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2024 SDE++ Aramis Carbon Capture and Storage Fee Review

Public Summary

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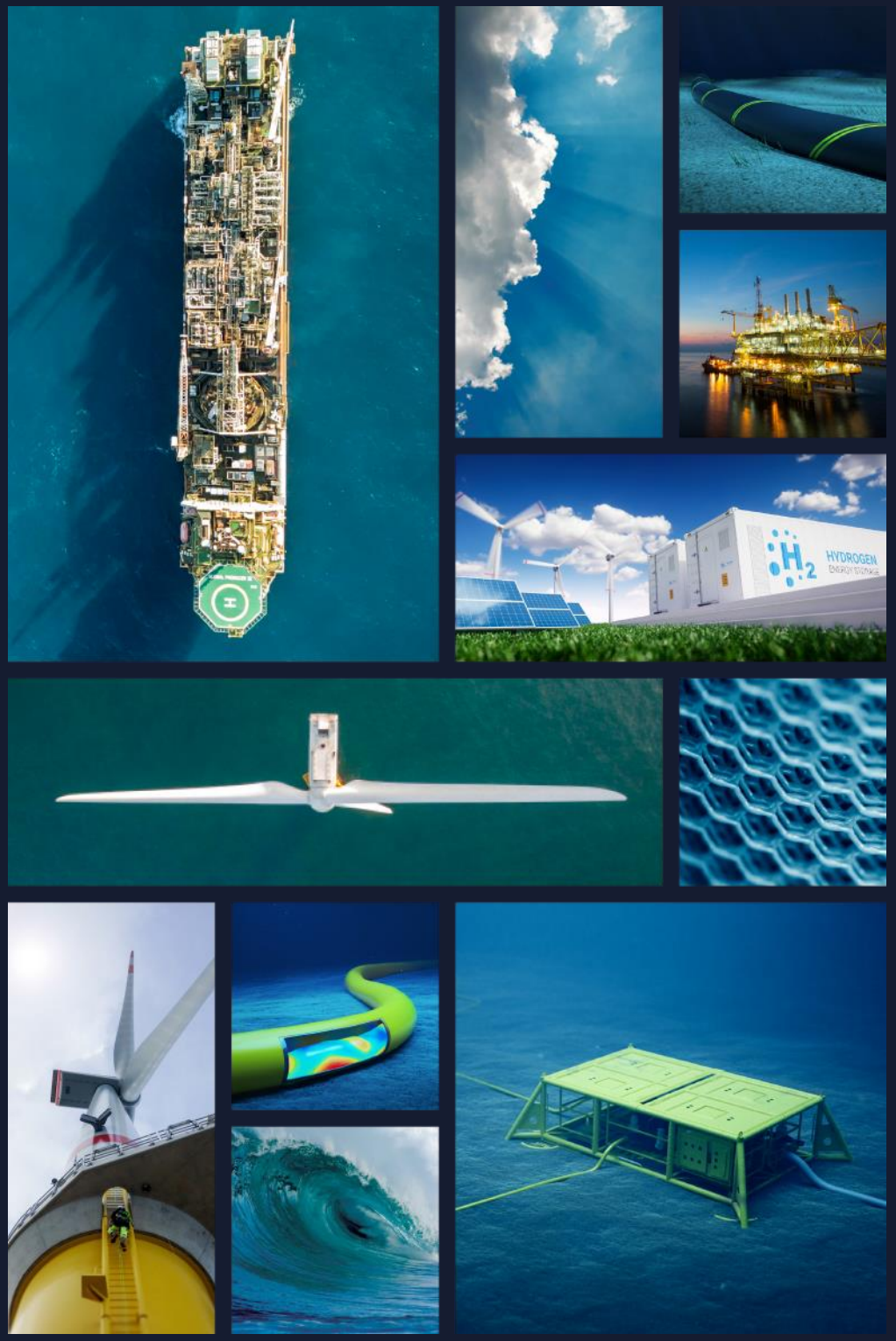

Public Summary

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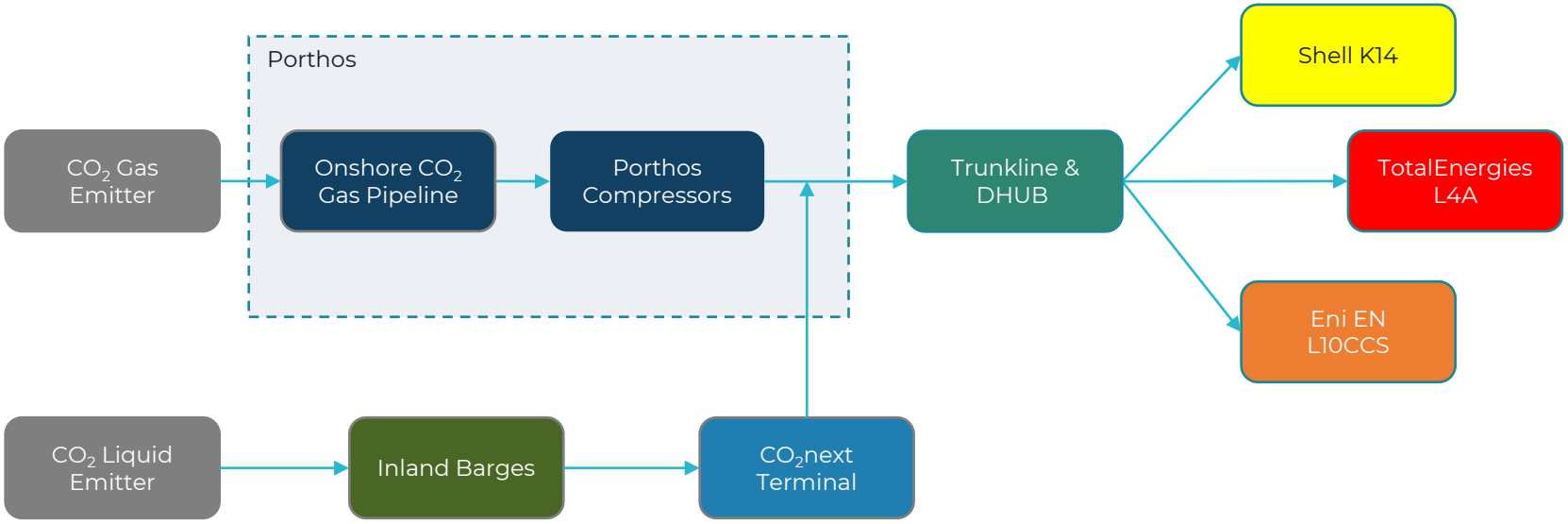
Study Overview

The Aramis CCS system is a next of a kind CCS project that links together a number of "building blocks", operated by disparate parties into a common "value chain" to offer emitters in the port of Rotterdam and wider afield transport and storage services for CO_2. The stores are located in the Dutch sector of the North Sea. The system comprises two separate emitter inlet options:

1. Cryogenic Liquid (Cryo) via ships and an offloading/storage terminal;
2. Gaseous via the existing Porthos landline and an expanded Porthos compression station.

The capacity of the different building blocks varies, with design and negotiation activities ongoing to finalise parts of the chain. The trunkline, which is being developed as a potential joint venture between EBN, Gasunie, Shell and TotalEnergies, called Aramis, has been sized to allow expansion of the system up to a maximum of 22 MTPA of dense phase fluids. During the launch phase, the system will be constrained by the capacity of the Compression, CO_2next Terminal and also the stores. The initial launch capacity is sized for 5 MTPA growing to circa 7 MTPA when the Eni Energy Netherlands (Eni EN, Formerly Neptune) storage project is commissioned. Further growth stores have the potential to push the system capacity above 7 MTPA. The Inland Barges, CO_2next Terminal, Porthos Compressor, and Stores businesses are all being designed around a scalable concept to allow for future expansion of the system. A simple block diagram showing the building blocks that make up the system is shown below.



It is expected that the CO_2 emitters using the Aramis system will apply for support from the Dutch Government via the 2024 SDE++ subsidy scheme. It is unclear following recent increases in the project cost estimates if the allowance made to transport and store CO_2 in the subsidy scheme is accurate. Xodus have been contracted by the Dutch Ministry of Economic Affairs and Climate (MEAC) to undertake a review of the transport and storage tariff for the Aramis system in order to help verify and validate the allowance being proposed for the 2024 SDE++ subsidy round. Xodus have also been directed to compile scenarios to be considered for inclusion in the SDE++ subsidy setting process. This report holds a summary of the results and findings of the review.

Review Methodology and Findings

A systematic and consistent review of the tariffs being proposed by the Aramis "building blocks" was completed by Xodus. The review used information provided by the building block companies to compile liquid and gaseous tariffs. The compiled tariffs are representative of the tariff that a gaseous or liquid user would be charged to transport and store CO_2 in the Aramis value chain based on the current understanding of project costs. A comparison was then made to the values published in the 2024 SDE++ Base Rate guidance document for the CCS transport and storage allowances, described as a "processing fee" (Ref 1.).

A brief summary of the steps followed in the building block review can be found below:

1. Review the scope and operation of the building block to gain an understanding of the purpose, scale and boundaries of the block.
2. Review the Capex and Opex profiles used in the tariff calculation and comment on the project maturity, uncertainty and risk..
3. Where helpful, highlight areas for reductions in Capex and Opex based on engineering judgement, benchmarking or errors found.
4. Compile a representative tariff using the information provided by the building blocks and compare this to the proposed allowance for Transport and Storage published in the SDE++ 2024 Base Rate guidance document for CCS projects.

The findings from the initial building block review were:

a) The building block companies are following due process when developing the cost estimate and tariff models provided. Some areas for potential cost reductions were found along the chain, but the ultimate reduction in tariff, if they can be captured, is very small and falls well within the cost estimate accuracy bands.

b) All building blocks assumed in their tariff calculations that there was no residual value in the assets after the 15 year SDE++ period ended and the tariffs were calculated assuming all Capex was discounted over the 15 year period. The proposed or typical design life of the transport building blocks are currently all longer than 15 years and there is a reasonable expectation that if a market exists for the service, they could generate revenue beyond the subsidy period.

c) Longer tariff calculation periods than 15 years, assuming longer revenue generation periods, would push the tariff lower if project Capex, Opex and IRR values remain the same. It is known however that the companies are likely to target higher IRRs if the calculation period is extended beyond the subsidy period to price the risk associated with revenue from emitters not supported by the SDE++ scheme. Higher target IRRs would push the Tariff higher counteracting some of the benefits of extending the tariff calculation period.

d) The costs for the Liquid Barges and CO_2next Liquid Terminal were difficult to verify because of the "first of a kind" nature of the system and the logistics challenges this type of project presents. As a result, the level of confidence in the liquid tariff calculation should be considered to be lower than for the gaseous tariff.

Following discussions with the MEAC team on the study findings, guidance has been provided to Xodus by MEAC to compile tariffs for this summary report which assume:

- Yearly stored volumes of 7.5 MTPA
- Tariff calculation period of 20 years for Transport building blocks.
- Tariff calculation period of 15 years for the Storage building blocks.

SDE++ 2024 T&S Allowance Verification

Transport & Storage Tariff Volume Basis	Route	Project Scope Definition	Estimate Basis	Illustrative Capex Accuracy	Illustrative Opex Accuracy	2023 SDE++ T&S Allowance 2024 €/t	Compiled T&S Tariff 2024 €/t 20 Year Transport Life 15 Year Storage Life
7.5 MTPA	Gas	Reliable	Pre-FEED	+/- 25 to 35%	+/- 30 to 40%	71.8	90.6
7.5 MTPA	Liquid	Developing	Concept Select /Pre-FEED	+/- 30 to 40%	+/- 30 to 40%	86.6	112.8

The T&S allowances published in the 2023 and 2024 version of the SDE++ Base Rate Guidance are 71.8 & 86.6 €/t and It can be seen that these values are lower than the compiled tariffs produced by this study.

This result is a combination of:

- The SDE++ 2023 and 2024 allowance for T&S tariff are based on a review of the project completed in 2022 and the figure has not been inflated since then.
- Project refinement and cost optimisation has not been able to keep pace with general inflation in the period between 2022 and 2024, a period when CPI was approximately 13% in the Netherlands.
- The majority of the equipment and services required to build the Aramis system such as pipelines and wells, draw on the same supply chain as the Oil and Gas industry which has seen high activity levels linked to relatively high gas prices in recent years. Industry data and Xodus experience supports this view.

The results of the verification check are typical for projects in the energy sector in 2024 with similar price increases being witnessed across multiple industries. Further cost escalation, linked to design development as well as price inflation could be expected across the value chain as the project matures. This observation is a function of the gated design process now including past inflation in the estimates, the current market environment for the supply chain and linked commodity prices.

Residual Value – Building Block Potential

The SDE++ scheme operates for a period of 15 years after which there is no guarantee of support for emitters connected to the system. The tariff calculations provided by all parties assume that the system will close after 15 years. However, the design life of most parts of the system is significantly longer than 15 years and there remains the opportunity for some parts of the system to have a long operational life after the subsidy period ends but only if a market exists for their services. The table below contains narrative on the potential operating life ("Op Life" in the table below) beyond the subsidy period for each of the Aramis building blocks.

Item	Typical Op Life	Note
Barges	Up to 20-25 years	Barges typically have a fixed operating life which varies from company to company. The residual value associated with the barges is linked to extending the operational life, which could be up to 10 years when compared to the tariff calculation period used but, because the barges for this application are linked to a specific location and emitter, the value may be harder to realise than elsewhere in the value chain. Given Opex does make up a large part of the total lifecycle costs for barges, the residual value gain for extending life is typically lower but the potential remains to capture the residual value if the market for liquid CO_2 endures.
CO_2next Liquid Terminal	25 Years+	Terminals can have long operating lives given the static nature of the bulk of equipment and the ability to refurbish ancillaries' equipment such as pumps and compressors at relatively small costs. The location of the terminal and its access to the offshore pipeline would make capturing the residual value relatively straightforward if the market for liquid CO_2 endures..
Onshore Compressors	25 Years	Compressor stations can have long design lives but do suffer from obsolescence issues, particularly on electric drive and control systems. It would not be unreasonable to assume a 25 year design for the compressor station. Opex costs for compression stations are a relatively large component of the lifecycle costs and, like Barges, the residual value gain for extending the life is less than elements of the system that have lower Opex profiles but there could be significant residual value for this part of the system.
Trunklines	30 Years+	The trunkline design life of Aramis and Porthos Landline is 30 years and it is not uncommon for hydrocarbon pipelines to have operating lives of 50 years+ if well maintained. It is thought that there could be significant residual value in this building block.
Stores	Project Specific	Stores are unlike the transport parts of the system because the value of the store is consumed as the project progresses and, at the end of the project, typically only liabilities remain. This is particularly true for the wells spend, which make up a large part of the Capex for the storage building blocks and have little value when the store is full, whereas the platform may be used as the host for new wells but this is very location specific. The relationship between volume injected and volume remaining in the store is complex and subject to revision throughout the operating life and a review of this sort falls outside the scope of this study. Based on the information provided by the building block companies and the scope of the study, it has been assumed that there is no residual value in the store building blocks after 15 years.

SDE++ 2024 Allowance Review - Results & Conclusions

Transport & Storage Tariff Volume Basis	Route	Project Scope Definition	Estimate Basis	Illustrative Capex Accuracy	Illustrative Opex Accuracy	Compiled T&S Tariff 2024 €/t 20 Year Transport Life 15 Year Storage Life
7.5 MTPA	Gas	Reliable	Pre-FEED	+/- 25 to 35%	+/- 30 to 40%	90.6
7.5 MTPA	Liquid	Developing	Concept Select /Pre-FEED	+/- 30 to 40%	+/- 30 to 40%	112.8

1. The findings of this study highlight the gap between the T&S allowances published in the 2023 and 2024 version of the SDE++ Base Rate Guidance and the compiled tariff based on current cost data provided by the companies during the course of the study. The compiled tariff, displayed in the table above, follows the tariff calculation guidance provided by MEAC. Following a review of the project scope, limited areas for cost reduction were found but these are reflected in the compiled tariffs displayed.

2. It was noted that the majority of the building blocks were at Pre-FEED or FEED stages in the project cycle, which have a relatively large estimate accuracy band, an indictive accuracy band for the combined building blocks are noted in the table above. The typical target accuracy band to allow a Final Investment Decision is normally circa -10 to +10-20%. It is expected that the project costs and tariff will evolve during the FEED process as the companies approach the joint FID decision for the value chain. The values in the table above represent the base case estimate for the system Tariffs in 2024 but the accuracy bands of the Capex and Opex Estimates are wide.

3. Varying the tariff calculation period by assuming the transport building blocks generate revenue for 15 years, which is aligned with the SDE++ scheme length, or for 20 years because there is a market for the service after SDE++ scheme ends, changes the results of the tariff calculation.

4. The 20 year transport tariff calculation case, which Xodus have been asked to compile by the MEAC team, demonstrates the effect of assuming some residual value in the transport elements of the system after the subsidy period. The risk and particularly the effect on IRR associated with selecting 15 or 20 years to calculate the SDE++ T&S allowance has not been addressed in the 20 year transport case noted in the results table above. The relationship between the calculation period and IRR is an important point that needs to be considered by the Government Team when selecting the tariff calculation period to be used in the SDE++ scheme.

5. Previous subsidy applications that use the Aramis value chain provide useful insight into the likely volumes the system will store and can be used to justify the volume basis for the Tariff calculation.

SDE++ 2024 T&S Allowance Review - Recommendations

1. Further work is needed to fully validate the Capex estimate for the CO_2next Terminal given the first of a kind nature of the project and the current level of design maturity. The unregulated nature of the system makes options to do this more limited in nature for the Government team but the projected conclusion of the FEED study in Q1 2025 presents the opportunity to revisit the tariff calculation when more detailed cost information has been produced. This approach may provide more confidence in the terminal costs and, in turn, improve the confidence in the outcome of any government intervention in the project or tariff.

2. The cost of operating a liquid CO_2 barge is based on emitter size and location. It may be difficult to settle on an allowance in the SDE++ for this method of transport without significant risk of it being set too high or too low. It appears that some policy development work is required to understand the opportunity and cost of having a more flexible allowance setting process for the liquid transport element of the network.

3. The outcome of the gaseous tariff review work highlights the requirement for all parties to revisit the tariff allowance published in the 2024 SDE++ scheme to ensure the aims of the project and subsidy scheme can be delivered.

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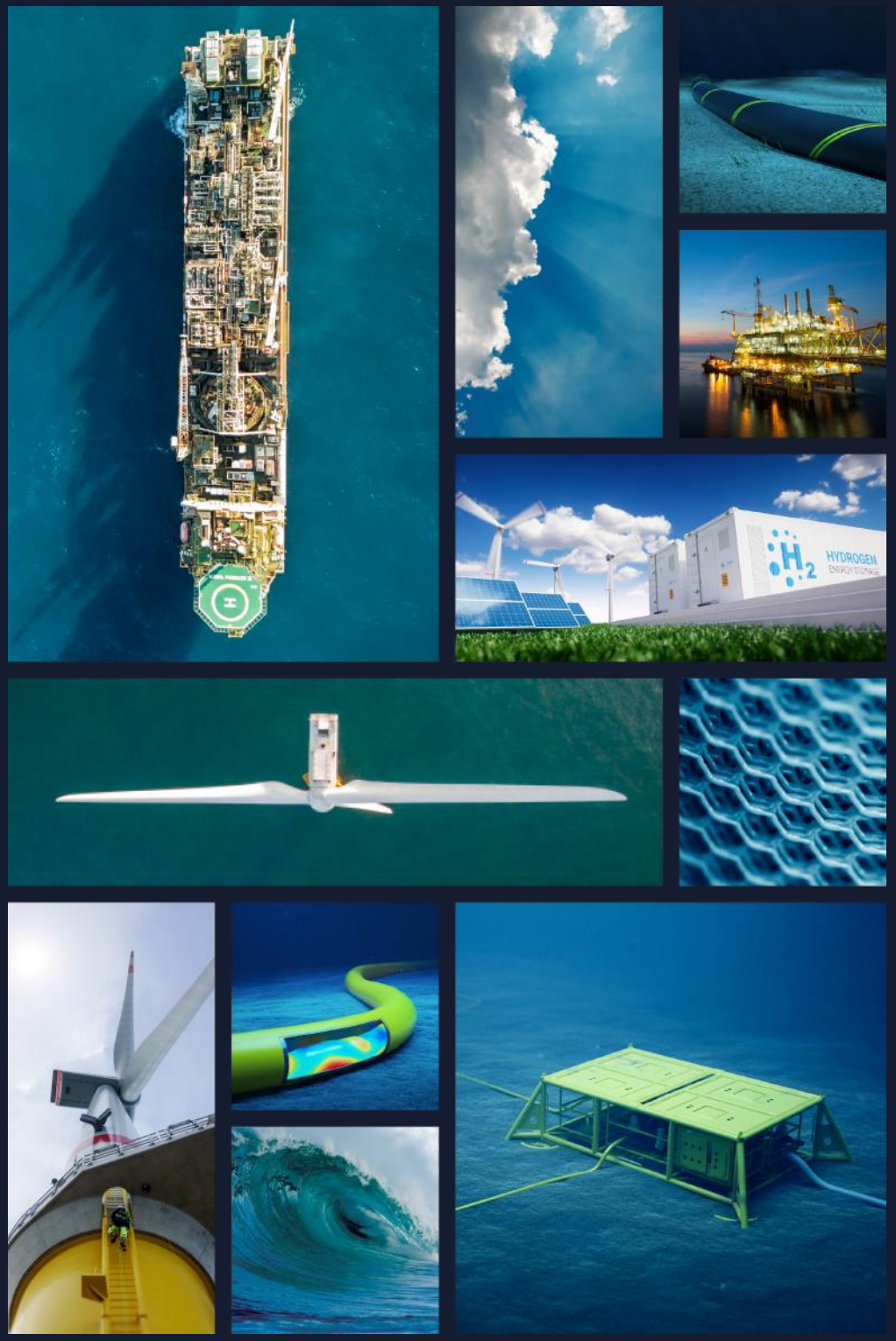
Abbreviations & References



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Acronyms and Abbreviations

Acronym	Description
Capex	Capital Expenditure
CCUS	Carbon Capture Utilisation and Storage
CO_2	Carbon Dioxide
EUR	Euros
EU ETS	European Union Emissions Trading Scheme
FID	Final Investment Decision
JV	Joint Venture
MTPA	Million Tonnes per Annum
MEAC	Dutch Ministry of Economic Affairs and Climate
Opex	Operating Expenditure
T&S	Transport and Storage

References

Ref 1: https://www.pbl.nl/publicaties/eindadvies-basisbedragen-sde-2024