγκεκριμένα την Χρηματική Εγγύηση (Financial Security and Financial Contribution).
- **ΑΔΠ (Αρχική Δημόσια Προσφορά) / IPO (Public Offering):** Η Αρχική Δημόσια Προσφορά (IPO) είναι η διαδικασία μέσω της οποίας μια ιδιωτική εταιρεία εισάγει για πρώτη φορά τις μετοχές της σε ένα χρηματιστήριο, προκειμένου να καθίσταται δυνατή η αγορά τους από το ευρύ επενδυτικό κοινό.
- **Σχέδιο MMV (Monitoring, Measurement and Verification Plan): Σχέδιο Παρακολούθησης, Μέτρησης και Επαλήθευσης** που καθορίζει τις δραστηριότητες και τεχνολογίες που χρησιμοποιούνται για την παρακολούθηση της απόδοσης, της συμπεριφοράς και της ακεραιότητας της αποθήκευσης CO_2.
- **Σφράγιση και Εγκατάλειψη (Plugging and Abandonment ή P&A):** η διαδικασία ασφαλούς παύσης λειτουργίας, σφράγισης και μόνωσης των γεωτρήσεων.
- **Περίοδος μετά το κλείσιμο** (**Post-Closure Period**): η περίοδος μετά τη διακοπή της έγχυσης CO_2, κατά την οποία συνεχίζονται οι υποχρεώσεις παρακολούθησης, διαχείρισης και λοιπές δραστηριότητες έως ότου η ευθύνη μεταβιβαστεί στην Αρμόδια Αρχή.
- **Έργο Αποθήκευσης CO_2 στον Πρίνο (Prinos CO_2)**: έργο CCS στην υπεράκτια περιοχή του Πρίνου, Περιφερειακή Ενότητα Καβάλας, Περιφέρεια Ανατολικής Μακεδονίας και Θράκης στην Ελλάδα, το οποίο αναπτύσσεται από την εταιρεία EnEarth.
- **ΣΔΚ (Σχέδιο Διαχείρισης Κινδύνων) / RMP (Risk Management Plan):** σχέδιο που καθορίζει την αναγνώριση, αξιολόγηση και αντιμετώπιση των κινδύνων που συνδέονται με την αποθήκευση CO_2.

- **Σύμβαση Αποθήκευσης (Storage Contract)**: νομικά δεσμευτική συμφωνία μεταξύ της EnEarth και των πελατών CO_2 για την παροχή υπηρεσιών έγχυσης και αποθήκευσης.
- **Άδεια Αποθήκευσης (Storage Permit)**: η άδεια που εκδίδεται από την ΕΔΕΥΕΠ (HEREMA), σύμφωνα με την Οδηγία CCS και την ελληνική νομοθεσία, και η οποία επιτρέπει τη λειτουργία του Έργου Αποθήκευσης CO_2 στον Πρίνο.
- **Κώδικας Μεταφοράς και Αποθήκευσης Πρίνου (Prinos Transport & Storage Code / T&S Code):** το ρυθμιστικό πλαίσιο που διέπει την παροχή υπηρεσιών έγχυσης και αποθήκευσης από την EnEarth.

2. Χρηματοοικονομική Ικανότητα και Επάρκεια του Αιτούντος

Ο αιτών για την έκδοση Άδειας Αποθήκευσης είναι ελληνική εταιρεία μορφής Ανωνύμου Εταιρείας, υπό την επωνυμία «EnEarth Greece Μονοπρόσωπη S.A.» (εφεξής «EnEarth»). Η EnEarth αποτελεί άμεση και 100% θυγατρική της EnEarth Limited, κυπριακής εμπορικής εταιρείας, η οποία έχει συσταθεί και είναι δεόντως καταχωρημένη σύμφωνα με το κυπριακό δίκαιο (με αριθμό εγγραφής ΗΕ 458885), με έδρα επί της οδού Λεύκωνος 22, Στρόβολος, 2064, Λευκωσία, Κύπρος, και δυνάμει της Ανακοίνωσης Συστάσεως της EnEarth εκδοθείσα από το Εμπορικό Μητρώο και ημερομηνίας 14.06.2024.

Περαιτέρω, η EnEarth Limited αποτελεί άμεση και 100% θυγατρική της Energean plc, σύμφωνα με το Πιστοποιητικό Μετόχων της EnEarth Limited, εκδοθέν από την αρμόδια κυπριακή αρχή και ημερομηνίας 19.04.2024.

Ο αιτών για την έκδοση της Άδειας Αποθήκευσης στον Πρίνο, ήτοι η EnEarth, .είναι Εταιρεία Ειδικού Σκοπού «EnEarth», συσταθείσα την 14.06.2024, δεν διαθέτει επί του παρόντος την απαιτούμενη χρηματοοικονομική ικανότητα και επάρκεια, αποτελεί συνήθη πρακτική - και σύμφωνα με την παράγραφο Α.Β.4. του Κατευθυντήριου Εγγράφου (Guidance Document) 4 της Ευρωπαϊκής Επιτροπής σχετικά με τη Χρηματική Εγγύηση και Χρηματοδοτική Συνεισφορά - ότι η αναγκαία χρηματοοικονομική ικανότητα για το έργο CCS στον Πρίνο θα καλυφθεί από την τελική μητρική εταιρεία, Energean plc.

Για την αξιολόγηση της χρηματοοικονομικής ικανότητας της τελικής μητρικής εταιρείας της EnEarth (με την επωνυμία Energean plc), λαμβάνονται υπ’ όψιν τα κατωτέρω:

Εφαρμοζόμενη Μεθοδολογική Προσέγγιση:

$$\boldsymbol{\text{Μέσος Όρος Τριετίας} \quad NWC + R}$$

Όπου:

- $\boldsymbol{NWC \ = \ Net\,Working\,Capital}$
  (ήτοι Καθαρό Κεφάλαιο Κινήσεως/ΚΚΚ)
- $\boldsymbol{R \ = \ Reserves + Retained\ Earnings}$
  (ήτοι Αποθεματικά + Κέρδη εις Νέον)

Εν προκειμένω, σημειώνονται αναλυτικότερα τα εξής:

Το **Καθαρό Κεφάλαιο Κινήσεως (ΚΚΚ ή NWC)** της τελικής μητρικής εταιρείας ισούται με **τα Στοιχεία του Κυκλοφορούντος Ενεργητικού μείον τις Βραχυπρόθεσμες Υποχρεώσεις**, όπως προσηκόντως δημοσιεύονται στις οικονομικές καταστάσεις της μητρικής εταιρείας.

Τα **Αποθεματικά ή Reserves (R)** της τελικής μητρικής εταιρείας, πέραν του τακτικού αποθεματικού, έχουν δημιουργηθεί είτε βάσει ειδικών νομοθετικών προβλέψεων, είτε από ποσά προοριζόμενα για αύξηση μετοχικού κεφαλαίου, είτε από αναπροσαρμογή της αξίας των ενσώματων παγίων περιουσιακών στοιχείων, ή με άλλον τρόπο, και **περιλαμβάνονται στα Ίδια Κεφάλαια της εταιρείας**.

Τα **Κέρδη εις Νέον ή Retained Earnings (R)** της τελικής μητρικής εταιρείας αποτελούνται από το **σωρευτικό καθαρό αποτέλεσμα** που έχει παραγάγει η εταιρεία, μείον τα μερίσματα που έχουν καταβληθεί στους μετόχους. Πρόκειται για **αδιάθετα κέρδη** που παραμένουν επανεπενδυμένα στην εταιρεία, σχηματίζοντας μέρος των Ιδίων Κεφαλαίων αποτελώντας **εσωτερική πηγή χρηματοδότησης νέων έργων**.

Βάσει του προσχεδίου εγγράφου με τίτλο **«Step-1-I»** που υπεβλήθη από την EnEarth, καθώς και της **Μελέτης Περιβαλλοντικών Επιπτώσεων** (ΜΠΕ ή Environmental Impact Assessment Study / EIAS στην Αγγλική), τα βασικά ενδεικτικά και μη οριστικοποιημένα οικονομικά στοιχεία του έργου έχουν ως εξής:

- **CapEx:** περίπου **€517,6 εκατ.**, αποσβενόμενο σε **23 έτη**.
- **Λοιπή εγκεκριμένη χρηματοδοτική ενίσχυση (cash grants):** Η Ευρωπαϊκή Επιτροπή έχει εγκρίνει **€150 εκατ.** κρατική ενίσχυση (cash grant) μέσω του **Ταμείου Ανάκαμψης και Ανθεκτικότητας (RRF)** για την υποστήριξη της κατασκευής της εγκατάστασης αποθήκευσης CO_2 στον Πρίνο.
- **Δείκτης Δανειακής Μόχλευσης (Debt-to-Equity): 1,3** (ήτοι **€240 εκατ. Δανειακά Κεφάλαια / €183 εκατ. Ίδια Κεφάλαια**).

Βάσει των ανωτέρω ενδεικτικών οικονομικών στοιχείων, τα **απαιτούμενα Ίδια Κεφάλαια** ανέρχονται σε **€183 εκατ.**

Από τις **δημοσιευμένες οικονομικές καταστάσεις 3ετίας (2022, 2023, 2024)** της τελικής μητρικής εταιρείας **Energean plc (standalone)**, προκύπτει ότι ο **μέσος όρος 3ετίας του Καθαρού Κεφαλαίου Κινήσεως + Αποθεματικά + Κέρδη εις Νέον (NWC + R, όπου NWC = ΚΚΚ και R = Αποθεματικά + Κέρδη εις Νέον)** ανέρχεται σε **€477,0 εκατ.**[1], ποσό **σημαντικά υψηλότερο** από τα **€183 εκατ. ίδια κεφάλαια** που εκτιμάται ότι απαιτούνται για την υλοποίηση της επένδυσης CCS στον Πρίνο.

Επιπλέον, σύμφωνα με τα **Ενοποιημένα Οικονομικά Αποτελέσματα του Ομίλου Energean**, τα **Κέρδη προ τόκων, φόρων και αποσβέσεων (εφεξής «EBITDA»)** του Ομίλου ανήλθαν σε **€1.123 εκατ. (USD 1.162 εκατ.) το 2024** και **€842 εκατ. (USD 931 εκατ.) το 2023**. Το υψηλό αυτό EBITDA αντικατοπτρίζει τη **χρηματοοικονομική ισχύ**, τις ισχυρές λειτουργικές ταμειακές ροές και τη στρατηγική ευελιξία της εταιρείας - στοιχεία κρίσιμα για την υποστήριξη και υλοποίηση **έργα εντάσεως κεφαλαίου**, όπως το CCS του Πρίνου.

Η Energean plc διατηρεί **μακροχρόνιες σχέσεις** τόσο με διεθνείς όσο και τοπικές τράπεζες, πολυμερείς οργανισμούς διαπραγμάτευσης και την αγορά ομολόγων των ΗΠΑ, ενώ διαθέτει **αποδεδειγμένη εμπειρία** άντλησης ιδίων κεφαλαίων στο **Χρηματιστήριο του Λονδίνου (LSE)**. Δυνάμει της **Επιστολής Υποστήριξης (Parent Company Support Letter)** που υπέβαλε η Energean plc, τεκμηριώνεται ότι η εταιρεία διαθέτει ισχυρή ικανότητα χρηματοδότησης των έργων των θυγατρικών της.

Αντλήσεις Ιδίων Κεφαλαίων (Equity Capital Raises)

- **£330 εκατ. / USD 460 εκατ. – IPO** στην Κατηγορία Premium (Premium Segment) του Χρηματιστηρίου του Λονδίνου / LSE (Μάρτιος 2018), η δεύτερη μεγαλύτερη έκδοση στον κλάδο Έρευνας και Παραγωγής Πετρελαίου και Φυσικού Αερίου (Oil & Gas E&P) κατά την προηγούμενη δεκαετία.
- **USD 265 εκατ. – accelerated bookbuild** για τη χρηματοδότηση της εξαγοράς της Edison E&P (Ιούλιος 2019), με έκδοση σε προσαύξηση (premium) **7%** σε σχέση με το προηγούμενο κλείσιμο.

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[1] Η μετατροπή από δολάρια ΗΠΑ σε ευρώ έχει διενεργηθεί βάσει της ισοτιμίας συναλλάγματος στο τέλος κάθε αντίστοιχου οικονομικού έτους (2022, 2023 και 2024).

Αντλήσεις Δανειακών Κεφαλαίων (Debt Capital Raises)

- **USD 1.275 εκατ. –** Χρηματοδότηση Κατασκευής (Construction Financing), εταιρεία με την επωνυμία «Energean Israel Finance S.a.r.l.» (Μάρτιος 2018).
- **USD 280 εκατ. –** Χρηματοδοτική Διευκόλυνση Βάσει Αποθεμάτων (Reserve Based Finance Facility) για την εξαγορά της εταιρείας Edison E&P (Ιούνιος 2020).
- **£80 εκατ. –** Διευκόλυνση Εγγυητικών Επιστολών (LC Facility) τον Ιούνιο του 2020 για την αντίστοιχη έκδοση εγγυητικών επιστολών που αφορούσαν σε εργασίες παροπλισμού (decommissioning) στη Βόρεια Θάλασσα του Ηνωμένου Βασιλείου.
- **USD 700 εκατ. –** Τοκοχρεωλυτικό Δάνειο (Term Loan) για την εξαγορά του 30% της Kerogen στην εταιρεία Energean Israel τον Φεβρουάριο του 2021.
- **USD 2.500 εκατ. –** Ομολογιακή Έκδοση (Bond Issuance), εταιρεία με την επωνυμία «Energean Israel Finance Ltd». (Μάρτιος 2021).
- **USD 450 εκατ. –** Ομολογιακή Έκδοση (Bond Issuance), στην εταιρεία «Energean plc» (Νοέμβριος 2021).
- **USD 300 εκατ. –** Ανακυκλούμενη Γραμμή Πίστωσης (Revolving Credit Facility) (Σεπτέμβριος 2022).
- **USD 750 εκατ. –** Ομολογιακή Έκδοση (Bond Issuance) (Ιούλιος 2023) για αναχρηματοδότηση λήξης 2024.
- **USD 750 εκατ. –** Τοκοχρεωλυτικό Δάνειο (Term Loan) Term Loan (Φεβρουάριος 2025) για αναχρηματοδότηση ομολόγων λήξης 2026 και υποστήριξη του έργου ονόματι Katlan.

Λαμβάνοντας υπ’ όψιν όλα τα ανωτέρω, τεκμαίρεται το συμπέρασμα ότι η **EnEarth**, ως μέλος του **Ομίλου Energean** και με τη χρηματοοικονομική στήριξη της τελικής μητρικής εταιρείας **Energean plc**, **διαθέτει την απαιτούμενη χρηματοοικονομική ικανότητα και επάρκεια**, τόσο σε ίδια κεφάλαια όσο και σε δανειακά κεφάλαια, για:

- την **κάλυψη του συνολικού κόστους** υλοποίησης της επένδυσης CCS στον Πρίνο,
- καθώς και την **εκπλήρωση όλων των πρόσθετων υποχρεώσεων** που απορρέουν από την Άδεια Αποθήκευσης CO_2 του έργου.

3. Χρηματική Εγγύηση

Η υποβληθείσα και αξιολογηθείσα Χρηματική Εγγύηση είναι σύμφωνη με την προσέγγιση που καθορίζεται στο Κατευθυντήριο Έγγραφο υπ’ αριθμόν 4 (GD4), στην Οδηγία CCS, καθώς και στην ΚΥΑ υπ’ αριθμόν ΥΠΕΝ/ΔΥΔΡ/16936/292 «Καθορισμός τύπου χρηματικών εγγυήσεων, εχέγγυων ισοδύναμων με την προβλεπόμενη χρηματική εγγύηση και κάθε άλλου θέματος για την εφαρμογή του άρθρου 24 του ν. 5261/2025 (Α΄ 231), σύμφωνα με την παρ. 8 του άρθρου 40 του ίδιου νόμου» (ΦΕΚ υπ’ αριθμόν 757/Β’/13.02.2026).
Το εν λόγω πλαίσιο αποσκοπεί στον ρητό καθορισμό όλων των μορφών εγγυήσεων που θεωρούνται ισοδύναμα εχέγγυα μέσα της χρηματικής εγγύησης, στο πλαίσιο της διαδικασίας έκδοσης άδειας αποθήκευσης. Στο πλαίσιο αυτό, τα εκτιμηθέντα και αξιολογηθέντα μέσα χρηματικής εγγυήσεως βασίζονται στο γεγονός ότι αναλαμβάνονται νέες νομοθετικές πρωτοβουλίες για τη διεύρυνση των προβλεπόμενων ισοδύναμων εχέγγυων μέσων χρηματικής εγγυήσεως, καθώς και στην εκτίμηση/ποσοτικοποίηση υποχρεώσεων που είναι βέβαιες ή τουλάχιστον πολύ πιθανές, καθώς και εκείνων που ενέχουν στοιχεία αβεβαιότητας ως προς την πιθανότητα επέλευσης τους.

3.1 Βέβαιες υποχρεώσεις, ήτοι υποχρεώσεις οι οποίες είναι βέβαιο ότι θα επέλθουν

Οι εν λόγω υποχρεώσεις, οι οποίες εκτείνονται σε όλο τον κύκλο ζωής του τόπου αποθήκευσης - από τη φάση της έγχυσης έως την φάση μετά την παύση λειτουργίας και το κλείσιμο της εγκατάστασης (post-closure) - αντιπροσωπεύουν προβλέψιμα κόστη και λειτουργικές παράμετροι. Ως εκ τούτου, πρέπει να ενσωματώνονται εξ αρχής στο επιχειρηματικό σχέδιο και στη στρατηγική χρηματοδότησης, διασφαλίζοντας την δέουσα διαφάνεια και ευθυγράμμιση με τις προσδοκίες των δανειστών.
Οι ακόλουθες υποχρεώσεις θεωρούνται βέβαιες ή τουλάχιστον εξαιρετικά πιθανές σύμφωνα με την Οδηγία CCS:

- **Σχέδιο Διαχείρισης Κινδύνων (Risk Management Plan)**
- **Παρακολούθηση κατά την έγχυση CO_2 (Monitoring during CO_2 injection)**, όπως προβλέπεται στο Άρθρο 13 της Οδηγίας CCS
- **Κόστη παύσης λειτουργίας και οριστικού κλεισίματος (Decommissioning and Closure Costs – DCC)**
- **Υποχρεώσεις υποβολής εκθέσεων (Reporting obligations)**, σύμφωνα με το Άρθρο 14 της άδειας αποθήκευσης

Τα ως άνω στοιχεία αντιμετωπίζονται ως βασικές (baseline) υποχρεώσεις στον χρηματοοικονομικό και λειτουργικό σχεδιασμό του έργου και αποτελούν μέρος του πλαισίου διαπραγμάτευσης με δανειστές και λοιπούς ενδιαφερόμενους φορείς. Παρότι ενδέχεται να προσθέτουν πολυπλοκότητα, παρέχουν μια δομημένη διαδικασία για συμμόρφωση και μετριασμό κινδύνων, ενισχύοντας τελικώς την αξιοπιστία και τη χρηματοδοτική βιωσιμότητα (bankability) του έργου.

3.1.1 Σχέδιο Διαχείρισης Κινδύνων (Risk Management Plan / RMP)

Το ετήσιο κόστος των €0,095 εκατ. θεωρείται ότι καλύπτει τις απαιτούμενες δαπάνες για την επικαιροποίηση των σχεδίων καθ’ όλη τη διάρκεια ζωής του έργου. Οι δαπάνες αυτές κατανέμονται ως εξής:

- RMP-1: Επικαιροποιήσεις μελετών που αφορούν το Σχέδιο Διαχείρισης Κινδύνων (Risk Management Plan), την Περιεκτικότητα/Ακεραιότητα (Containment) και την

Παρακολούθηση, Μέτρηση και Επαλήθευση (Monitoring, Measurement & Verification / MMV), με συνολικό εκτιμώμενο κόστος €0,7 εκατ., με συχνότητα ανά 5 έτη για περίοδο 20 ετών, οδηγώντας σε ετήσιο κόστος €0,035 εκατ. Η εκτίμηση κόστους βασίζεται σε προσφορές τρίτων και αντανακλά το κόστος αντίστοιχων μελετών σε έργα της βιομηχανίας CCS.

- RMP-2: Επιθεώρηση και επισκευές του συστήματος παρακολούθησης, με συνολικό εκτιμώμενο κόστος €1,2 εκατ., σε ετήσια βάση για τα πρώτα 20 έτη, οδηγώντας σε ετήσιο κόστος €0,06 εκατ. Το κόστος αποτυπώνει τρέχουσες τιμές αγοράς για αισθητήρες (gauges) και συναφές εξοπλισμό.

Ένας συντελεστής απροβλέπτων (contingency factor) της τάξεως του 30% εφαρμόζεται στο ποσό του Σχεδίου Διαχείρισης Κινδύνων (RMP), με στόχο τη διασφάλιση μιας συντηρητικής χρηματοοικονομικής εκτίμησης.

Πίνακας 1: Στοιχεία κόστους του Σχεδίου Διαχείρισης Κινδύνων

Σχέδιο Διαχείρισης Κινδύνων No (RMP No)	Περιγραφή	Συνολικό Κόστος (€ εκατ.)	Συχνότητα	Ετήσιο Κόστος (€ εκατ.)
RMP-1	Επικαιροποίηση μελετών	0,7	Κάθε 5 έτη (για 20 έτη)	0,035
RMP-2	Έλεγχος και επισκευή του συστήματος παρακολούθησης	1,2	Ετησίων (για 20 έτη)	0,060
Συνολικό Κόστος Σχεδίου διαχείρισης Κινδύνων (RMP)		**1,9**		**0,095**
RMP συμπεριλαμβανομένου του συντελεστή απροβλέπτων /contingency factor (30%)		**2,47**		**0,123**

3.1.2 Κόστη παρακολούθησης (Monitoring costs)

Τα κόστη παρακολούθησης περιλαμβάνουν τόσο λειτουργικές δαπάνες (Operational Expenditures/OpEx) όσο και κεφαλαιουχικές δαπάνες (Capital Expenditures/CapEx), που συνδέονται με την περίοδο βάσης πριν την Ημερομηνία Έναρξης Εμπορικής Λειτουργίας (Commercial Operation Date/COD) καθώς και με την περίοδο έγχυσης. Τα κόστη αυτά εκτιμώνται συνολικά σε περίπου **€72,9 εκατ.** Η εκτίμηση βασίζεται στο σενάριο όπου η βασική (baseline) περίοδος διαρκεί ένα έτος και η περίοδος έγχυσης είκοσι έτη.

Αντίθετα, τα κόστη παρακολούθησης κατά τη φάση μετά την παύση λειτουργίας και το κλείσιμο (post-closure), διάρκειας είκοσι ετών, αναμένεται να μειωθούν σημαντικά στα περίπου **€13,5 εκατ.** Η μείωση αυτή οφείλεται κυρίως στην σφράγιση, στεγανοποίηση και εγκατάλειψη **(plugging and abandonment/P&A)** των φρεατίων παρακολούθησης και στον **παροπλισμό (decommissioning)** των πλατφορμών, γεγονός που καταργεί την ανάγκη συνεχούς λειτουργίας φρεατίων και επιφανειακών εγκαταστάσεων.

Εκτιμάται ότι εντός ενός (1) έτους από το κλείσιμο του τόπου αποθήκευσης (δηλαδή στο 21^{ο} έτος από την Ημερομηνία Έναρξης της Εμπορικής Λειτουργίας), θα έχουν συλλεχθεί επαρκή δεδομένα παρακολούθησης ώστε να επιβεβαιωθεί η απουσία οδών διαρροής, υποστηριζόμενη από μετρήσεις πίεσης ταμιευτήρα και από την αποδεδειγμένη επαναληψιμότητα των προβλέψεων του μοντέλου προσομοίωσης, τεκμηριώνοντας έτσι την ακεραιότητα της συγκράτησης του CO_2.

Τα κόστη Παρακολούθησης καλύπτουν τα OpEx και CapEx για τις ακόλουθες τεχνολογίες και εργασίες:

- **Παρακολούθηση, Μέτρηση και Επαλήθευση (MMV-1): Single-Source, Single-Receiver systems (εταιρεία SpotLight)**

Η εταιρεία Spotlight έχει πραγματοποιήσει μελέτη σκοπιμότητας που επιβεβαιώνει ότι η τεχνολογία είναι πλήρως εφαρμόσιμη στο πεδίο του Πρίνου. Βάσει της εμπορικής τους πρότασης, το εκτιμώμενο κόστος ανά λήψη (acquisition) ανέρχεται σε €0,5 εκατ. ετησίως, συμπεριλαμβανομένων όλων των σχετικών δαπανών. Προβλέπεται μία έρευνα στην βασική (baseline) περίοδο, δέκα έρευνες κατά την περίοδο έγχυσης (κάθε δύο έτη), και δύο επιπλέον έρευνες κατά την περίοδο μετά το κλείσιμο (στα έτη 2 και 5).

- **Παρακολούθηση, Μέτρηση και Επαλήθευση (MMV-2): Τεχνολογίες που χρησιμοποιούνται για την παρακολούθηση των συνθηκών του υπεδάφους, μέσω συνεχούς μέτρησης ακουστικών και θερμοκρασιακών μεταβολών κατά μήκος οπτικών ινών (Distributed Acoustic and Temperature Sensing / DAS/DTS)**

Η εταιρεία Silixa πραγματοποίησε επίσης μελέτη σκοπιμότητας, η οποία επιβεβαίωσε ότι οι τεχνολογίες DAS/DTS είναι κατάλληλες για τα φρεάτια και τον λιθολογικό σχηματισμό του Πρίνου. Βάσει της εμπορικής τους προσφοράς:

- Το κόστος εγκατάστασης για 4 φρεάτια παρακολούθησης ανέρχεται σε €1,62 εκατ.
- Επιπλέον, υπάρχει ετήσια χρέωση €0,68 εκατ. για κόστος διαχείρισης έργου (project management) και μίσθωση εξοπλισμού παρακολούθησης.

Σύμφωνα με τα ανωτέρω:

- Η baseline OpEx περιλαμβάνει ένα έτος συλλογής δεδομένων,
- Κατά την περίοδο έγχυσης προβλέπονται 20 έτη παρακολούθησης (monitoring),
- Κατά την περίοδο μετά το κλείσιμο (post-closure) προβλέπονται 2 επιπλέον έτη συλλογής δεδομένων.

- **Παρακολούθηση, Μέτρηση και Επαλήθευση (MMV-3): Well Sentinel (9 συστήματα συλλογής / gathering systems)**

Το κόστος κάθε συστήματος WellSentinel ανέρχεται σε €0,35 εκατ., σύμφωνα με προσφορές που ελήφθησαν σε αρχική έρευνα αγοράς. Η τεχνολογία αυτή είναι καθιερωμένη για την παρακολούθηση εγκαταλελειμμένων φρεατίων από τον θαλάσσιο πυθμένα και έχει αποδειχθεί ιδιαιτέρως αξιόπιστη.

- Η ανωτέρω τιμή περιλαμβάνει τα κόστη εγκατάστασης.
- Κάθε σύστημα επιβαρύνεται με ετήσια χρέωση €0,006 εκατ. για δορυφορική παρακολούθηση.
- Τα συστήματα θα εγκατασταθούν κατά την baseline και θα παραμείνουν λειτουργικά καθ’ όλη την περίοδο έγχυσης.

- **Παρακολούθηση, Μέτρηση και Επαλήθευση (MMV-4): Silixa 4D DAS VSP**

Η μελέτη σκοπιμότητας της Silixa περιέλαβε επίσης τη χρήση της τεχνολογίας DAS VSP στα φρεάτια παρακολούθησης για έλεγχο της ακεραιότητας των παλαιών γεωτρήσεων (legacy wells).

- Το κόστος ανά λήψη DAS VSP εκτιμάται σε €0,06 εκατ. (με 4 φρεάτια παρακολούθησης).
- Προβλέπεται μία λήψη στην baseline περίοδο και 20 λήψεις για την περίοδο έγχυσης (περίπου δύο ανά δύο έτη).
- Το συνολικό εκτιμώμενο κόστος ανέρχεται σε €1,2 εκατ.

- **Παρακολούθηση, Μέτρηση και Επαλήθευση (MMV-5): Μετρητές πίεσης και θερμοκρασίας (surface & downhole gauges)**
  - Το κόστος προμήθειας εκτιμάται σε περίπου **€0,2 εκατ.**, πριν από την έναρξη της έγχυσης.
  - Τα λειτουργικά κόστη κατά τη διάρκεια της έγχυσης εκτιμώνται μεταξύ **€0,02** και **€0,06 εκατ. ανά έτος**, σύμφωνα με τρέχοντα δεδομένα της αγοράς.
  - Επιπλέον λειτουργικές δαπάνες περίπου **€0,06 εκατ. ανά έτος** προβλέπονται για τα δύο πρώτα χρόνια μετά το τέλος της έγχυσης.

Οι εκτιμήσεις αυτές αντικατοπτρίζουν αναλυτική αξιολόγηση βάσει βιομηχανικών προτύπων και παρέχουν αξιόπιστη βάση προϋπολογισμού χωρίς δέσμευση σε οριστικά ποσά σε αυτό το στάδιο.

- **Παρακολούθηση, Μέτρηση και Επαλήθευση (MMV-6): Επικαιροποίηση Υπόγειας γεωλογικής Μοντελοποίησης (Subsurface Modelling Updates)**

Αφορά λογισμικό, υλικό και εξειδικευμένη τεχνική υποστήριξη τρίτων για ενημερώσεις δυναμικών μοντέλων και αξιόπιστων προβλέψεων, ενσωματώνοντας όλα τα διαθέσιμα δεδομένα.

- Κόστος **€4,25 εκατ.** για την ενσωμάτωση όλων των βασικών (baseline) δεδομένων, καθώς και των δεδομένων που λήφθηκαν από τις γεωτρήσεις.
- Πρόσθετο κόστος **€1 εκατ. ανά έτος** κατά τη διάρκεια της έγχυσης για ενημέρωση μοντέλων και επιβεβαίωση προβλεψιμότητας.
- Κατά τη διάρκεια μετά το κλείσιμο υποτίθεται ότι τα μοντέλα έχουν ωριμάσει, επομένως απαιτείται μόνο **€4 εκατ. σε βάθος 20 ετών**.

- Οι εκτιμήσεις συνάδουν με αντίστοιχα έργα βιομηχανικής κλίμακας και διεθνείς κατευθυντήριες γραμμές.

- **Παρακολούθηση, Μέτρηση και Επαλήθευση (MMV-7): Περιβαλλοντικές Έρευνες (Environmental Surveys)**

Οι εκτιμήσεις κόστους βασίζονται σε προσφορά της εταιρείας Inosys. Η EnEarth σχεδιάζει πυκνή δειγματοληψία σε έκταση 1 km^2 πάνω από το δομικό ύψωμα του τόπου αποθήκευσης στον Πρίνο με εκτιμώμενο κόστος πέριξ των **€0,6 εκατ.** Τα κόστη περιλαμβάνουν ναύλωση/απονaύλωση σκάφους, εργασίες πεδίου (περίπου 4 ημέρες) και ανάλυση δεδομένων. Σε περιοχές με χαμηλότερο κίνδυνο διαρροής από υφιστάμενες γεωτρήσεις (legacy wells), απαιτείται αραιότερο δειγματοληπτικό πλέγμα. Το συνολικό κόστος ανά περιβαλλοντική έρευνα εκτιμάται σε **€1,2 εκατ.** Προβλέπεται **μία βασική (baseline) έρευνα**, και έρευνες στα έτη **5, 10, 15, 19** της περιόδου έγχυσης. Στην περίοδο μετά το κλείσιμο προβλέπονται **δύο έρευνες** στα έτη **5 και 15**.

Πίνακας 1: Στοιχεία κόστους της Παρακολούθησης, Μέτρησης και Επαλήθευσης

Παρακολούθηση, Μέτρηση και Επαλήθευση Νο (MMV Νο)	Περιγραφή	Βασικό επίπεδο αναφοράς (baseline) (€εκατ.)		Φάση Έγχυσης (€εκατ.)		Φάση μετά το κλείσιμο (€εκατ.)	
		Λειτουργικές δαπάνες OpEx	Κεφαλαιουχικές δαπάνες CapEx	Λειτουργικές δαπάνες OpEx	Κεφαλαιουχικές δαπάνες CapEx	Λειτουργικές δαπάνες OpEx	Κεφαλαιουχικές δαπάνες CapEx
MMV-1	Single-Source, Single-Receiver systems (SpotLight)	0,50	-	5,00		2,50	
MMV-2	Τεχνολογίες μέτρησης ακουστικών και θερμοκρασιακών μεταβολών κατά μήκος οπτικών ινών (DAS/DTS)	0,68	1,62	13,56		1,36	
MMV-3	Well Sentinel systems	0,05	3,16	1,05			
MMV-4	DAS (Silixa)	0,06	-	1,20			

MMV-5	Όργανα μέτρησης πίεσης και θερμοκρασίας (επιφανειακά και εντός γεώτρησης)	0,20	-	0,76	-	0,12	
MMV-6	Επικαιροποίηση του μοντέλου υπεδάφους (Update of Subsurface Modeling)	4,25	-	18,00		4,00	
MMV-7	Περιβαλλο-ντικές Έρευνες	1,00	-	4,80		2,40	
MMV		**6,54**	**4,78**	**44,37**	**0**	**10,38**	**0**
Συνολικό κόστος MMV συμπεριλαμβανομένου του συντελεστή απροβλέπτων (30%)		**9,02**	**6,21**	**57,68**	**0**	**13,49**	**0**
Ετήσιο Ποσό		**3,65**				**0,67**	

3.1.3 Αναφορά / Υποβολή Αναφορών (Reporting)

Ο Φορέας Εκμετάλλευσης θα υποβάλλει όλα τα αποτελέσματα παρακολούθησης, σύμφωνα με το Άρθρο 13 της Οδηγίας CCS και το ν.5261/2026, στην Αρμόδια Αρχή (ΑΑ) σε μηνιαία βάση κατά τον πρώτο χρόνο και τριμηνιαία κατά τα επόμενα έτη.

Η αναφορά θα περιλαμβάνει, επιπλέον, πληροφορίες σχετικά με:

- την τεχνολογία παρακολούθησης που χρησιμοποιείται,
- τις ποσότητες και τις ιδιότητες των ρευμάτων CO_2 που παραδίδονται, εγχέονται και αποθηκεύονται, συμπεριλαμβανομένης της σύστασής τους,
- απόδειξη ύπαρξης του Συστήματος Χρηματικής Εγγυήσεως (Financial Security) σύμφωνα με το Άρθρο 19 και το Άρθρο 9(9),

- και οποιαδήποτε άλλη πληροφορία κρίνει σχετική η ΑΑ για τους σκοπούς:
    - της αξιολόγησης της συμμόρφωσης με τους όρους της Άδειας Αποθήκευσης και
    - της ενίσχυσης της κατανόησης της συμπεριφοράς του διοξειδίου του άνθρακα (CO_2) στον τόπο αποθήκευσης.

Για την κάλυψη των ανωτέρω υποχρεώσεων, εκτιμάται ετήσιο κόστος €0,075 εκατ., επαρκές για την κάλυψη των αναγκών αναφοράς του έργου. Όπως και στα προηγούμενα στοιχεία κόστους, προστέθηκε συντελεστής απροβλέπτων 30%, με αποτέλεσμα το τελικό ετήσιο ποσό να ανέρχεται σε €0,098 εκατ.

3.1.4 Κόστη Παροπλισμού και Παύσης Λειτουργίας / Κλεισίματος (Decommissioning and Closure Costs / DCC)

Τα κόστη παροπλισμού και κλεισίματος (DCC) λαμβάνουν υπ’ όψιν όλες τις πρόσθετες δαπάνες που απαιτούνται ώστε ο τόπος αποθήκευσης να κλείσει με τρόπο απόλυτα στεγανό ως προς το CO_2. Τα στοιχεία που περιλαμβάνονται στο DCC είναι:

- οι εργασίες σφράγισης και εγκατάλειψης (Plugging & Abandonment - P&A) της νέας γεώτρησης που θα διανοιχθεί και
- η απενεργοποίηση όλων των συναφών εγκαταστάσεων που θα κατασκευαστούν ειδικά για το έργο Prinos CO_2,

όπως παρουσιάζονται στον παρακάτω πίνακα.

Πίνακας 2: Στοιχεία κόστους του παροπλισμού και της παύσης λειτουργίας / κλεισίματος (DCC cost elements)

Κόστος απενεργοποίησης και κλεισίματος Νο (DCC No)	**Περιγραφή**	**Συνολικό Κόστος (€εκατ.)**
DCC-1	Παροπλισμός των εγκαταστάσεων που κατασκευάστηκαν ειδικά για το έργο Prinos CO_2	4,38
DCC-2	Σφράγιση, στεγανοποίηση και εγκατάλειψη (P&A) νέων γεωτρήσεων που θα διανοιχθούν από νέες τοποθεσίες	21,09
DCC-3	Αποξήλωση και παροπλισμός της νέας Πλατφόρμας (Πλατφόρμα Omega)	15,35
DCC-4	Συμπληρωματικές εγκαταστάσεις και γεωτρήσεις	Όπως προσδιοριστεί σε μελλοντική επέκταση του έργου
DCC	**Σύνολο**	**40,82**

Η χρηματική εγγύηση (financial security) για την κάλυψη του κόστους εγκατάλειψης μπορεί να προσδιοριστεί μέσω μιας προσέγγισης Καθαρής Παρούσας Αξίας (ΚΠΑ ή Net Present Value/NPV) και να προστεθεί στο συνολικό κόστος των «Συγκεκριμένων Στοιχείων». Πιο συγκεκριμένα, για κάθε έτος n, η προεξοφλημένη αξία της μελλοντικής υποχρέωσης υπολογίζεται σύμφωνα με τον ακόλουθο τύπο:

$$Ετήσια\ πρόβλεψη\ (Annual\ provision) = \frac{DCC_{Total}}{(1 + WACC)^{20-n}}$$

όπου:

- *WACC* (Weighted Average Cost of Capital) είναι το Μεσοσταθμικό Κόστος Κεφαλαίου όπως εγκρίθηκε από την Ευρωπαϊκή Επιτροπή στην απόφαση κρατικής ενίσχυσης SA.108267 (2024/N) και σύμφωνα με τους υπολογισμούς του χρηματοδοτικού κενού που οδήγησαν στη χορήγηση της επιδότησης CEF (Connecting Europe Facility), βάσει της συμφωνίας μεταξύ του Διαχειριστή και της Ευρωπαϊκής Επιτροπής.
- *n* είναι το τρέχον έτος

Η ετήσια πρόβλεψη παραμένει σταθερή σε κάθε πενταετή περίοδο και επανυπολογίζεται στην αρχή κάθε νέας περιόδου βάσει της επικαιροποιημένης Καθαρής Παρούσας Αξίας (NPV). Ως αποτέλεσμα, η πρόβλεψη διαμορφώνεται ως εξής:

- **€5,34 εκατ.** ετησίως για τα Έτη 1–5
- **€9,12 εκατ.** ετησίως για τα Έτη 6–10
- **€15,57 εκατ.** ετησίως για τα Έτη 11–15
- **€26,60 εκατ.** ετησίως για τα Έτη 16–20

3.2 Μη βέβαιες υποχρεώσεις, ήτοι υποχρεώσεις των οποίων η επέλευση δεν θεωρείται βεβαία

Οι μη βέβαιες υποχρεώσεις δύνανται να καλυφθούν μέσω ασφαλιστηρίου συμβολαίου, σύμφωνα με το άρθρο 3 παρ. 1 iii) της ΚΥΑ ΥΠΕΝ/ΔΥΔΡ/16936/292 (ΦΕΚ υπ’ αριθμόν 757/Β’/13.02.2026), προκειμένου να υποστηριχθούν:

- Τα διορθωτικά μέτρα όπως προβλέπονται στο Άρθρο 16, συμπεριλαμβανομένης της επικαιροποίησης του εγκεκριμένου σχεδίου διορθωτικών μέτρων.
- Οι δαπάνες που απορρέουν από την υποχρέωση παράδοσης δικαιωμάτων εκπομπών της Ευρωπαϊκής Ένωσης (EUAs), σύμφωνα με τις διατάξεις της Οδηγίας 2023/959/ΕΕ («Οδηγία ETS»), για κάθε τόνο CO_2 που έχει διαφύγει
- Επιπλέον, η Χρηματική Εγγύηση (Financial Security / FS) θα πρέπει να εξετάζει επιλογές κάλυψης του κόστους που βαρύνει την Αρχή κατά τη διάρκεια μιας προσωρινής λειτουργίας του τόπου στην απίθανη περίπτωση που η άδεια αποθήκευσης του φορέα εκμετάλλευσης έχει ανακληθεί σύμφωνα με το Άρθρο 11(4). Το εν λόγω κόστος αφορά τη διαδικασία αποδοχής διαρροής διοξειδίου του άνθρακα (συμπεριλαμβανομένης της τήρησης μητρώου των παραδιδόμενων ροών CO_2) καθώς και τη διενέργεια παρακολούθησης.

3.2.1 Διορθωτικά μέτρα (Corrective measures)

Τα διορθωτικά μέτρα αναφέρονται σε ενέργειες που λαμβάνονται για την αντιμετώπιση σοβαρών ζητημάτων, όπως η διαρροή CO_2 από το συγκρότημα αποθήκευσης. Τα μέτρα αυτά ενσωματώνονται στο Σχέδιο Διαχείρισης Κινδύνων (RMP) του έργου, με σκοπό τη διασφάλιση της μακροχρόνιας ακεραιότητας και ασφαλούς συγκράτησης του αποθηκευμένου CO_2.

Σε περίπτωση επιβεβαιωμένης διαρροής, ο φορέας εκμετάλλευσης υποχρεούται να προβεί στην εφαρμογή των αναγκαίων μέτρων αποκατάστασης, τα οποία δύνανται να περιλαμβάνουν την αποκατάσταση μιας γεώτρησης που τυχόν παρουσιάσει σημαντική ανωμαλία μέσω της εκτέλεσης μιας βαθιάς τέμνουσας γεώτρησης (deep intersection well), λειτουργικώς αντίστοιχης με γεώτρηση αποσυμπίεσης (relief well), ιδίως στις περιπτώσεις όπου η άμεση πρόσβαση στην προβληματική γεώτρηση δεν είναι εφικτή. Η ως άνω υποχρέωση καταλαμβάνει τόσο τις υφιστάμενες όσο και τις νέες γεωτρήσεις.

Το εκτιμώμενο κόστος για μια τέτοια παρέμβαση ανέρχεται σε €29,6 εκατ., όπως παρουσιάζεται στον ακόλουθο πίνακα:

Πίνακας 4: Ανάλυση κόστους για διάτρηση βαθιάς τέμνουσας γεώτρησης (deep intersection)

Ανάλυση κόστους (deep intersection) (€εκατ.)	
Σχεδιασμός Δράσης / Campaign Planning	0,25
Mobilization / Demobilization Εργοταξίου (ανά δράση) / Campaign Mobilization / Demobilization (Per Campaign)	0,80

Φάση αποκατάστασης υποδομής γεώτρησης-δότη (εξοπλισμός και υπηρεσίες) / Donor well slot recovery phase (equipment and services)	10,02
Βαθιά τέμνουσα γεώτρηση (deep intersection well): Εξοπλισμός μεγάλης προθεσμίας προμήθειας (long-lead) και αναλώσιμα (ανά γεώτρηση) / Deep Intersection: Long Lead Equipment & Consumables (Per Well)	2,34
Βαθιά τέμνουσα γεώτρηση (deep intersection well): Υπηρεσίες / Deep Intersection: Services	13,06
ΣΥΝΟΛΙΚΟ ΚΟΣΤΟΣ ΓΕΩΤΡΗΣΗΣ	**29,56**

Λόγω των αβεβαιοτήτων που υφίστανται στις εκτιμήσεις κόστους για βαθιές γεωτρήσεις διασταύρωσης, έχει προστεθεί συντελεστής απροβλέπτων της τάξεως του 20%. Πρόσθετες δαπάνες θα προκύψουν όταν ο θύσανος CO_2 (CO_2 plume) προσεγγίσει γεωτρήσεις με γνωστές ανωμαλίες, ενεργοποιώντας ενισχυμένα μέτρα παρακολούθησης. Η εν λόγω «ενεργοποιούμενη παρακολούθηση» (triggered monitoring), η οποία απαιτείται βάσει της Οδηγίας CCS της ΕΕ όταν οι παρατηρούμενες συνθήκες αποκλίνουν από τις προβλεπόμενες στο μοντέλο, αποτελεί μέρος του σχεδίου διορθωτικών ενεργειών και συμβάλλει στη διαπίστωση του κατά πόσον απαιτείται βαθιά επέμβαση. Για τον χώρο Πρίνου, η ενεργοποιούμενη παρακολούθηση ενδέχεται να περιλαμβάνει την απόκτηση τοπικού 4D σεισμικού συνόλου δεδομένων, προκειμένου να επιβεβαιωθεί ο περιορισμός του θυσάνου CO_2 εντός του ταμιευτήρα. Οι σχετικές δαπάνες παρουσιάζονται στον ακόλουθο πίνακα.

Πίνακας 5: Δαπάνη ενεργοποιούμενης παρακολούθησης (Triggered monitoring cost)

Τεχνολογία		**Βασικό επίπεδο αναφοράς (baseline) (€M)**		**Injection (€M)**		**Post Closure (€M)**
	OpEx	CapEx	OpEx	CapEx	OpEx	CapEx
Νέα τρισδιάστατη (3D) σεισμική έρευνα – συλλογή και επεξεργασία δεδομένων (γραμμή βάσης) στο πλαίσιο ενεργοποιούμενης παρακολούθησης New 3D Seismic Survey Acquisition and Processing – Baseline (Triggered Monitoring)		2,78				
Silixa 4D DAS VSP (Ενεργοποιούμενη παρακολούθηση/Triggered Monitoring)			0,6		4	
Σύνολο ανά φάση		**2,78**	**0,6**		**4**	
Σύνολο ανά φάση, συμπεριλαμβανομένου συντελεστή απροβλέπτων (contingency factor) 30%		**3,61**	**0,78**		**5,2**	

3.2.2 Παράδοση των απαιτούμενων δικαιωμάτων εκπομπών (Surrender of allowances)

Σε μια εξαιρετικά απίθανη περίπτωση διαρροής από τον ταμιευτήρα (reservoir), ο κάτοχος της άδειας υποχρεούται να αγοράσει Δικαιώματα Εκπομπών της Ευρωπαϊκής Ένωσης (EUAs) βάσει της Οδηγίας 2023/959/ΕΕ, με ένα EUA να απαιτείται για κάθε τόνο CO_2 που έχει διαρρεύσει. Ένα σενάριο μέγιστης αρνητικής περίπτωσης (worst case), όπως προσομοιώθηκε από τον Φορέα Εκμετάλλευσης, εκτιμά ρυθμό διαρροής 23 τόνων/ημέρα για 204 ημέρες, ήτοι συνολικά 950 τόνοι εκλυόμενοι από μία παλαιά γεώτρηση (legacy well). Το σενάριο αυτό προϋποθέτει μέγιστη πίεση ταμιευτήρα και ρηχή ζώνη εκκίνησης της διαρροής, με το CO_2 να μεταναστεύει αργότερα προς τον θαλάσσιο πυθμένα σε ορίζοντα 1.000 ετών. Στο συντηρητικότερο σενάριο, εξετάζεται επίσης το ενδεχόμενο ταυτόχρονων διαρροών από τέσσερις γεωτρήσεις με γνωστές ανωμαλίες, παρά την πολύ χαμηλή πιθανότητα εμφάνισης (1e-04), με τις παρεμβάσεις αποκατάστασης να πραγματοποιούνται διαδοχικά, περιορίζοντας τον χρόνο επιδιόρθωσης σε 80 ημέρες ανά γεώτρηση μετά την πρώτη. Το συνολικό θεωρητικό φορτίο CO_2 που θα μπορούσε να εκλυθεί από όλες τις γεωτρήσεις εκτιμάται σε 6.035 τόνους, γεγονός που συνεπάγεται δυνητική χρηματοοικονομική έκθεση ύψους €603 χιλ. με τιμή €100 ανά τόνο.

Πίνακας 6: Συνολική έκλυση CO_2 από γεωτρήσεις με ανωμαλίες

Πλήθος γεωτρήσεων που παρουσιάζουν διαρροή ταυτοχρόνως	Αριθμός ημερών διαρροής CO_2 από τη γεώτρηση πριν τη διακοπή	Εκτιμώμενος όγκος δυνητικής έκλυσης CO_2 στον θαλάσσιο πυθμένα (τόνοι CO_2)
1	204	950
2	284	1.323
3	364	1.695
4	444	2.068
Σύνολο		**6.035**

3.2.3 Κάλυψη ποσών που αφορούν υποχρεώσεις μη βέβαιες προς επέλευση (Coverage of Uncertain Amounts)

Το κόστος των στοιχείων που καθίστανται αβέβαια ως προς την επέλευσή τους, προτείνεται να καλυφθεί μέσω ασφάλισης (insurance). Η EnEarth βρίσκεται ήδη σε συνεργασία με διεθνείς ασφαλιστικούς διαμεσολαβητές (όπως παρουσιάζεται στον παρακάτω πίνακα), με σκοπό τον σχεδιασμό της κατάλληλης κάλυψης, των ορίων και των απαλλαγών, καθώς και την προσέγγιση ασφαλιστικών διαμεσολαβητών για τη διαπραγμάτευση των όρων και προϋποθέσεων μετά της τιμολογήσεως για τη μεταβίβαση των κινδύνων λειτουργίας CCS. Το αναμενόμενο ασφάλιστρο ανέρχεται επί του παρόντος στο επίπεδο του 3% των συνολικών αβέβαιων ποσών που θα καλυφθούν και παρουσιάζονται ανωτέρω.

Ημερομηνία	**Δραστηριότητα**
Μάιος 2023	**Διήμερες συζητήσεις με κορυφαίες ασφαλιστικές εταιρείες στο Λονδίνο** για την παρουσίαση του έργου και την έναρξη διαβουλεύσεων
Λοιπό 2023	Άτυπες συζητήσεις με μεσίτες ασφαλίσεων για την κατανόηση των δυνατοτήτων υποστήριξης του Prinos CO_2 καθώς και άλλων στοιχείων ενεργητικού της Energean.
H1- Q3 2024	Αίτημα υποβολής προτάσεων για την παροχή συμβουλευτικών υπηρεσιών στον Όμιλο Energean σχετικά με ασφαλιστικά προϊόντα. Το αίτημα περιλάμβανε και αντικείμενο αποθήκευσης CO_2. Στον διαγωνισμό συμμετείχαν έξι εταιρείες. Εταιρείες χωρίς εμπειρία στο CCS αποκλείστηκαν.
Δεκέμβριος 2024	Workshop με τον επιλεγέντα φορέα (AON) σχετικά με τις Συμβουλευτικές Υπηρεσίες και τη Στρατηγική Τοποθέτησης & Marketing για το Prinos CO_2 (το σχετικό υλικό είναι διαθέσιμο κατόπιν αιτήματος). Πραγματοποιήθηκε η 1η αίτηση παροχής δεδομένων από την EnEarth προς τον Μεσίτη.
Φεβρουάριος-Μάρτιος 2025	Workshops για τα ασφαλίσιμα στοιχεία της χρηματικής εγγυήσεως (ειδικά για το Prinos). Υποβλήθηκε η 2η αίτηση παροχής δεδομένων από την EnEarth προς τον Μεσίτη.
Ιούνιος 2025	Workshop σχετικά με τους κινδύνους κατασκευής και έγχυσης.
Ιούλιος 2025	Αξιολόγηση από τους Μεσίτες του επικαιροποιημένου εσωτερικού σχεδίου του μηχανισμού Χρηματικής Εγγυήσεως. Κατόπιν εισήγησής τους, η σχετική ενότητα (5ο μέρος του ασφαλιστηρίου) επικαιροποιήθηκε ώστε να ενσωματώνει θέματα ακεραιότητας του ταμιευτήρα. Υποβλήθηκε η 3η λεπτομερής αίτηση παροχής δεδομένων.
Οκτώβριος 2025	Διήμερο workshop στην Αθήνα για την παρουσίαση των τελευταίων εξελίξεων του έργου και συζήτηση θεμάτων (Q&A) επί των αιτημάτων δεδομένων. Εύρη εκτιμώμενων ασφαλίστρων και ορίων κάλυψης αναμένεται να παρασχεθούν το προσεχές διάστημα, τουλάχιστον για τα εξής: διορθωτικά μέτρα, δικαιώματα εκπομπών CO_2, καθώς και για ανάκληση άδειας ή πρόωρο τερματισμό λειτουργίας.

3.3 Χρηματοδοτική Συνεισφορά (Financial Contribution)

Σύμφωνα με το Άρθρο 15 παρ. 11 της Άδειας Αποθήκευσης, το ποσό της Χρηματοδοτικής Συνεισφοράς καθορίζεται μετά το κλείσιμο του τόπου αποθήκευσης και πριν από τη μεταβίβαση της ευθύνης στο Ελληνικό Δημόσιο.

Η συνεισφορά του Φορέα Εκμετάλλευσης λαμβάνει υπ’ όψιν τα στοιχεία που σχετίζονται με το ιστορικό της αποθήκευσης CO_2 και καλύπτει τις αναμενόμενες δαπάνες παρακολούθησης επί 30 έτη καθώς και συμπληρωματικά τις διατάξεις του π.δ. 148/2009 (Α’ 190). Μετά τη μεταβίβαση της ευθύνης, η χρηματοδοτική αυτή συνεισφορά χρησιμοποιείται για την κάλυψη των δαπανών που βαρύνουν την αρμόδια αρχή, προκειμένου να εξασφαλίζεται η μόνιμη και ασφαλής απομόνωση του CO2 σε τόπους αποθήκευσης σε γεωλογικούς σχηματισμούς. Το ύψος της χρηματοδοτικής συνεισφοράς καθορίζεται με απόφαση της Αρχής CCS, η οποία εκδίδεται μετά το κλείσιμο του τόπου αποθήκευσης και πριν από τη μεταβίβαση της ευθύνης, μετά από εισήγηση του φορέα αποθήκευσης, σχετικά με τη μεθοδολογία υπολογισμού, λαμβάνοντας υπόψη τις δαπάνες παρακολούθησης του συγκεκριμένου τόπου αποθήκευσης.

Η μεθοδολογία υπολογισμού θα προταθεί από την EnEarth και θα λαμβάνει υπ’ όψιν το κόστος παρακολούθησης του συγκεκριμένου τόπου αποθήκευσης για την περίοδο μετά τη μεταβίβαση της ευθύνης. Ως εκ τούτου, η Χρηματοδοτική Συνεισφορά δεν συμπεριλαμβάνεται ούτε πρέπει να συμπεριλαμβάνεται στον υπολογισμό της χρηματικής εγγυήσεως.

3.4 Συνοπτικά ποσά Χρηματικής Εγγυήσεως κατά την διάρκεια όλων των φάσεων του Έργο

Πίνακας 7: Εκτίμηση απαιτούμενης Χρηματικής Εγγυήσεως / Ασφάλειας (€εκατ.)
(Έγχυση: Έτη 1 – 20, Μετά το Κλείσιμο: Έτη 21 -40 μετά την Ημερομηνία Έναρξης Εμπορικής Λειτουργίας)

Τύπος	Έτος 1	Έτος 2	Έτος 3	Έτος 4	Έτος 5	…	Έτος 19	Έτος 20[2]	Έτος 21	…	Έτος 37	Έτος 38	Έτος 39	Έτος 40[3]
Βέβαια Στοιχεία														
Σχέδιο Διαχείρισης Κινδύνων (Risk Management Plan)	0,12	0,12	0,12	0,12	0,12		0,12	0,12	0,12		0,12	0,12	0,12	0,12
Παρακολούθηση (Monitoring)	3,65	3,65	3,65	3,65	3,65		3,65	3,65	0,67		0,67	0,67	0,67	0,67
Αναφορά (Reporting)	0,098	0,098	0,098	0,098	0,098		0,098	0,098	0,098		0,098	0,098	0,098	0,098
Παροπλισμός και παύση λειτουργίας/ κλείσιμο (Decommissioning and Closure)	5,34	5,34	5,34	5,34	5,34		26,6	26,6	0		0	0	0	0
Κόστος εποπτείας από την Αρμόδια Αρχή (CA oversight)	0,05	0,05	0,05	0,05	0,05		0,05	0,05	0,05		0,05	0,05	0,05	0,05
Σύνολο	**9,26**	**9,26**	**9,26**	**9,26**	**9,26**		**30,5**	**30,5**	**0,95**		**0,95**	**0,95**	**0,95**	**0,95**
Αβέβαια Στοιχεία														
Παράδοση Δικαιωμάτων Εκπομπών CO_2 (Surrender of Allowances CO_2)	0	0	0	0	0		1,62	1,67	1,72		1,9	1,9	1,9	1,9
Διορθωτικά Μέτρα (Corrective Measures)	29,56	29,56	29,56	29,56	29,56		29,56	29,56	29,56		29,56	29,56	29,56	29,56
Ενεργοποιούμενη παρακολούθηση (Triggered Monitoring)	0,039	0,039	0,039	0,039	0,039		0,039	0,039	0,26		0,26	0,26	0,26	0,26
Σύνολο	**29,6**	**29,6**	**29,6**	**29.6**	**29,6**		**31,3**	**31,3**	**31,6**		**31,8**	**31,8**	**31,8**	**31,8**
Γενικό Σύνολο	**38,9**	**38,9**	**38,9**	**38.9**	**38,9**		**61,8**	**61,8**	**32,5**		**32,8**	**32,8**	**32,8**	**32,8**

Σημείωση:

- Τα «Βέβαια Στοιχεία» αφορούν υποχρεώσεις των οποίων η επέλευση καθίσταται βεβαία ή, τουλάχιστον, πολύ πιθανή.
- Τα «Αβέβαια Στοιχεία» αφορούν υποχρεώσεις των οποίων η επέλευση δεν καθίσταται βεβαία και κρίνεται ως μη πιθανή.

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[2] Πέρας της εμπορικής έγχυσης διοξειδίου του άνθρακα (CO_2)

[3] Πέρας της μετά το κλείσιμο περιόδου / Διαβίβαση στο δημόσιο

3.5 Μεθοδολογία Αναπροσαρμογής της Χρηματικής Εγγυήσεως

Το άρθρο 19(2) της Οδηγίας CCS προβλέπει ότι η χρηματική εγγύηση πρέπει να αναπροσαρμόζεται περιοδικά, ώστε να λαμβάνει υπ’ όψιν τυχόν μεταβολές στον εκτιμώμενο κίνδυνο διαρροής και το κατ’ εκτίμηση κόστος όλων των σχετικών υποχρεώσεων. Η Οδηγία CCS δεν προσδιορίζει πότε πρέπει να λαμβάνουν χώρα οι αναπροσαρμογές των ποσών της χρηματικής εγγυήσεως, ελλείψει πυροδοτικού γεγονότος (όπως μεταβολή του εκτιμώμενου κινδύνου διαρροής). Περαιτέρω, το Αρ. 24 του Ν.5261/2025 ορίζει ότι η Χρηματική Εγγύηση πρέπει να αναπροσαρμόζεται κάθε πέντε έτη, λαμβάνοντας υπ’ όψιν τις ανωτέρω παραμέτρους.

Ο Φορέας Εκμετάλλευσης προτείνει η Χρηματική Εγγύηση (Financial Security) να υπόκειται σε υποχρεωτική επαναξιολόγηση και αναπροσαρμογή του ποσού της:

- Τουλάχιστον ανά πέντε (5) έτη, ώστε να λαμβάνονται υπ’ όψιν τυχόν μεταβολές στον εκτιμώμενο κίνδυνο διαρροής και στο εκτιμώμενο κόστος όλων των υποχρεώσεων που απορρέουν από την Άδεια Αποθήκευσης, καθώς και τυχόν πρόσθετες υποχρεώσεις που προκύπτουν από τις διατάξεις της Οδηγίας ETS, και/ή
- Κατόπιν αιτήματος της Αρμόδιας Αρχής ή του Φορέα Εκμετάλλευσης, όταν υφίστανται ουσιώδεις μεταβολές στο εκτιμώμενο κόστος των υποχρεώσεων που απορρέουν από την Άδεια Αποθήκευσης ή όταν μεταβάλλονται κρίσιμες παράμετροι (συμπεριλαμβανομένων μεταβολών στον εκτιμώμενο κίνδυνο διαρροής, επικαιροποιημένων γεωλογικών μοντέλων, τεχνολογικών εξελίξεων, τροποποιήσεων του κανονιστικού πλαισίου ή σημαντικών διακυμάνσεων στην τιμή των δικαιωμάτων εκπομπών CO_2).

Η αναπροσαρμογή τεκμηριώνεται μέσω επικαιροποιημένων υπολογισμών και αξιολογήσεων που υποβάλλονται από την EnEarth και εγκρίνονται από την Αρμόδια Αρχή.

Η διαδικασία για την επαναξιολόγηση και αναπροσαρμογή του ύψους της Χρηματικής Εγγυήσεως παρουσιάζεται κατωτέρω. Το εν λόγω διάγραμμα ροής αποτυπώνει τη διαδικασία υποχρεωτικής επαναξιολόγησης και αναπροσαρμογής της Χρηματικής Εγγυήσεως (Financial Security), όπως προτείνεται. Η Χρηματική Εγγύηση πρέπει να επανεξετάζεται τουλάχιστον ανά πέντε (5) έτη ή κατόπιν αιτήματος, όταν επέλθουν ουσιώδεις μεταβολές. Η αναπροσαρμογή τεκμηριώνεται μέσω επικαιροποιημένων υπολογισμών και αξιολογήσεων που καταρτίζονται από την EnEarth και εγκρίνονται από την Αρμόδια Αρχή (ΕΔΕΥΕΠ).

Έναρξη

Χρηματική Εγγύηση εν ισχύι Financial Security (FS)

Συμβάν ενεργοποιήσεως

Υποχρεωτική επανεξέταση κάθε 5 έτη ή κατόπιν αιτήματος της Αρμόδιας Αρχής ή του Φορέα Εκμετάλλευσης λόγω ουσιωδών μεταβολών

Εντοπισμός Ουσιωδών Μεταβολών (Material Changes)

Μεταβολές στον εκτιμώμενο κίνδυνο διαρροής· στο εκτιμώμενο κόστος όλων των υποχρεώσεων που απορρέουν από την Άδεια Αποθήκευσης CO_2· σε τυχόν υποχρεώσεις που προκύπτουν από τις διατάξεις της Οδηγίας ETS· ή τροποποιήσεις σε άλλες κρίσιμες παραμέτρους, συμπεριλαμβανομένων μεταβολών στον εκτιμώμενο κίνδυνο διαρροής, επικαιροποιημένων γεωλογικών μοντέλων, τεχνολογικών εξελίξεων, τροποποιήσεων του κανονιστικού πλαισίου ή σημαντικών διακυμάνσεων στην τιμή των δικαιωμάτων εκπομπών CO_2.

Κατάρτιση των Επικαιροποιημένων Αξιολογήσεων (EnEarth)

Επικαιροποίηση των εκτιμήσεων κόστους και του κινδύνου διαρροής· ανανέωση των γεωλογικών/τεχνικών παραδοχών· επανυπολογισμός του ποσού της Χρηματικής Εγγυήσεως· κατάρτιση φακέλου τεκμηρίωσης.

Υποβολή στην Αρμόδια Αρχή (ΕΔΕΥΕΠ ή HEREMA στην Αγγλική)

EnEarth submits updated calculations, assessments, and supporting documentation to HEREMA

Απόφαση

Έγκριση του αναθεωρημένου ποσού της Χρηματικής Εγγυήσεως ή αίτημα για αναθεωρήσεις / πρόσθετες πληροφορίες

Υλοποίηση της Αναθεωρημένης Χρηματικής Εγγυήσεως

Εφόσον εγκριθεί: εφαρμογή νέου ποσού FS από τον Φορέα Εκμετάλλευσης · καταχώριση έγκρισης/ημερομηνίας ισχύος από την Αρμόδια Αρχή · έναρξη νέας περιόδου ισχύος.»

4. Αξιολόγηση προς αποδοχή εκδοτών και ειδικότεροι όροι για την αποδοχή χρηματικών εγγυήσεων και ισοδύναμων εχέγγυων

4.1 Αξιολόγηση Μέσων Χρηματικής Εγγυήσεως από Χρηματοπιστωτικούς Οργανισμούς

Ο κάτοχος της Άδειας θα πρέπει επίσης να εξηγεί με ποιον τρόπο το μέσο Χρηματικής Εγγυήσεως πληροί τα κριτήρια επιλεξιμότητας για τον συγκεκριμένο τύπο μέσου, καθώς και να αιτιολογεί τυχόν αποκλίσεις από τα εν λόγω κριτήρια και να περιλαμβάνει δήλωση σχετικά με τον αντίκτυπο των αποκλίσεων αυτών στη βεβαιότητα και ρευστότητα της Χρηματικής Εγγυήσεως. Ο κάτοχος της Άδειας θα πρέπει επίσης να παρέχει τεκμηρίωση σχετικά με την επιλεξιμότητα των παρόχων της Χρηματικής Εγγυήσεως. Δυνάμει του άρθρου 4 της ΚΥΑ υπ’ αριθμόν ΥΠΕΝ/ΔΥΔΡ/16936/292/13.02.2026 (Β΄757) ισχύουν τα εξής:

- Οι χρηματικές εγγυήσεις και τα ισοδύναμα εχέγγυα των άρθρων 2 και 3 της ως άνω ΚΥΑ εκδίδονται αποκλειστικά από τράπεζες, ασφαλιστικές επιχειρήσεις ή λοιπά χρηματοπιστωτικά ιδρύματα που διαθέτουν νόμιμη άδεια λειτουργίας εντός κράτους-μέλους της Ευρωπαϊκής Ένωσης, σύμφωνα με το ισχύον κανονιστικό πλαίσιο, και τελούν υπό την εποπτεία των αρμόδιων αρχών.
- Σε περίπτωση που το εκδίδον ίδρυμα έχει έδρα εκτός Ευρωπαϊκής Ένωσης, απαιτείται να διαθέτει νόμιμη άδεια λειτουργίας εντός κράτους-μέλους της Ε.Ε. ή να δραστηριοποιείται μέσω εγκατεστημένου υποκαταστήματος το οποίο τελεί υπό την εποπτεία αρμόδιας αρχής κράτους-μέλους.
- Τα ως άνω ιδρύματα οφείλουν να διαθέτουν ελάχιστη πιστοληπτική αξιολόγηση “investment grade” (τουλάχιστον BBB-) ή ισοδύναμη, βάσει αξιολόγησης αναγνωρισμένου οίκου αξιολόγησης κατά τα οριζόμενα στην ισχύουσα νομοθεσία.
- Όσον αφορά την περ. ii της παρ. 1 του άρθρου 3 της ως άνω ΚΥΑ, η εν λόγω εγγύηση δεν θα γίνεται δεκτή αν προέρχεται από εταιρεία που εδρεύει σε κράτος μη συνεργάσιμο δυνάμει των παρ. 1 έως 4 του άρθρου 65 του ν. 4172/2013 ή εφόσον εμπίπτει σε απαγορευτικές διατάξεις του εθνικού ή ενωσιακού δικαίου.

Κάθε Εγγυητική Επιστολή που εκδίδεται εκτός Ελλάδος πρέπει να συνοδεύεται από επίσημη και επικυρωμένη μετάφραση στην ελληνική γλώσσα, η οποία διασφαλίζει ότι το περιεχόμενό της αντιστοιχεί στο παρόν πρότυπο. Όπου εφαρμόζεται, η μετάφραση πρέπει να φέρει σφραγίδα Apostille, σύμφωνα με τη Σύμβαση της Χάγης.

4.2 Αξιολόγηση Μέσων Χρηματικής Εγγυήσεως από Συνδεδεμένη, Μητρική ή Θυγατρική Εταιρεία

Στην περίπτωση έκδοσης μέσων Χρηματικής Εγγυήσεως από συνδεδεμένη, μητρική ή θυγατρική εταιρεία, πέραν των άνωθι κριτηρίων αξιολόγησης των εκάστοτε μέσων, αξιολογούνται και τα εξής:

η χρηματοοικονομική ισχύ - ήτοι την ικανότητα, δυνατότητα ή επάρκεια - της σχετικής οντότητας, υποστηριζόμενη από πρόσθετα αποδεικτικά στοιχεία, όπως αποδεδειγμένο ιστορικό επιτυχημένων αυξήσεων μετοχικού κεφαλαίου ή δημόσιων προσφορών (Public Offerings).

Η χρηματοοικονομική ισχύς, επάρκεια και ικανότητα της μητρικής εταιρείας, ήτοι της Energean plc, ως βασικό κριτήριο για την έκδοση μέσων χρηματικής εγγυήσεως, έχει αναλυθεί και δεόντως τεκμηριωθεί διεξοδικώς στο Κεφάλαιο 2 ανωτέρω».

Διατήρηση της ισχύος και αποτελεσματικότητας της χρηματικής εγγυήσεως

Ο εκδότης δεν επιτρέπεται να προβεί σε οποιεσδήποτε μεταβολές στους όρους και τις προϋποθέσεις των μέσων Χρηματικής Εγγυήσεως χωρίς την προηγούμενη έγγραφη έγκριση της Αρμόδιας Αρχής.

Θα πρέπει να παρέχεται επαρκής προηγούμενη ειδοποίηση στην Αρμόδια Αρχή για οποιαδήποτε πρόθεση του εκδότη να ακυρώσει, καταγγείλει, μη ανανεώσει, ακυρώσει ή αναστείλει το μέσο, ώστε να μπορεί να παρασχεθεί εγκαίρως μέσο αντικατάστασης.

Η Αρμόδια Αρχή πρέπει να έχει το δικαίωμα να αντλήσει κεφάλαια από το μέσο πριν από την ακύρωση, καταγγελία, μη ανανέωση, ακύρωση ή αναστολή του - εάν ο Φορέας Εκμετάλλευσης δεν προσκομίσει εγκαίρως εγκεκριμένο μέσο αντικατάστασης. Οποιοδήποτε προτεινόμενο μέσο χρηματικής εγγυήσεως θα πρέπει να επιτρέπει ρητώς μια τέτοια υποκατάσταση.

ENERGEAN

Energean plc
Accurist House
44 Baker Street
London W1U 7AL

Date: 14 October 2025

Dear Sirs,

PARENT COMPANY SUPPORT LETTER – PRINOS CO2

Taking into consideration that:

(a) EnEarth Greece Single Member S.A (“EnEarth Greece”), a subsidiary of Energean plc, is developing the Prinos CO2 Storage Project (“Prinos CO2”), a carbon dioxide storage facility located in northern Greece, which shall contribute to reducing GHG emissions in accordance with the Greek national energy plan, the long-term strategy as per Regulation (EU) 2018/1999, and the scope and targets of the Green Deal.

(b) Prinos CO2 is the only storage project of commercial scale in the Southeast Mediterranean, which has concluded the works envisaged in the Exploration Permit as per Directive 2009/31/EC and has applied for a storage permit under the same Directive for injection capacity of up to 1 MTPA.

(c) Prinos CO2 is a project of common interest (“PCI”) included in the Union list of projects of common interest and projects of mutual interest under the Priority Thematic Area Cross-border carbon dioxide network (13.11 - “Prinos – Offshore storage at Prinos field for emissions from EL, by pipeline, and from BG, HR, CY, EL, IT and SI by ship”) adopted by means of the Commission Delegated Regulation (EU) 2024/1041 of 28 November 2023 amending Regulation (EU) 2022/869 of the European Parliament and of the Council as regards the Union list of projects of common interest and projects of mutual interest.

(d) Phase 1 of Prinos CO2 (injection of up to 1 MTPA of compressed CO2 received from local sources) is in line to receive support from the Greek Recovery and Resilience plan (ST 10152/06.07.2021/ Produce-E Green, Measure ID: 16831 of the relevant Annex). To meet market demand and contribute to the national and European decarbonization goals, Prinos CO2 will be further developed to accommodate liquid CO2 handling facilities at the existing onshore site, with the intention of increasing its capacity to handle up to 3 MTPA (Phase 2).

(e) Phase 2 of Prinos CO2 (injection of up to 2.8 MTPA of liquid CO2) has been approved for funding under the Connecting Europe Facility (CEF) initiative.

1. Energean plc confirms that as at the date of this letter:

(i) Energean plc is a public limited company registered under the laws of England and Wales under company number 10758801 of the Registrar of Companies for England and Wales and is listed on the London Stock Exchange;

(ii) Enearth Limited is a Cyprus-registered, wholly-owned subsidiary of Energean plc;

(iii) Enearth Greece is a company incorporated and registered under the law of Greece with registration number 177955001000, and a wholly-owned subsidiary of Enearth Limited; and

(iv) Energean Oil & Gas - Aegean Energy Exploration and Production of Hydrocarbons Societe Anonyme is a company incorporated and registered under the law of Greece with registration number 007741201000 (“EOGSA”), and is an indirect subsidiary of Energean plc and an affiliate of Enearth Greece.

2.1 Energean plc hereby confirms its intention to support its subsidiary EnEarth Greece towards the successful development and operation of Prinos CO2 by:

(i) providing, either directly or through its subsidiaries Enearth Limited and EOGSA, technical support, human resources, and professional services and assistance to Enearth Greece to enable it to develop and operate Prinos CO2;

(ii) making available on behalf of Enearth Greece a Parent Company Guarantee or Bank Guarantee/Letter of Credit up to the amount of 10m € to enable Enearth Greece to perform its obligations under the Storage Permit to be issued and as defined in the Financial Security Proposal submitted by Enearth Greece to the competent authority in the context of the Storage Permit application;

(iii) making available to Enearth Greece, or procuring, the financial means, including by way of (i) arranging external financing, (ii) capital injection, (iii) Parent Company Guarantee, (iv) Bank Guarantee / Letter of Credit or (v) intercompany loan, to enable it to perform its obligations under the Storage Permit to be issued. Examples of Energean plc’s ability to arrange external financing are provided in Cl. 3, evidence of historical capital injections to its subsidiaries is shown in Energean plc Financial Statements and EOGSA Financial Statements and financial strength of Energean plc is evidenced by its ability to pay dividends since 2022. For the avoidance of doubt, this letter does not constitute any obligation or commitment by Energean plc to provide equity, debt or other form of financial support to the Prinos CO2 project or EnEarth Greece.

3. Proven Access to Capital and Ability to Fund Developments:

Energean plc has long-standing relationships with both international and local banks, multilaterals, and the US bond market, and has a proven track record of raising equity on the London Stock Exchange (LSE). Energean plc has a demonstrated capability of raising financing for project developments, is an established capital markets issuer, and has a track record in raising capital to support its subsidiaries and fund its projects, as follows:

Equity Capital Raises:

- £330 MM / $460 MM IPO on the Premium Segment of the London Stock Exchange in March 2018, representing the second largest issuance in the Oil & Gas E&P sector over the previous decade at the time of issuance; and
- $265 MM accelerated bookbuild equity raise to finance the acquisition of Edison E&P, with issuance at a 7.0% premium to the prior day’s closing share price, in July 2019.

Debt Capital Raises:

- $1,275 MM construction financing facility at Energean Israel Finance S.a.r.l. for the development of Karish in March 2018;
- $280 MM Reserve Based Finance Facility for the acquisition of Edison E&P in June 2020;
- £80 MM LC Facility in June 2020 for issuance of LCs for decommissioning in the UK North Sea;
- $700 MM Term Loan for the acquisition of Kerogen’s 30% share in Energean Israel in February 2021;
- $2,500 MM bond issuance at Energean Israel Finance Ltd. in order to refinance construction financing facility and term loan in March 2021;
- $450 MM bond issuance at Energean PLC to refinance reserve-based lending facilities in November 2021;
- $300 MM Revolving Credit Facility in September 2022 for general corporate purposes; and
- $750 MM bond issuance to refinance the 2024 maturity bonds for Energean Israel in July 2023.
- $750 MM Term Loan to refinance the 2026 maturity bonds and provide headroom for the Katlan field offshore development, for Energean Israel in February 2025

4. This Letter of Support, and any non-contractual obligations arising out of or in connection with it, shall be governed by and construed in accordance with the laws of England and Wales. The courts of England and Wales shall have exclusive jurisdiction over any dispute or claim (including non-contractual disputes or claims) arising out of or in connection with this Letter of Support.

Yours faithfully,

Mathios Rigas
CEO of Energean plc

Panos Benos
CFO of Energean plc

Η απόφαση αυτή να δημοσιευθεί στην Εφημερίδα της Κυβερνήσεως.

Αθήνα, 16 Φεβρουαρίου 2026

Ο Διευθύνων Σύμβουλος
ΑΡΙΣΤΟΦΑΝΗΣ ΣΤΕΦΑΤΟΣ

ΕΘΝΙΚΟ ΤΥΠΟΓΡΑΦΕΙΟ

Το Εθνικό Τυπογραφείο αποτελεί δημόσια υπηρεσία υπαγόμενη στην Προεδρία της Κυβέρνησης και έχει την ευθύνη τόσο για τη σύνταξη, διαχείριση, εκτύπωση και κυκλοφορία των Φύλλων της Εφημερίδας της Κυβερνήσεως (ΦΕΚ), όσο και για την κάλυψη των εκτυπωτικών - εκδοτικών αναγκών του δημοσίου και του ευρύτερου δημόσιου τομέα (ν. 3469/2006/Α΄ 131 και π.δ. 29/2018/Α΄58).

1. ΦΥΛΛΟ ΤΗΣ ΕΦΗΜΕΡΙΔΑΣ ΤΗΣ ΚΥΒΕΡΝΗΣΕΩΣ (ΦΕΚ)

- Τα **ΦΕΚ σε ηλεκτρονική μορφή** διατίθενται δωρεάν στο **www.et.gr**, την επίσημη ιστοσελίδα του Εθνικού Τυπογραφείου. Όσα ΦΕΚ δεν έχουν ψηφιοποιηθεί και καταχωριστεί στην ανωτέρω ιστοσελίδα, ψηφιοποιούνται και αποστέλλονται επίσης δωρεάν με την υποβολή αιτήματος στην ηλεκτρονική διεύθυνση feksales@et.gr.

- Τα **ΦΕΚ σε έντυπη μορφή** διατίθενται σε μεμονωμένα φύλλα είτε απευθείας από το Τμήμα Πωλήσεων και Συνδρομητών, είτε ταχυδρομικά με την αποστολή αιτήματος παραγγελίας στην ηλεκτρονική διεύθυνση feksales@et.gr.
  - Το κόστος ενός ασπρόμαυρου ΦΕΚ από 1 έως 16 σελίδες είναι 1,00 €, αλλά για κάθε επιπλέον οκτασέλιδο (ή μέρος αυτού) προσαυξάνεται κατά 0,20 €. Το κόστος ενός έγχρωμου ΦΕΚ από 1 έως 16 σελίδες είναι 1,50 €, αλλά για κάθε επιπλέον οκτασέλιδο (ή μέρος αυτού) προσαυξάνεται κατά 0,30 €.
  - Το τεύχος Α.Σ.Ε.Π. διατίθεται δωρεάν.
  - Υπάρχει δυνατότητα ετήσιας συνδρομής οποιουδήποτε τεύχους σε έντυπη μορφή μέσω του Τμήματος Πωλήσεων και Συνδρομητών.

- **Τρόποι αποστολής κειμένων προς δημοσίευση:**

Α. Αποστολή των εγγράφων προς δημοσίευση στο ΦΕΚ στην ηλεκτρονική διεύθυνση **https://eservices.et.gr**. Σχετικές εγκύκλιοι και οδηγίες στην ηλεκτρονική διεύθυνση του Εθνικού Τυπογραφείου (**www.et.gr**) στη διαδρομή **Ανακοινώσεις** → **Εγκύκλιοι**.

Β. Κατ' εξαίρεση, όσοι πολίτες δεν διαθέτουν προηγμένη ψηφιακή υπογραφή μπορούν είτε να αποστέλλουν ταχυδρομικά, είτε να καταθέτουν με εκπρόσωπό τους κείμενα προς δημοσίευση εκτυπωμένα σε χαρτί στο Τμήμα Παραλαβής και Καταχώρισης Δημοσιευμάτων.

- Πληροφορίες, σχετικά με την αποστολή/κατάθεση εγγράφων προς δημοσίευση, την ημερήσια κυκλοφορία των Φ.Ε.Κ., με την πώληση των τευχών και με τους ισχύοντες τιμοκαταλόγους για όλες τις υπηρεσίες μας, περιλαμβάνονται στον ιστότοπο (www.et.gr). Επίσης μέσω του ιστότοπου δίδονται πληροφορίες σχετικά με την πορεία δημοσίευσης των εγγράφων, με βάση τον Κωδικό Αριθμό Δημοσιεύματος (ΚΑΔ). Πρόκειται για τον αριθμό που εκδίδει το Εθνικό Τυπογραφείο για όλα τα κείμενα που πληρούν τις προϋποθέσεις δημοσίευσης.

2. ΕΚΤΥΠΩΤΙΚΕΣ - ΕΚΔΟΤΙΚΕΣ ΑΝΑΓΚΕΣ ΤΟΥ ΔΗΜΟΣΙΟΥ

Το Εθνικό Τυπογραφείο ανταποκρινόμενο σε αιτήματα υπηρεσιών και φορέων του δημοσίου αναλαμβάνει να σχεδιάσει και να εκτυπώσει έντυπα, φυλλάδια, βιβλία, αφίσες, μπλοκ, μηχανογραφικά έντυπα, φακέλους για κάθε χρήση, κ.ά.

Επίσης σχεδιάζει ψηφιακές εκδόσεις, λογότυπα και παράγει οπτικοακουστικό υλικό.

Ταχυδρομική Διεύθυνση: **Καποδιστρίου 34, 10432 Αθήνα**

ΤΗΛΕΦΩΝΙΚΟ ΚΕΝΤΡΟ: 210 5279000

Ιστότοπος: **www.et.gr**

Πληροφορίες σχετικά με την λειτουργία του ιστότοπου: **helpdesk.et@et.gr**

Αποστολή εγγράφων προς δημοσίευση στο ΦΕΚ στην ηλεκτρονική διεύθυνση
https://eservices.et.gr

ΕΞΥΠΗΡΕΤΗΣΗ ΚΟΙΝΟΥ

Πωλήσεις - Συνδρομές: (Ισόγειο, τηλ. 210 5279178 - 180)
Πληροφορίες: (Ισόγειο, Γραφείο 3 και τηλεφ. κέντρο 210 5279000)
Παραλαβή Δημοσιευτέας Ύλης: (Ισόγειο, τηλ. 210 5279139)

Ωράριο για το κοινό: Δευτέρα έως και Παρασκευή: 8:00 - 13:30