GAUSSIAN WELLWORKS
RESERVOIR INTELLIGENCE

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

CARBON STORAGE ESTIMATION

Gaussian Wellworks helps operators, emitters, storage developers, and investors provide quantitative assessments of carbon storage capacity and pressure and CO_2 plume migration forecasts using the proprietary Gaussian technology — a statistically rigorous, physics-based technology for geological carbon storage (GCS) projects. The service is designed for operators and project developers that need defensible, audit-ready assessments of storage potential, containment behavior, and project risk across saline aquifers and depleted hydrocarbon reservoirs.

This is achieved through an integrated storage decision framework:

Geological Framework Structural and stratigraphic models, reservoir geometry, seals, faults, contacts, and legacy wells.	**Reservoir Characterization** Petrophysical interpretation, core and rock properties, pressure history, PVT/fluid data, and dynamic calibration.
Dynamic Forecasting GPT rate and cumulative-injection forecasts under reservoir, well, boundary, and operating constraints.	**Uncertainty and Reporting** P90/P50/P10 capacity ranges, sensitivities, containment risks, and SRMS-aligned technical documentation.

The clients receive:

CAPACITY	OPERATIONS	CONTAINMENT	DECISION SUPPORT
TSR + EUS Storage resource, usable capacity, and storage coefficient	**Rate / BHP** Injectivity, deliverability, and operating envelopes	**Plume + Pressure** Migration, pressure front and monitoring focus	**SRMS** P1/P2/P3 classification and audit-ready reporting

The assessments are prepared in accordance with SRMS-aligned reporting, ensuring:

Standardized Classification	**Transparent Probability**	**Global Review Readiness**	**Auditability**
Storage resources categorized consistently using P1, P2 and P3 terminology.	Capacity and injectivity uncertainty carried through to decision-relevant outcomes.	Technical basis prepared for regulators, investors, partners, and internal governance.	Traceable data, assumptions, calculations, calibration evidence, and documented limitations.

STORAGE VOLUME IS ONLY USEFUL WHEN PRESSURE, INJECTIVITY, CONTAINMENT AND UNCERTAINTY ARE UNDERSTOOD TOGETHER.

FROM STATIC PORE VOLUME TO USABLE STORAGE CAPACITY

The Gaussian Wellworks workflow evaluates both storage volume and dynamic reservoir response. Clients understand not only how much CO_2 may fit in the pore space, but also how injection pressure, plume migration, reservoir boundaries, well design and uncertainty influence the capacity that can be used safely and commercially.

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

We assess:

Storage Capacity ▪ Total storage resource (TSR). ▪ Estimated ultimate storage (EUS). ▪ Storage coefficients and usable capacity.	**Injectivity and Pressure** ▪ Well deliverability. ▪ Rate and BHP limits. ▪ Pressure buildup, dissipation, and safe operating windows.
Plume and Containment ▪ CO_2 plume radius. ▪ Pressure-front advance. ▪ Vertical containment, faults, seals, and pressure communication.	**Uncertainty** ▪ Net-to-gross, porosity, and permeability. ▪ Thickness, pressure, and completion assumptions. ▪ P90/P50/P10 ranges and sensitivities.

The assessment is used for:

Portfolio Screening Rapidly rank saline aquifers and depleted reservoirs before detailed appraisal.	**Appraisal and Permitting** Test whether storage targets are achievable within injectivity, pressure, and caprock constraints.	**Investment Review** Explain capacity, data quality, uncertainty, and operational dependencies to partners and capital providers.	**Field Redevelopment** Use legacy production, pressure, and injectivity evidence to calibrate depleted-field storage performance.

Why it matters

AVOID **Static Optimism** Do not rely on pore volume alone	**DEFINE** **Operating Limits** Pressure and completion constraints	**PRIORITIZE** **High-Value Data** Focus appraisal and monitoring	**ALIGN** **Stakeholders** One transparent technical narrative

A TECHNICALLY CREDIBLE STORAGE TARGET MUST BE ACHIEVABLE BY THE WELLS AND REMAIN INSIDE PRESSURE AND CONTAINMENT LIMITS.

WHAT PROBLEMS GAUSSIAN SOLVES

CLIENT CHALLENGE	HOW GAUSSIAN ADDRESSES IT
Uncertain storage capacity	Converts volumetric estimates into time-dependent capacity forecasts with probabilistic P90/P50/P10 ranges.
Pressure escalation risk	Quantifies pressure buildup, dissipation, and safe operating windows before caprock, fault, or well-integrity limits are reached.
Unclear plume behavior	Forecasts plume migration, pressure-front progression, vertical containment, and likely monitoring focus areas.
Sparse or legacy data	Uses production history, injectivity tests, logs, and available public or proprietary data to calibrate reservoir behavior.
Screening delays	Provides fast, physics-based prospect screening before committing to full-field numerical simulation.
Investment and permitting uncertainty	Packages technical assumptions, risk drivers, and probabilistic outcomes for stakeholder review and SRMS-aligned reporting.

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

TECHNICAL METHOD: FAST, PHYSICS-BASED AND UNCERTAINTY-AWARE

The core workflow uses Gaussian Pressure Transient (GPT) solutions of the pressure-diffusivity equation. GPT is a closed-form, non-gridded method for modeling pressure propagation, well rates, and cumulative injection under defined reservoir, fluid, boundary, and operating conditions. It connects storage performance to permeability, porosity, compressibility, viscosity, pressure, well design, and boundary behavior.

It is useful for:

Rapid Screening	History Calibration	Operating Realism	Probabilistic Capacity
Evaluate multiple prospects and scenarios quickly before a detailed simulation study.	Constrain hydraulic diffusivity and reservoir response using production, pressure, or injectivity evidence.	Forecast storage under rate, bottomhole-pressure, completion, and boundary constraints.	Generate P90/P50/P10 EUS cases and identify the parameters that dominate uncertainty.

GPT CONVERTS AVAILABLE FIELD RESPONSE INTO A CALIBRATED BASIS FOR FUTURE INJECTION PERFORMANCE.

Where geomechanical effects are material, pressure-dependent rock stiffness can be included to reflect changes in bulk modulus, hydraulic diffusivity and pressure dissipation as injection raises pore pressure. This avoids treating the reservoir as an unchanging container.

The work follows a seven-Step workflow:

WORKFLOW STEP	WHAT IS DONE
1. Define the storage system	Reservoir geometry, stratigraphy, seals, faults, contacts, legacy wells, and operating constraints.
2. Assemble and QC data	Logs, core, PVT/fluid properties, production history, injectivity tests, pressure history, and completion data.
3. Estimate TSR	Volumetric storage resource from net rock volume, porosity, fluid saturations, and formation volume factors.
4. Forecast EUS	GPT rate and cumulative-injection modeling under pressure, boundary, completion, and operating constraints.
5. Model plume and pressure front	Plume radius, pressure transient, boundary-dominated flow onset, vertical limits, and containment scenarios.
6. Quantify uncertainty	P90/P50/P10 storage ranges, parameter sensitivities, and high-value data-acquisition priorities.
7. Classify and report	SRMS-aligned classification, assumptions, decision implications, and development recommendations.

HOW GAUSSIAN COMPARES TO TRADITIONAL STORAGE WORKFLOWS

Rapid analytical screening adds dynamic pressure, injectivity, and uncertainty context to volumetric and simulation approaches.

GAUSSIAN WELLWORKS
RESERVOIR INTELLIGENCE

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

TRADITIONAL METHOD	TYPICAL GCS LIMITATION	GAUSSIAN ENHANCEMENT
Static volumetric estimates	Useful first-pass screening but often treats storage as a fixed pore-volume problem.	Adds time-dependent injection, pressure, and uncertainty behavior.
Storage-efficiency factors	Fast, but may obscure pressure limits, net-to-gross, accessible pore space, and capacity uncertainty.	Separates TSR from EUS and derives the storage coefficient from EUS/TSR.
Empirical decline analysis	Familiar, but less robust with short, noisy, or boundary-affected histories.	Uses physics-based GPT history matching to infer reservoir behavior.
Full-field numerical simulation	Powerful but slower, data-intensive and costly for early screening or many prospects.	Provides rapid analytical screening and sensitivity analysis to focus detailed simulation.
Constant-modulus poroelasticity	May miss pressure-dependent changes in bulk modulus and diffusivity.	Can represent pressure-induced elastic stiffening and changing pressure dissipation.

APPLICATIONS AND CLIENT VALUE

Storage Prospect Screening
- Rank saline aquifers and depleted reservoirs.
- Compare capacity, pressure risk, and data quality.
- Select prospects for detailed appraisal.

Field Development Planning
- Define injection phases and expansion pathways.
- Estimate well count, spacing, and deliverability.
- Plan pressure management and monitoring.

Completion and Operating Design
- Evaluate perforated length, BHP limits, and injection rates.
- Understand boundary-dominated flow and pressure communication.
- Avoid caprock, fault, and well-integrity exceedance.

Reservoir Understanding
- Calibrate hydraulic diffusivity.
- Understand pressure dissipation and plume stabilization.
- Identify the parameters driving uncertainty.

CLIENT DELIVERABLES

OPERATORS

Capacity and Classification
- TSR, EUS and storage coefficients
- P90/P50/P10 capacity ranges

Injection Performance
- Injectivity and cumulative injection
- Rate/BHP operating envelopes

Containment Forecasts
- CO_2 plume and pressure-front forecasts
- Containment-risk assessment

Development Guidance
- Well placement and completion design
- Operating and monitoring recommendations

INVESTORS AND LENDERS

Capacity Cases
- Conservative P90
- Base P50
- Upside P10

Target Feasibility
- Injectivity constraints
- Pressure constraints
- Containment constraints

Risk Drivers
- Sensitivity ranking
- Data-quality gaps
- Operating dependencies

Investment Support
- SRMS-aligned results
- Due diligence
- Financing and partner review

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

AUDITORS AND REGULATORS

Classification Support SRMS-aligned resource classification and probabilistic reporting.	**Reproducible Workflow** Documented methodology, equations, calculations, and decision logic.	**Traceable Inputs** Data sources, assumptions, calibration evidence, and uncertainty parameters.	**Audit-Ready Risk Pack** Pressure, plume, containment, monitoring, and technical-risk documentation.

CASE STUDY—VALIDATION OF CARBON STORAGE CAPACITY IN THE DEPLETED OIL RESERVOIR, GREENSAND PROJECT, NINI WEST, OFFSHORE DENMARK

Summary

Project Greensand targets depleted offshore oil fields in the Danish North Sea for CO_2 storage. Nini West is the first storage target in the program, with a planned initial storage target of 0.45 Mtpa over 10 years, or 4.5 Mt CO_2. The independent appraisal reviewed publicly available data and applied an SRMS-style probabilistic workflow to test whether the storage target was technically supported.

The target reservoir is the Frigg Sandstone at a depth of approximately 1,800 m. The reservoir is a 12-30 m thick sandstone with a typical porosity of around 35% and permeability in the 100-300 mD range, capped by the Horda/Lark shale formations that have retained hydrocarbons over geologic time. These attributes make Nini West a strong client-facing example of storage appraisal in a depleted hydrocarbon reservoir.

Objective

- Test whether the planned 4.5 Mt CO_2 storage target could be supported under realistic reservoir and well-performance assumptions.
- Fit through historical daily production data using GPT technology for determining the fitting parameters for dynamic model calibration.
- Quantify deterministic and probabilistic EUS using GPT technology and obtain fitting parameters and explain how the results map to SRMS-style uncertainty ranges.
- Forecast plume-radius growth, pressure transient behavior, and the transition between lateral pressure-driven movement and buoyancy-dominated behavior.
- Identify the parameters that most influence storage uncertainty and therefore deserve better data or closer operational monitoring.

Provided solution

The appraisal used a staged workflow. First, annual production data were history-matched with the GPT model. This helped determine key dynamic inputs, including hydraulic diffusivity, effective porosity, reservoir pressure, and drainage radius.

The calibrated GPT model was then switched from production-history interpretation to storage forecasting. It was used to estimate deterministic EUS, generate P90/P50/P10 probabilistic forecasts, evaluate pressure-front behavior, estimate plume radial advancement, and compare lateral pressure-transient flow against buoyancy-driven vertical movement. This is the core value of Gaussian technology: historical field response

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

serves as a calibrated basis for future injection performance, rather than relying solely on a static capacity factor.

The study also used pilot injectivity data from the water injection well. During the actual pilot, reported injection rates were typically 20-30 t/hr, with a maximum of about 32 t/hr under reservoir conditions. The reported pressure operating window is about 60 bar below the 280 bar caprock integrity limit. This highlights a key completion-design lesson: a 70 m perforated legacy injector has different deliverability than a longer purpose-designed injector, and completion assumptions materially affect whether annual storage targets can be achieved.

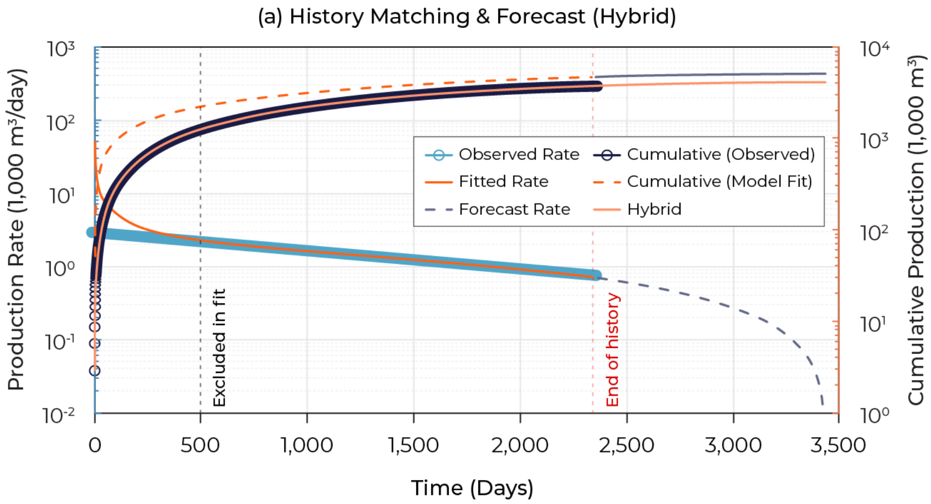

Figure 1 – GPT history match actual production data to calibrate reservoir behavior for storage-capacity forecasting.

Results and Findings

The GPT history match produced a lower cumulative-volume error of about 0.0068%, indicating a strong match between the physics-based Gaussian model and the production behavior (**Figure 1**). This calibrated reservoir response was then used for storage forecasting.

Figure 2 shows the deterministic GPT forecast, which estimates 8.38 Mt CO_2 over 10 years, corresponding to an average storage rate of about 2,296 t/day. This exceeds the 4.5 Mt initial target, but the probabilistic forecast provides a more decision-useful picture: P90 is about 3.25 Mt, P50 is about 7.73 Mt, and P10 is about 12.32 Mt, as shown in **Figure 3**. The planned target therefore sits above the conservative P90 case but below the P50 case. In client terms, the target appears technically achievable, but operational readiness, completion design, injectivity management and data uncertainty remain important.

Figure 4 depicts plume modeling, which showed rapid radial growth during the early injection period, followed by a gradual slowdown as pressure gradients flatten. The modeled plume radius stabilizes around 405 m after 10 years under the reservoir and operating conditions. Pressure-transient analysis shows steep near-well gradients early in injection, with the pressure front reaching the drainage boundary after roughly two years and pressure gradients becoming less steep with time.

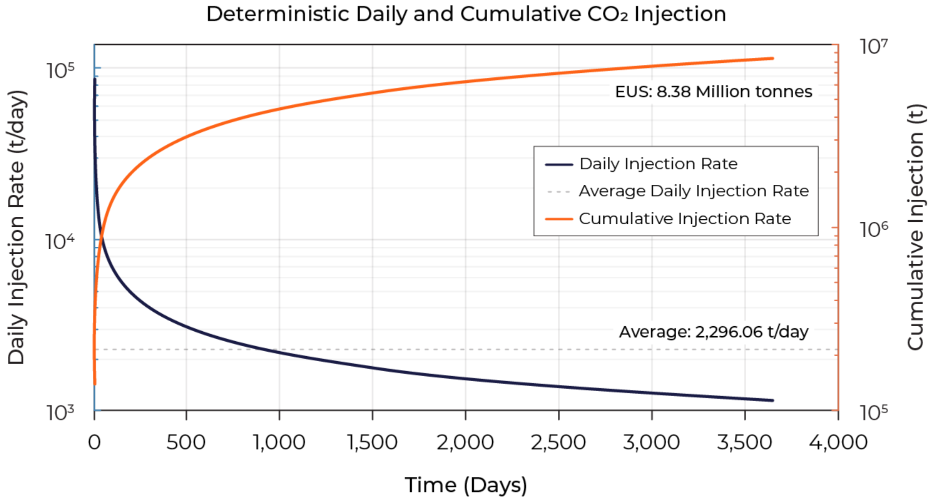

Figure 2 – Deterministic injection forecast.

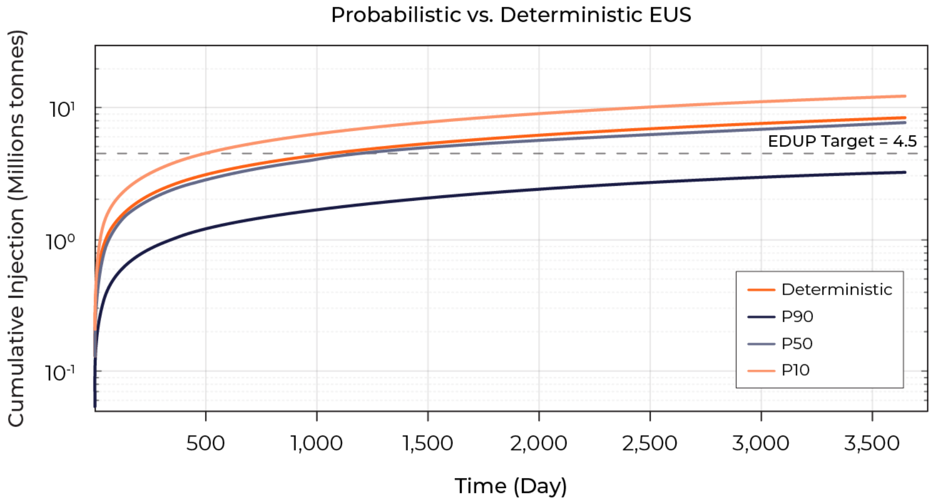

Figure 3 – Probabilistic EUS compared with the 4.5 Mt project target.

Flow-scaling analysis, presented in **Figure 5**, is particularly important for monitoring design. During early injection and close to the wellbore, lateral pressure-driven flow dominates. After approximately three years, buoyancy becomes increasingly influential, and by 10 years the modeled lateral-to-buoyancy ratio falls below 1. This helps define where and when plume monitoring should focus on lateral sweep versus vertical migration tendencies.

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

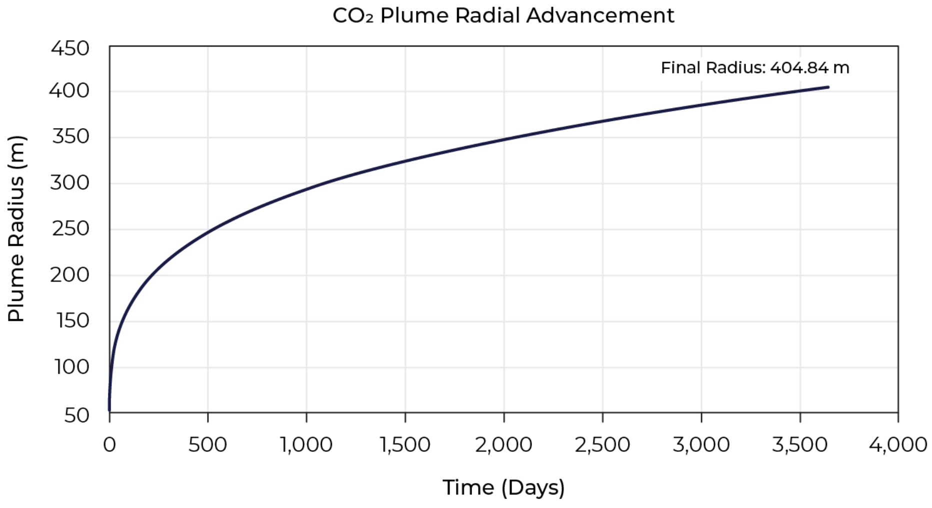

Figure 4 – Plume radial advance slows over time and approaches about 405 m after 10 years.

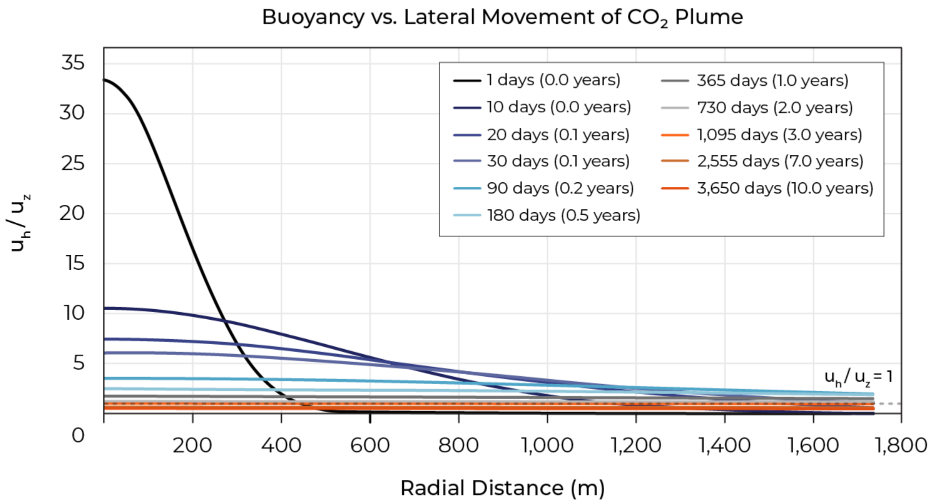

Figure 5 – Lateral pressure-transient movement dominates early; buoyancy becomes more important after about three years.

The Greensand case demonstrates that Gaussian technology can translate incomplete data and legacy production behavior into a quantified, uncertainty-aware storage-capacity forecast, helping operators rank prospects, define data-acquisition priorities, support SRMS-aligned reporting, and communicate storage upside and technical risk. The method highlights not only whether a target may be achievable, but also what must be true operationally for it to be achieved.

READ THE FULL CASE STUDY

HEADQUARTERS
3730 Kirby Drive, Suite 1200
Houston, TX 77098
+1 949 244 1918
Info@GaussianWellworks.com

OFFICES
Houston
Stavanger
Brisbane

ADDITIONAL EVIDENCE

Explore peer-reviewed studies validating Gaussian approaches for Carbon Storage Estimation.

[1]. Toko, A.D.P., and Weijermars, R. 2026. Elastic Stiffening of Reservoir Rocks with Rising Pore Pressures under Constant Biaxial Far-Field Stress: Application to the Porthos Geological Carbon-Dioxide Sequestration Project. Geomechanics and Geophysics for Geo-Energy and Geo-Resources. DOI

[2]. Weijermars, R., Afagwu, C., Tian, Y., Alves, I.N., 2026. Estimation of Storage Capacity Coefficients: Porthos GCS Project Case Study. Unconventional Resources. DOI

[3]. Afagwu, C. and Weijermars, R., 2026. Benchmarking physics-based GPT and empirical Arps DCA for EUR and CO_2 storage capacity assessment of depleted gas reservoirs. Fuel. DOI

[4]. Weijermars, R., 2024. CO_2 Storage capacity classification and compliance. First Break, 42 (11), 85-93. DOI

[5]. Weijermars, R., 2024. Deferring Flood Damage in Coastal Lowlands: Assessing Surface Uplift by Geo-Engineered CO_2-Sequestration with Easy-to-Use Land-Uplift Model. First Break 42 (4), 63–70. DOI

[6]. Afagwu, C. and Weijermars, R., 2025. Sensitivity Analysis of CO_2-Migration Paths in Geological Carbon-Dioxide Sequestration: Case Study of the Gorgon GCS Project. SSRN. DOI

[7]. Weijermars, R., 2023. Surface subsidence and uplift resulting from well interventions modeled with coupled analytical solutions: Application to Groningen gas extraction (Netherlands) and CO_2-EOR in the Kelly-Snyder oil field (West Texas). Geoenergy Science and Engineering, Vol. 228 (2023) 211959. DOI

[8]. Alotaibi, M.; Alotaibi, S.; Weijermars, R. Stream and Potential Functions for Transient Flow Simulations in Porous Media with Pressure-Controlled Well Systems. Fluids 2023, 8, 160. DOI

