

Applying the Sustainable Asset Valuation (SAVi) to the 9.5 GW Offshore Wind Farm, North Sea, The Netherlands

Client:

Rijkswaterstaat, Ministry of Infrastructure and Water Management, The Netherlands

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The Scope of this SAVi Assessment

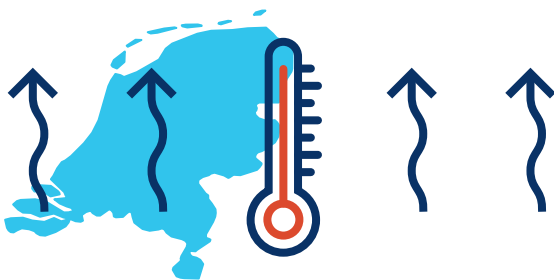


In 2017, the Dutch Ministry of Infrastructure and Environment (Rijkswaterstaat) requested that IISD use SAVi to:

- Compare the financial attractiveness of the planned 9.5 gigawatt (GW) offshore wind farm in the North Sea with other energy technologies. In this summary, we provide the comparison between the offshore wind farm and a coal energy plant that generates the same capacity of 9.5 GW. The comparison with other technologies is available on request.
- Assess the cost of physical and transitional climate risks
- Value, in financial terms, a range of material externalities

Risks

Rijkswaterstaat identified the following climate risks to energy infrastructure:



Physical Risk

An increase in temperature by 1.5°C.

SAVi calculated to what extent this increase in temperature affects the performance of energy infrastructure. An increase in temperature decreases the energy efficiency of a coal power plant and makes wind energy, in comparison, more performant.

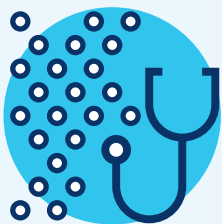


Transitional Risk

Imposition of a carbon tax of EUR 16.27/MWh throughout the operation of the asset.

SAVi calculates the impact of this tax on energy infrastructure. The carbon tax negatively affects the performance of a coal power plant.

Externalities



Emissions

Valuation of CO₂, PM_{2.5}, SO₂ and NO_x emissions based on their related health costs. For clean energy solutions such as the wind farm, this will result in an avoided health cost compared to coal.



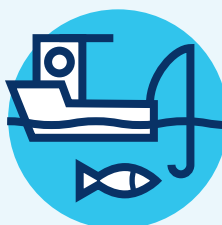
Labour income

Valuation of income spending from additional employment created for construction and operations of the energy infrastructure. This is based on average income per worker and share of discretionary income spent in the Netherlands.



Land use

Valuation of benefits of retaining land for agriculture instead of power generation on land. This opportunity cost is calculated based on the productivity per hectare of agriculture land and the land required for an onshore wind farm to generate 9.5 GW of electricity.



Loss of fisheries

Revenues lost for the fishing industry, as the wind turbines are located offshore.



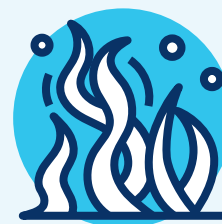
Sand mining

Whether the construction of wind farms will constrain the ability to harvest sand.



Recreation

Changes in revenues from tourism and recreation measured by changes in real estate prices in Ijmuiden and the surrounding coastal areas.



Seaweed

The farming of seaweed in between the wind turbines developing into a new industry.

Summary of the SAVi Analysis

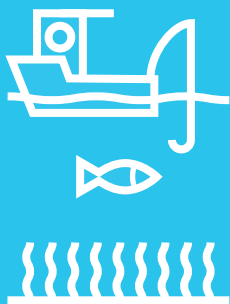
The SAVi analysis compared the financial performance of the offshore wind farm to a coal power plant that generates the same output of 9.5 GW.

The analysis of each of the two assets is organized under the following four scenarios:



Scenario 1: Business-as-Usual (BAU) assessment

Under the BAU scenario, coal emerged as the most profitable technology. It has a lower levelized cost of electricity, higher internal rate of return and a more attractive debt service coverage ratio and loan life coverage ratio.



Scenario 2: The SAVi+ Scenario: BAU and the value of the externalities (see list on page 3)

When correcting the levelized costs of electricity for the value of the positive and negative externalities, offshore wind came in cheaper at EUR 65 per MWh compared to coal at EUR 171 per MWh. Similarly, the internal rate of return (IRR) for wind increased to 17 per cent, and coal decreased to 4 per cent.



Scenario 3: The SAVi+ Scenario and the physical climate risk

Adding the impacts of a higher temperature, offshore wind came out as the clear winner with an IRR at a steady 17 per cent, while coal fell to 0 per cent.



Scenario 4: The SAVi+ Scenario and the physical and transitional climate risk

When adding in a carbon tax, the offshore wind has a significantly higher IRR than a coal plant.

SAVi estimates that the offshore wind project will create 2,780 jobs (estimated in full-time equivalents)

Rijkswaterstaat requested that we use SAVi to calculate the carbon emissions of different energy technologies. We calculated emissions across the asset life cycle, which includes fuel use during the manufacturing and installation of the power capacity. The emissions of coal- and gas-powered generation are significantly higher than for any other renewable option.

SAVi analysis on the carbon emissions of different energy technologies (in million tonnes)

Scenarios	Wind (off)	Coal	Gas	Nuclear	Biomass	Hydro	Solar	Wind (on)
CO ₂ Emissions-fuel	-	1,652.0	731.6	-	-	-	-	-
CO ₂ Emissions-life cycle	19.6	1,661.5	745.1	7.1	8.2	4.7	56.2	31.4

SAVi analysis on the levelized cost of electricity (LCOE) (in EUR/MWh)

Scenarios	Offshore wind	Coal
Scenario 1: BAU	72.93	46.08
Scenario 2: SAVi+*	65.22	171.08
Scenario 3: SAVi+* and physical climate risk	65.22	171.77
Scenario 4: SAVi+* and physical and transitional climate risks	65.22	185.92

*Externalities listed on page 3.

The LCOE is the net present value of the unit cost of electricity over the lifetime of the asset. It is considered to be a proxy for the average price that an energy-generating asset must receive to break even over its lifetime.

- When externalities are not considered, coal appears to have the lowest LCOE with EUR 46 per MWh. This is mainly because the offshore wind project has larger capital costs, and this increases the cost of financing.
- When the **LCOE is corrected for the externalities, the LCOE for offshore wind decreases to EUR 65 per MWh and coal increases to EUR 171 per MWh.**
- When climate risks are taken into account, the LCOE for coal increases even further to EUR 186 per MWh. The LCOE for offshore wind remains stable at EUR 65 per MWh.



SAVi analysis on Internal Rate of Return (IRR)

Scenarios	Offshore wind	Coal	Difference
Scenario 1: BAU	14.39%	23.43%	- 9.04%
Scenario 2: SAVi+*	16.61%	3.89%	+ 12.71%
Scenario 3: SAVi+* and physical climate risk	16.61%	3.85%	+ 12.76%
Scenario 4: SAVi+* and physical and transitional climate risks	16.61%	0%	+ 16.61%

*Externalities listed on page 3.

Equity IRR is an indicator for the profitability prospects of a potential investment. The IRR is the discount rate that makes the net present value of all cash flows from a particular project equal to zero. Cash flows net of financing gives us the equity IRR.

- The IRR for the offshore wind project is over 12 per cent higher than the IRR for the coal plant when we consider the value of the positive and negative externalities.
- When climate risks are considered, the difference in IRR increases to more than 16 per cent, and the IRR of the coal plant falls to close to zero.

SAVi analysis on the minimum debt service coverage ratio (DSCR)

Scenarios	Offshore wind	Coal	Difference
Scenario 1: BAU	1.45x	2.75x	- 1.30x
Scenario 2: SAVi+*	1.58x	1.00x	+ 0.58x
Scenario 3: SAVi+* and physical climate risk	1.58x	0.99x	+ 0.59x
Scenario 4: SAVi+* and physical and transitional climate risks	1.58x	0.16x	+ 1.42x

*Externalities listed on page 3.

DSCR is a measure of the cash flow available to pay current debt obligations. The ratio states net operating income as a multiple of debt obligations due within one year, including interest and principal.

- The offshore wind project demonstrates much more attractive minimum DSCR ratios than the coal plant when we consider the value of the positive and negative externalities.
- When climate risks are considered, the DSCR of the offshore wind project is 1.58x compared to 0.16x for the coal plant.

SAVi analysis on the equity net present value (NPV) (in million EUR)

Scenarios	Offshore wind	Coal	Difference
Scenario 1: BAU	5,224	13,119	- 7,894
Scenario 2: SAVi+*	8,094	- 1,851	+ 9,944
Scenario 3: SAVi+* and physical climate risk	8,094	- 1,876	+ 9,970
Scenario 4: SAVi+* and physical and transitional climate risks	8,094	- 3,827	+ 11,920

*Externalities listed on page 3.

Equity NPV is the difference between the present value of cash inflows net of financing costs and the present value of cash outflows. It is used to analyze the profitability of a projected investment or project.

- The equity NPV of the offshore wind project is EUR 11,920 million higher than that of the coal plant when externalities and climate risks are accounted for.

About SAVi

SAVi is an assessment methodology that helps governments and investors steer capital toward sustainable infrastructure. The SAVi characteristics are:

Simulation

- SAVi combines the outputs of systems thinking and system dynamics simulation with project financing modelling. The SAVi systems dynamics model is built on Vensim simulation software. The project finance model is built following Corality's SMART methodology.

Valuation

- **Cost of Risk:** SAVi places a financial value on economic, social and environmental risks and shows how these risks affect the financial performance of infrastructure projects and portfolios across their life cycle. Such risks are often overlooked in traditional financial valuations.
- **Cost of Externalities:** SAVi identifies and values, in financial terms, the externalities that arise as a direct consequence of infrastructure projects. This enables policy-makers and investors to appreciate the second order gains and trade-offs of infrastructure investments.
- **Costs of Emerging Risks:** SAVi simulates how externalities today can transform into direct project risks tomorrow. Such valuations help holders make decisions in favour of sustainable infrastructure.
- **Customisation:** SAVi is customized to individual investment projects and portfolios. SAVi can therefore value the cost of risks and as well as externalities that are directly material to the asset under consideration.

Visit the SAVi webpage:

<https://www.iisd.org/project/SAVi-sustainable-asset-valuation>