Accelerating the Shift to Offshore Wind Energy

Repurposing old oil rigs for platforms for offshore electrical substations to eliminate decommissioning costs and increase economic viability of wind energy.

TKS x

Walkthrough video of deck here.

Executive Summary

Opportunity

Partial Decommissioning & Floating Offshore Wind Farms

1. Decommissioning is a 10-15 year process that costs up to **$200 million for each structure**, produces 10K tons of emissions, and has no inherent financial returns for Shell.
2. Electrical substations are essential for offshore floating wind farms, but are expensive to get to float due to the hardware, making up **8.5% of offshore wind costs**.
3. The need for electrical substations for offshore wind energy gives oil rigs that would otherwise have to be removed the opportunity to be repurposed.

Solution

Repurposing Oil Rig Platforms for Floating Wind Substations

1. As opposed to the full decommissioning process, **partial decommissioning** offers a platform to place electrical substations on, thus accelerating the transition to wind energy,
2. The decommissioning process is done regularly up to the step where the top structural components of the oil rig and the pipelines have been decommissioned.
3. The topside and the jacket of the oil rig can be repurposed for the offshore substation to be built on top (depending on the size and infrastructure).

Impact

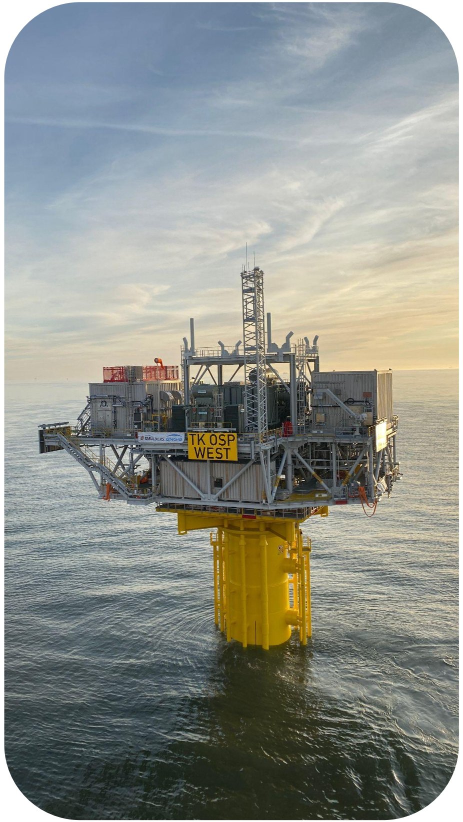
Reduced Decommissioning Costs & Accelerated Wind Transition

1. Repurposing oil rigs will result in a **$4.65 million reduction** in decommissioning costs.
2. There is a **7.36% difference in cost** between the status quo and our solution of repurposing the platform for electrical substations for our pilot program for Goldeneye.
3. Our solution will offset **94,500 tonnes of CO_2 and 135 tonnes of NO_x per year** due to emissions being saved on decommissioning operations that utilize high-polluting equipment and green electricity generated from wind.

Opportunity: Repurposing Oil Rig Platforms for Floating Wind Substations

The Technical Barrier:

A large technical challenge with offshore wind substations is **developing models that can float.** Building and scaling these floating substations will require a whole new supply chain and close collaboration and coordination with both the energy companies and the platform designers.



The Cost Barrier:

Approximately **8.5% of costs** for large-scale offshore wind farms goes to building the substation and cabling. This margin is increased in future projects as it is anticipated that larger projects will require a large array of substations, especially if the expected energy output is more than approximately 500 MW.

01 Through the process of repurposing aging offshore oil rigs for offshore substations, we can **reduce decommissioning costs** by a large margin by reusing the platform, the topside, and the jacket.

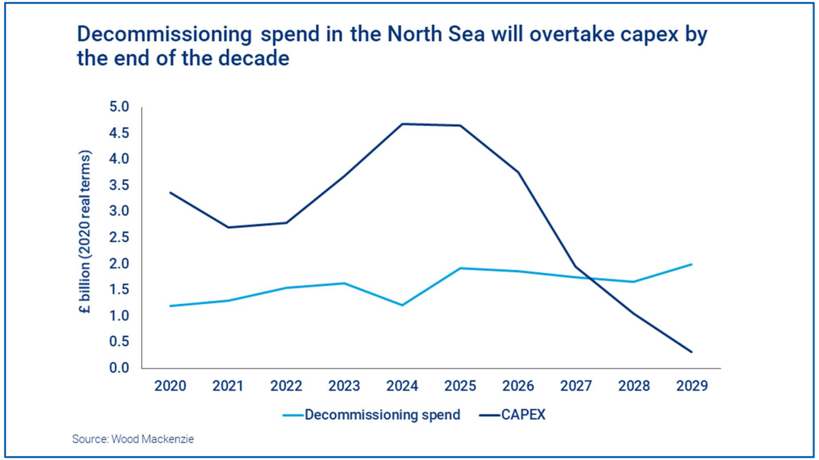
02 By repurposing the aging oil rigs for electrical substations, a key component in the development of an offshore wind farm, we are reducing a significant cost driver in **accelerating wind energy production**, while giving oil rig platforms a second life.

> "There is a really interesting opportunity here!"
>
> - *Torben Bang, COO Siemens Gamesa*

In the North Sea, 100 platforms, 2,000 km of pipeline and 450+ wells are **set to be decommissioned by 2027.**

The Turn to Decommissioning: Shell set to spend $3.2 billion on ABEX in the North Sea by 2030

The market for decommissioning is projected to increase dramatically in the next decade. In comparison to other UK operators, Shell is set to have the **highest Abandonment and Decommissioning Expenditure (ABEX) liability** to abandon oil-producing fields in the North Sea within the next 8 years.



Trajectory for Offshore Decommissioning

01 In the next 5 years, **more than 600 projects** are expected to be disposed of.

02 Spending is forecasted to reach almost **$100 billion** for the 2021-30 period, **up by over 200%** compared to the previous 10-year period.

03 The market is valued at $9,235 million in 2020 and is projected to reach a value of **$17,099 million by 2031**, with a **CAGR of 5.8%**.

The Major Drivers

Maturing Oil Fields: As fields reach a state of declining production after 25 years of production, a growing number of O&G platforms are approaching the end of their expected life.

Push Towards Low-Carbon: The global economy is pushing toward a low carbon economy and energy transition, leaving many O&G platforms obsolete and without purpose in the next decade.

Requirements by Law: The United Nations Convention on the Law of the Sea (UNCLOS) obliges member countries to remove any abandoned or disused installations or structure to ensure safety of navigation.

Oil Price Crashes: Low oil prices, compounded by the impact of COVID-19 and decreasing demand for oil, make it economically unattractive to keep oil rig platforms in operation as they are operating at a loss.

Problem Overview: Conventional Decommissioning Methods

Why Shell needs an alternative to conventional decommissioning methods.

Decommissioning is a difficult and time-intensive process.

- Decommissioning is done in phases, and generally **takes 10-15 years** from the cessation of production to the end of removal.
- Obtaining permits alone can take **up to 3 years** to complete.
- Safely removing massive structures that weigh **150,000 tonnes** from deep waters presents a technological challenge.
- The providers of decommissioning vessels and services are **limited and fragmented**, causing many delays.

Millions of dollars will be wasted on decommissioning.

- Decommissioning costs in the North Sea are projected to reach **£16 billion by 2030** and **£19 billion by 2040**.
- Removing structures from deep water, could cost **£30 million to £200 million** each, depending on the size.
- The process is capital intensive and required by law, with **no inherent financial return**.
- Decommissioning is often put off due to the high costs – even if it means producing at a loss, meaning **even more money is lost**.

GHG emissions are produced from this process.

- Offshore decommissioning activities cause major regional air emissions resulting from the use of heavy and **high-polluting equipment**.
- Jacket removal produces **31% of total NOx emissions** per platform due to the extensive use of tugboats and the large derrick barge.
- The total emissions for the average platform is **460 tonnes of NOx** for full abandonment.

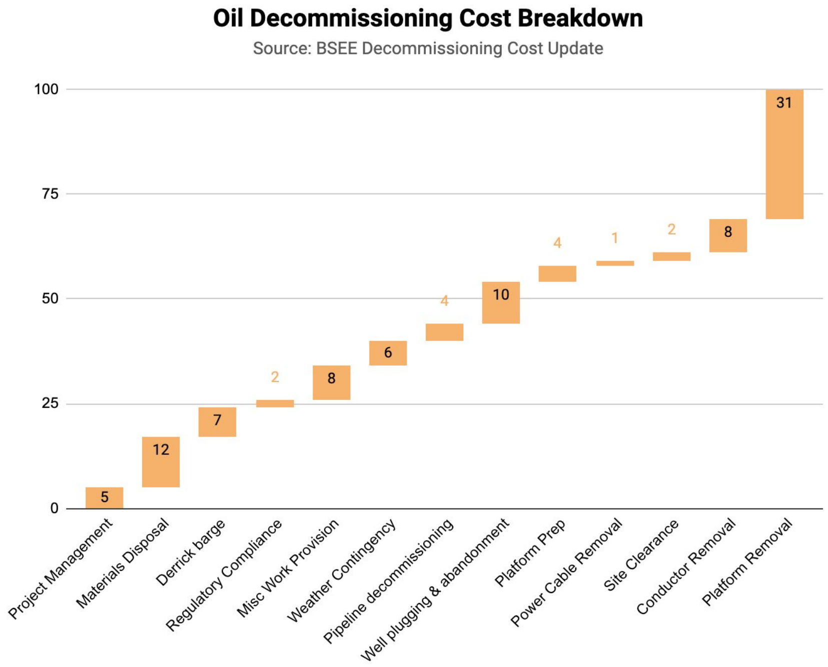
Opportunity: Repurposing Oil Rig Platforms Reduces Decommissioning Costs by 31%

Quantifying Economic Losses

Decommissioning costs in the North Sea are projected to reach $17 billion by 2030 and **$26 billion by 2040**. Removing structures is capital-intensive and required by law, with no inherent financial return. Decommissioning is often put off due to the high costs – even if it means producing at a loss due to low oil prices, meaning even more money is lost.

An enormous amount of the costs come from the platform removal. All platform components including conductor casings must be removed. The topsides are taken apart and lifted onto the derrick barge, and the jacket is removed which requires heavy lifting equipment.

When Shell left concrete legs of three of the **Brent platforms** in place, there was proven to be no measurable impact on the environment and a significant amount of money was saved. However, nothing happened with these legs, thus providing an opportunity to give the platform a second life because **the platform itself can last 100-200 years**.



If the average shallow-water decommissioning project costs $15 M USD, **platform removal alone makes up 31%, or $4.65 million.**

Opportunity Intersection: Giving Aging Oil Platforms a Renewed Purpose

01 Offshore Oil & Gas Decommissioning

Problem: Decommissioning is a long and expensive process that is not only required by law but produces emissions and has no inherent financial returns.

- Takes 10-15 years
- Costs $30 million to $200 million each
- Produces over 10,000 tons of NOx total

Opportunity it Offers: Partial decommissioning offers a platform to place electrical substations on and thus, accelerate the transition to wind energy.

- Global floating wind market has a 32.5% CAGR
- Floating offshore wind can be installed in water depths of 60-300 m, with higher wind potential

02 Electrical Substations for Offshore Wind

Problem: Electrical substations are essential for offshore floating wind farms but are expensive to get to float due to the hardware.

- Substations are needed to maximize voltage generated offshore and transmit to shore
- Installation accounts for 8.5% of the cost

Opportunity it Offers: The need for offshore electrical substations gives platforms that would otherwise have to be removed a purpose.

- Disused structures must be removed by law
- Repurposing instead of removing platforms reduces decommissioning costs by 31%

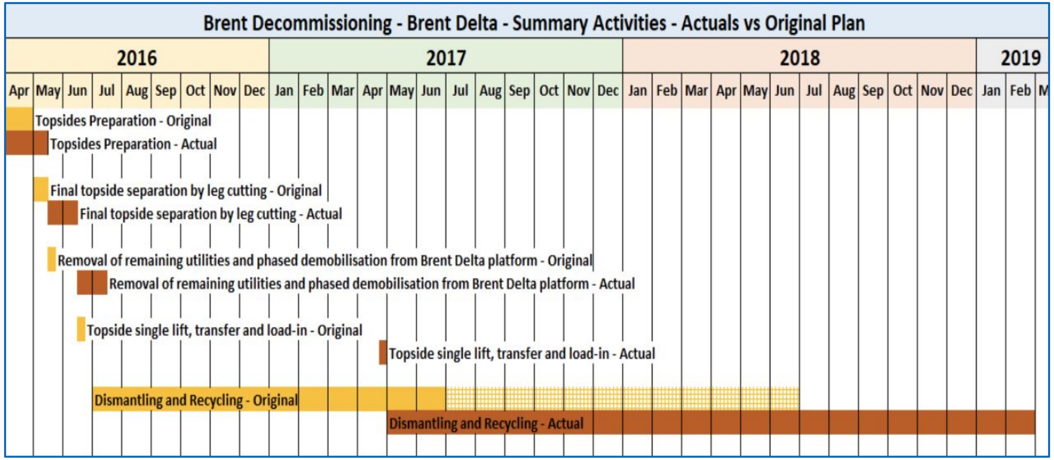
Case Study: Decommissioning the Brent Oil Rigs Consumed Money, Time & Resources

Taking a Look at Brent Field

The Brent Field rigs were built in the 1970s and produced approximately one tenth of the UK's North Sea oil. Three of the four had to shut down, and 14 years ago Shell had to embark on a multibillion-dollar 10 year+ project to remove the large drilling and accommodation structures.

Brent was not the first field to be decommissioned in the North Sea, but it was one of the biggest. Because the rigs (with unusually complex construction) were more than 100 miles north of Shetland in deep, hostile waters, this was a big challenge. The total plug and abandonment expenditure alone for the Brent field reached **$900m** and spanned from 2008 to 2020 with **over 150 wells** in total.

What is important to note here is the manmade structures stayed in the North Sea. Shell believed it was the safest and most environmentally-friendly option to leave the 300,000-tonne concrete bases beneath three of the platforms. If Shell removed all of Brent's platforms this would cost an extra $700m, **providing an opportunity** for repurposing.



Process Overview

01 **Total Cost:** In total, plugging and abandoning the Brent oil rigs cost **$900 million**.

02 **# of Wells:** There were approximately **150 wells** in the Brent Field and 4 platforms in total.

03 **The Gap:** Removing all of the Brent platforms would have cost an additional **$7 million** with significantly added time investment.

Incentive Analysis: Onshore vs. Offshore Wind Farms

Offshore vs. Onshore: Most commercial wind turbines have a capacity of 2-3 MW, but **offshore turbines can generate as much as 12 MW**. An average offshore wind turbine of 3.6 MW can power more than 3,312 average EU households, as opposed to onshore which can supply 1,500 average EU households with electricity. Offshore revenue generation is expected to increase from $31.8 billion to $56.8 from 2021-2026.

Floating vs. Fixed: Global floating wind turbine market size was valued at $3.2 billion in 2019, and is projected to reach $30.6 billion by 2027, growing at a **CAGR of 32.5% from 2020 to 2027**. Fixed foundation offshore wind is limited to water depths of up to around 50-60 metres. Floating offshore wind, based on floating structures rather than fixed structures, opens the door to sites further offshore by allowing the deployment of wind turbines in larger and **deeper areas with a higher wind potential**. Currently, it is feasible to install floating platforms between 60 and 300 metres.

How a Floating Wind Farm Works

01 A floating offshore wind platform is the concrete, steel or hybrid substructure on which a wind turbine is installed, providing it with buoyancy and stability.

02 Floating wind farms are made up of wind turbines that are placed on floating structures and stabilised by moorings and anchors.

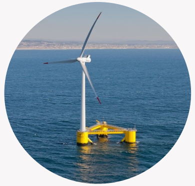
03 When offshore turbines generate power, and electricity is carried via underwater cables through an offshore substation towards the shore.

Why this Matters for Shell

Offshore wind is a critical way of generating renewable electricity for Shell's customers and moving Shell towards its target of being a net-zero emissions energy business.

Shell has more than **8 GW of wind projects in their portfolio and in development.** Shell is also heavily investing in the next generation of wind technologies, including floating wind.

Some floating wind projects Shell is involved in include the Tetraspar Demo project with Stiesdal Offshore Technology in Norway, ScotWind Projects in the UK, the Emerald Project in Ireland, the Groix & Belle-Île pilot wind farm in France and the MunmuBaram floating wind project in South Korea.



Cost Breakdown: Summary of a Floating Offshore Reference Project

6.1-MW Turbines	$/kW	$/MWh
Turbine Capital Cost	1,301	22.7
Balance of system	3,237	56.6
Financial costs	790	13.8
Capital expenditure	5,328	93.1
Operational expenditure ($/kW/year)	130	39.2
Fixed charge rate (real, %)	5.8%	
Net annual energy production (MWh/MW/yr)	3,328	
Net capacity factor (%)	38.0%	
Levelized cost of energy ($/MWh)	132	

Driving Cost Factors

The total cost is comprised of the following:

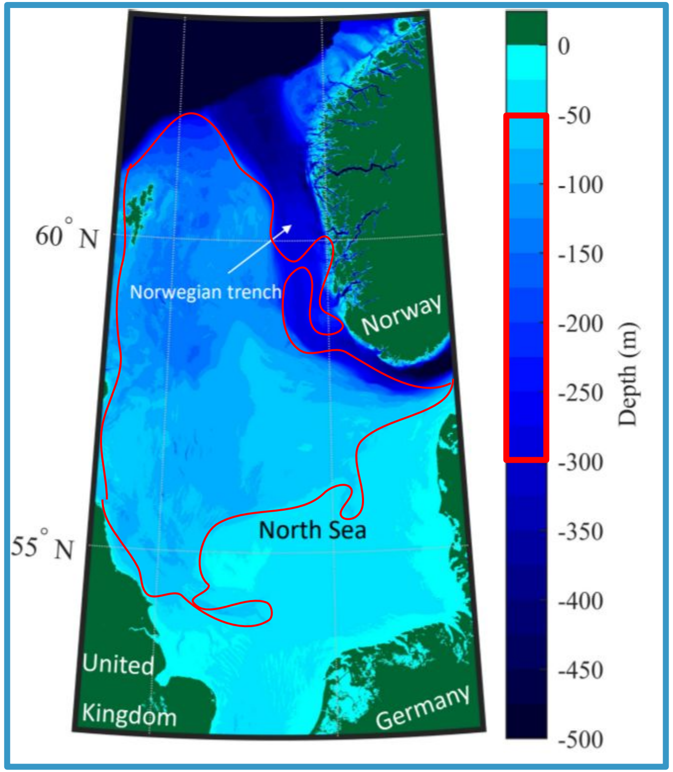
1. Capital expenditure (including development expenditure)
2. Cost of finance for that CAPEX
3. Operational expenditure (OPEX)
4. Decommissioning expenditure (DECEX)

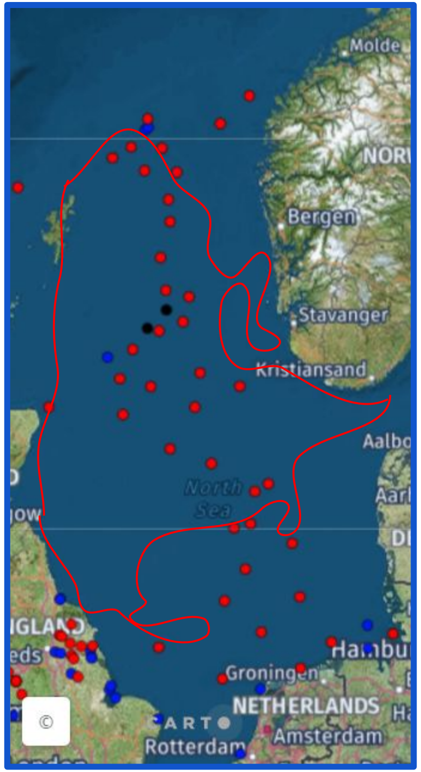
Capital Expenditure

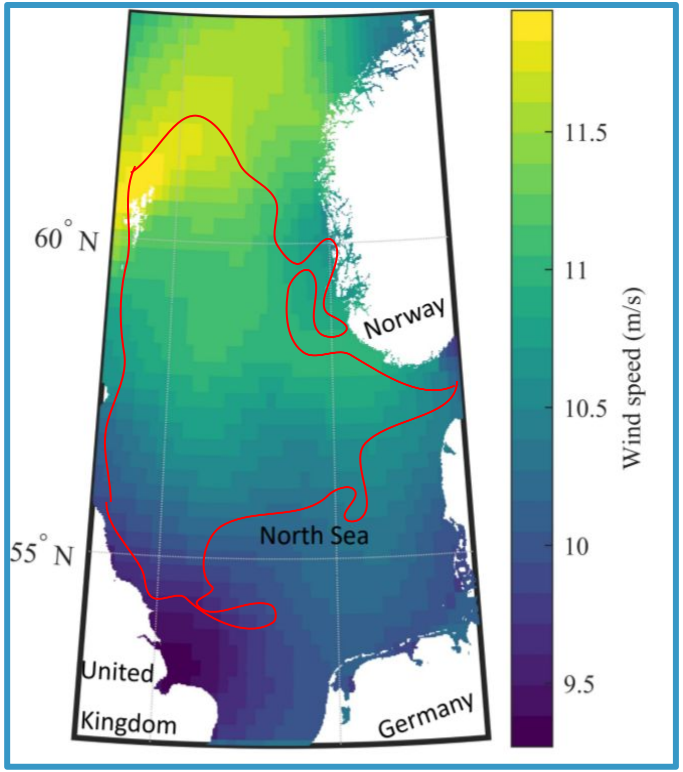
CapEx for offshore wind energy, which account for the highest costs in the table to the left, mainly concern the turbine foundation, cables, and offshore substation, accounting for **16.7% of all offshore costs.** Cost reduction in this area presents an opportunity to accelerate the wind energy transition.

The Opportunity: Geographic Harmonization of Offshore Oil Rigs and Wind

The area in the North Sea where the depth of water is suitable for floating offshore wind (60-300 m) not only has greater wind speeds, meaning higher wind energy potential, but **already has a significant number of offshore oil rigs located in the area** that can be used to support the electrical substations.







Solution Process Overview: Repurposing Oil Rigs for Substation Platforms

DECOMMISSIONING

Platform Management and Preparation

Project management & operational planning begins 3 years before a well runs dry. Obtaining permits to decommission an offshore rig can take up to 3 years to complete and are required from regulatory agencies.

Tanks, processing equipment, and piping must be flushed and cleaned in order to dispose of residual hydrocarbons. Platform equipment must also be removed, which includes cutting cables to separate the modules.

Well Plugging and Rig Abandonment

Plugging & abandonment contributes to **49% of decommissioning costs**.

1. All platform components including conductor casings must be removed.
2. The pipeline is flushed with water and disconnected from the platform.
3. The open end is plugged and buried 3 ft below the seafloor and covered with concrete.

SUBSTATION DEV.

Topside & Jacket

The structure of the offshore substation topside is dependent on factors including the electrical equipment layout, the operating conditions, and port requirements.

The topside and the jacket of the oil rig can be repurposed for the substation.

Electrical Equipment Installation

The electrical equipment of the offshore substation depends on the type of electrical current used for transmission.

The transmission distance to shore is the key factor between using HVDC or HVAC to transmit power to onshore systems.

Cabling & Wind Power Collection

Wind power plants utilize medium voltage collection systems that consist of underground cables.

The cables travel 50 miles or more to collect power from all the wind turbines and may include reactive power control components.

Oil Rig To Substation Conversion Process: Decommissioning

1

Permitting And Regulatory Compliance

Contractual obligations and the procedure for decommissioning must be reviewed at the beginning of the well's lifespan. There are numerous legal and regulatory factors which must be resolved before any steps can be undertaken for decommissioning, and local policies to consider, such as the Petroleum Act in the North Sea.

2

Oil Platform Preparation

Before the decommissioning process can fully take place, **the residual hydrocarbons in the oil rig must be removed.** This involves cleaning out all of the pipes, tanks, equipment and any other areas that might contain hazardous materials or residue from drilling.

3

Well Plugging and Abandonment

This is the main element of the decommissioning process, comprising **approximately 49% of total costs**. The wellbore must be cleaned out and plugs carefully installed in the well. Once the well is emptied of downhole equipment, cleaned out, and filled with fluid, the open hole and any perforated intervals at the bottom of the well can be plugged.

4

Conductor Removal

The conductor pipe provides the initial stable structural foundation for an oil well. **The pipe and its casings must be removed to at least 15 ft below the ocean floor**, depending on the type of structure or ocean-bottom conditions. The process involves severing the casings in 40 ft sections using explosive, mechanical or abrasive cutting.

5

Demobilization Of Derrick Barges

The derrick barges are required to lift and transport the oil rig platform. During the planning stage, stakeholders can determine the best process to remove the topside if necessary; either in one piece, in groups of modules or in smaller pieces. The method will determine the size and lifting capacity of the derrick barge.

6

Pipeline and Power Cable Decommissioning

When decommissioned, the oil pipelines are flushed with water, disconnected from the platform and then filled with seawater. The open end is then plugged and buried under concrete, 3 ft below the seafloor. However, if the BOEMRE rules that it is a hazard during their review at the permit stage, all elements must be removed along with the rest of the platform elements.

Playbook On In-Depth Oil Rig to Substation Process [Here]

Oil Rig To Substation Conversion Process: Substation

1

Topside and Jacket Integration

The topside and the jacket of the oil rig can be repurposed for the offshore substation depending on the size and infrastructure of the oil rig. **The structure of the offshore substation topside is dependent on a multitude of factors** including the layout of electrical equipment, the operating conditions of electrical equipment, and topside port requirements

2

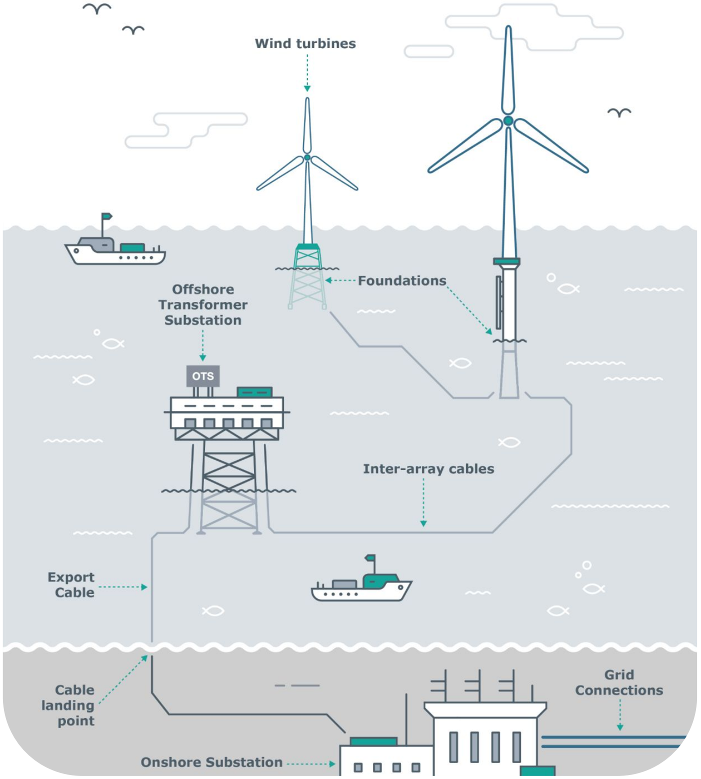
Installation of Substation Electrical Equipment

The electrical equipment of the offshore substation depends on the type of electrical current used for the transmission of electrical energy. The decision between using HVDC instead of HVAC to transmit power from offshore to onshore systems are often complex, but in most cases, **the transmission distance to the shore is the key factor.**

3

Cabling and Wind Power Collection From Turbines

Wind power plants utilize medium voltage collection systems that consist of underground cables. In typical projects, the cables travel 50 miles or more to collect power from all the wind turbines and sometimes includes reactive power control components.



Pilot: Goldeneye Gas Field, Central North Sea

Why Goldeneye?

01 **Decommissioning Planning Confirmed & In Progress:** With no production since 2011, the decommissioning programme for the Goldeneye field platform and pipelines was approved by the BEIS in November 2019.

02 **Ideal Location for Floating Wind:** At a depth of 120 metres and 110 km from shore, Goldeneye is located at a technically sufficient depth for floating offshore wind farms. Moreover, the Central North Sea boasts a wide range of floating offshore wind projects - many of which Shell has already invested in (e.g. Hywind and TetraSpar).

1 Decommissioning Process Completion

8-12 months

Most decommissioning procedures at Goldeneye have been completed, with the exception of jacket, topside, and subsea removal, which was heavily delayed due to COVID-19.

The first step would be to start with completing the decommissioning process, which would translate to completing subsea infrastructure removal, and repurposing the jacket and topside facilities for the electrical substation construction.

2 Construction of Offshore Substation

4-6 months

The most important part of the substation construction process is the topside and jacket integration. The structure of the offshore substation topside is dependent on a multitude of factors including the layout of electrical equipment, operating conditions, and port requirements. Then, the electrical equipment can be installed based on the electrical current used (HVAC or HVDC). Subsea cabling systems can be installed after installation of the wind turbines.

3 Construction of Offshore Floating Wind Farm

12-24 months

First the tower is constructed. The steel sections of the tower are normally assembled on the site, and the tower is lifted into position by a crane. Bolts are tightened and on completion, stability is tested. Afterwards, the fiberglass nacelle is installed. The gear box, main drive shaft, yaw controls and blade pitch are assembled and mounted onto a base frame at a factory.

In commercial wind turbines, fiberglass with a hollow core is used for the blades, however, aluminium and lightweight woods can also be used. The blades are normally bolted on the nacelle after placing it on the tower. Then, the utility box for the wind turbines and electrical communication system for a wind farm is installed along with placing the blades and the nacelle.

Pilot: Goldeneye Decommissioning Impact Analysis

Economics

Estimated Cost of Goldeneye Decommissioning	$15,000,000
Platform Removal Cost as a %	31%
USD Saved By Leaving Platform	$4,650,000
Total Decommissioning Cost	$10,350,000

Conclusion: Leaving the Goldeneye platform in place

- Prevents **135 tons of NOx** from being released into the atmosphere
- Results in a **$4.65 million reduction in decommissioning costs**

Emissions

Total Emissions from Decommissioning	460 tons NOx
Emissions from Platform Removal Alone	135 tons NOx
Net Emissions from Goldeneye Decommissioning	325 tons NOx

Pilot: Goldeneye Floating Wind Farm Cost Breakdown

	Total Cost	Substation Cost	(Total - Substation) Cost
50 MW Floating	$ 482.83 M	$ 41.04 M	$ 441.78 M
50 MW Fixed Bottom	$ 65 M	$ 5.53 M	$ 59.48 M

	Floating Turbines + Fixed Substations	Status Quo Floating Wind Farm
Offshore Building	$ 441.78 M	$ 441.78 M
Substation Cost	$ 5.53 M	$ 41.04 M
Total Cost	$ 447.31 M	$ 482.83 M

There is a **7.36%** difference in cost between the status quo (Shell would be building a 50 MW offshore wind farm from scratch) and our proposed solution of repurposing the Goldeneye platform for electrical substations.

Pilot: Goldeneye Floating Wind Farm Details

Modelled after Kincardine Offshore Floating Wind Farm in Aberdeen, SC

Land Size: 110 km^2

Total Capacity: 49.625MW

Turbine Type: five V164-9.525 MW turbines and one V80-2.0 MW from MHI Vestas

Foundation Type: Semi-submersible foundations

Average Lifespan: 25 years

CO_2 emissions offset: 94,500 tons per year

LCOE = lifetime costs divided by energy production
AEP = average energy production

$$\text{Levelized Cost of Energy (LCOE)} = \frac{\text{CapEx + OpEx}}{\text{AEP over life}}$$

$$= \frac{\$\,447{,}309{,}875 + \$\,78{,}937{,}037}{218{,}000\ \text{MWh} * 25}$$

Levelized Cost of Energy (LCOE) = $96.52

Total CapEx	$447,309,875
Total OpEx over lifespan	$78,937,037
Annual Energy Production	218,000 MWh
Annual Revenue	$ 62,450,460.00
Annual OpEx	$ 3,157,481
Annual Gross Profit	$59,292,978.53
Years to Break Even	7.54

It will take Shell **7.5 years to break even at Goldeneye** with the construction of 6 offshore renewable wind turbines, calculated using the annual gross profit.

Impact: Aligning with Shell's Long-Term Net-Zero Goals

1

Decreasing Costs

Repurposing old oil rig platforms for offshore electrical substations allows Shell to decrease costs in both the decommissioning and wind installation processes. This would result in **$4.65 million saved in decommissioning** and **$35.52 million saved in wind installation**

2

Increasing Revenue

By investing in offshore floating wind, Shell can increase revenue by selling electricity. One project can generate $62,450,460 a year. Combined with the decreased costs, this results in a **profit of $59,292,978.53 annually.**

3

Net-Zero

Shell can reduce its emissions by cutting short the length of the decommissioning process and making the transition to renewable wind energy from non-renewable sources. One project will result in **135 tonnes of NOx reduced in decommissioning, 94,500 tonnes of CO2 offset through wind, and 218,000 MWh renewable electricity per year**

Providing Enough Renewable Electricity for 50 Million Households by 2030

One project will provide renewable electricity for 55,000 households.

Double Electricity Sold

One project will sell 218,000 MWh/year.

Reduce Absolute Emissions by 50% by 2030

One project will reduce 94960 tons of NOx and CO2 emissions.

Investing Around $1 Billion Every Year in Low-Carbon Energy

Investing in one repurposing project will be investing $152.26 million per year in low-carbon energy.

Future Opportunity: Green Hydrogen

Once this solution is operating successfully, something to look into down the line could be generating offshore green hydrogen in tandem with the existing solution.

The offshore hydrogen production process:

01 **Powering the Hydrogen Plant:** Electricity generated by offshore wind turbines will power a hydrogen plant on the platform, converting seawater into demineralised water. The efficiency of an electrolyser with a variable supply from offshore wind will have to be tested, to obtain costs of installation and maintenance.

02 **Production of Hydrogen:** The demineralised water will be converted to hydrogen via electrolysis. Electrolysis works by using an electric current to split water into hydrogen and oxygen. If the electricity is produced by renewable sources, such as solar or wind, the resulting hydrogen can be renewable as well.

03 **Selling the Hydrogen:** The produced green hydrogen will be mixed with the gas and transported via the existing gas pipeline to the coast. Extensive infrastructure network is connected to international grids and can easily accommodate wind farms further out at sea by converting the production of green electricity into green hydrogen and transporting it to the grid onshore.

Case Study

A consortium is building the world's first offshore green hydrogen project on operational oil platforms, and have received a **$3.9m subsidy** from the Dutch government. To solve challenges around grid connectivity and intermittency of supply in the North Sea, Aquaterra Energy has partnered with Lhyfe and Borr Drilling in a production concept for a hydrogen jack-up rig.

The process works by using offshore wind turbines to desalinate sea water through a 1 MW electrolyser that splits the purified water into hydrogen and oxygen. The **400 kg of green hydrogen produced each day** will then be mixed with extracted fossil gas and transported to shore by gas pipelines already in place.

The consortium's ambition is to begin producing hydrogen in 2-3 years' time and have chosen the best location to pilot at **Neptune Energy's Q13a-A**, a platform already fully electrified using renewable energy in the Netherlands. Project Haldane solves grid connectivity issues by leveraging the existing infrastructure to reduce costs.

Timeline: Our Next Steps of Action

2022-2025

Implementation of Pilot Program

The pilot plan at Goldeneye as previously outlined will be fully implemented; this process will comprise completing subsea infrastructure removal, and repurposing the jacket and topside facilities for the electrical substation construction.

2030

Integration of Green Hydrogen

Electricity generated by offshore wind turbines can hydrogen plant on the substation platform, while converting seawater into demineralised water that can be converted to hydrogen via electrolysis. Renewable sources can be used to power the plant.

2035

Scaling Decommissioning

After the pilot program has been implemented and the green hydrogen tested for feasibility, the oil rig to substation conversion process can be implemented in either the Mayflower or Atlantic Shores offshore wind projects or any upcoming offshore wind developments.

2040

Integrating Conversion Globally

By integrating the rig to substation conversion process in all their offshore wind projects, Shell can save costs on building substations, especially for increasingly large wind farms which require multiple offshore substations and extensive cabling.

Thank you, Shell!

Dear Shell,

We'd like to thank you for giving us the opportunity to make a real change in the world within the energy sector!

Throughout our research and our process of gathering perspective, we learned so much about how to move the needle within this rapidly transforming industry and where exciting areas are emerging with new innovations.

We hope that we were able to provide a feasible solution to the problems that Shell and its customers face today. We would love to answer any questions you have about our recommendation via email. We're all so excited to see how Shell pioneers the way to being net zero emitters by 2050.

All the best,
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