Sustainable Asset Valuation (SAVi) facility

Demonstrating why sustainable infrastructure assets can be more financially attractive

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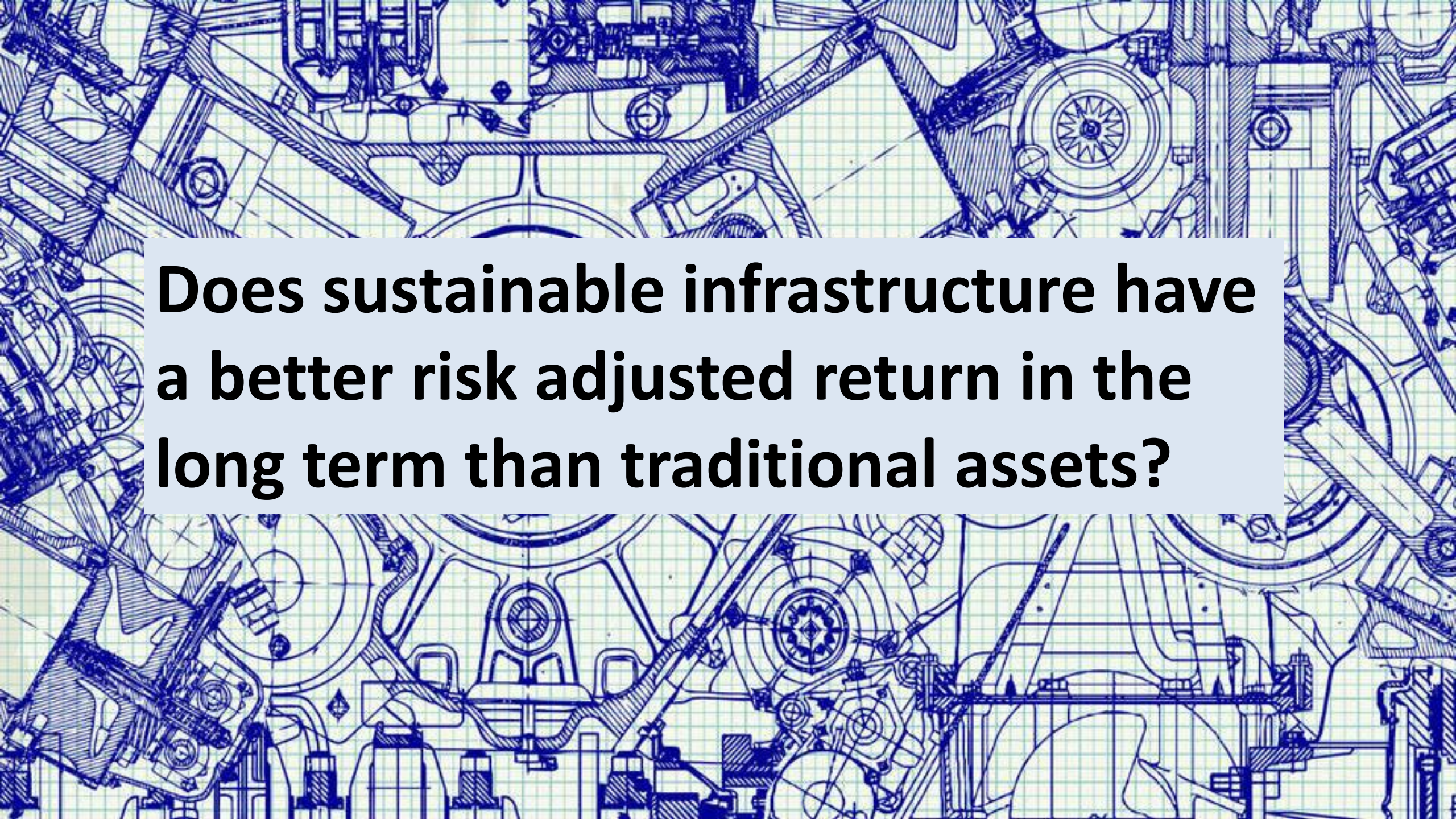

Does sustainable infrastructure have a better risk adjusted return in the long term than traditional assets?

SAVi can be used by governments and investors to:

- **Quantify the ESG performance of an asset**
- **Quantify the ESG externalities of assets and evaluate how they increase and decrease risks across the project life cycle**
- **Evaluate how ESG performance affects capital expenditure and future project cash flows.**

  Conventional project finance valuation methodologies ignore a range of material risks, intangibles and externalities

Questions we can answer for investors:

How climate + ESG risks affect the project's internal rate of return (IRR)

How climate + ESG risks affect the project's credit ratios:

- **debt service coverage ratio (DSCR),**
- **loan life coverage ratio (LLCR)**

How Savi is built

System Dynamics Model

- Vensim. Industrial Strength Software.
- Non-linear, systemic, dynamics
- Capable of explicitly representing feedback loops and delays on ESG performance and ESG externalities
- Correlations are a result of the model as opposed to being a static input.

Vensim
VENTANA systems, inc.

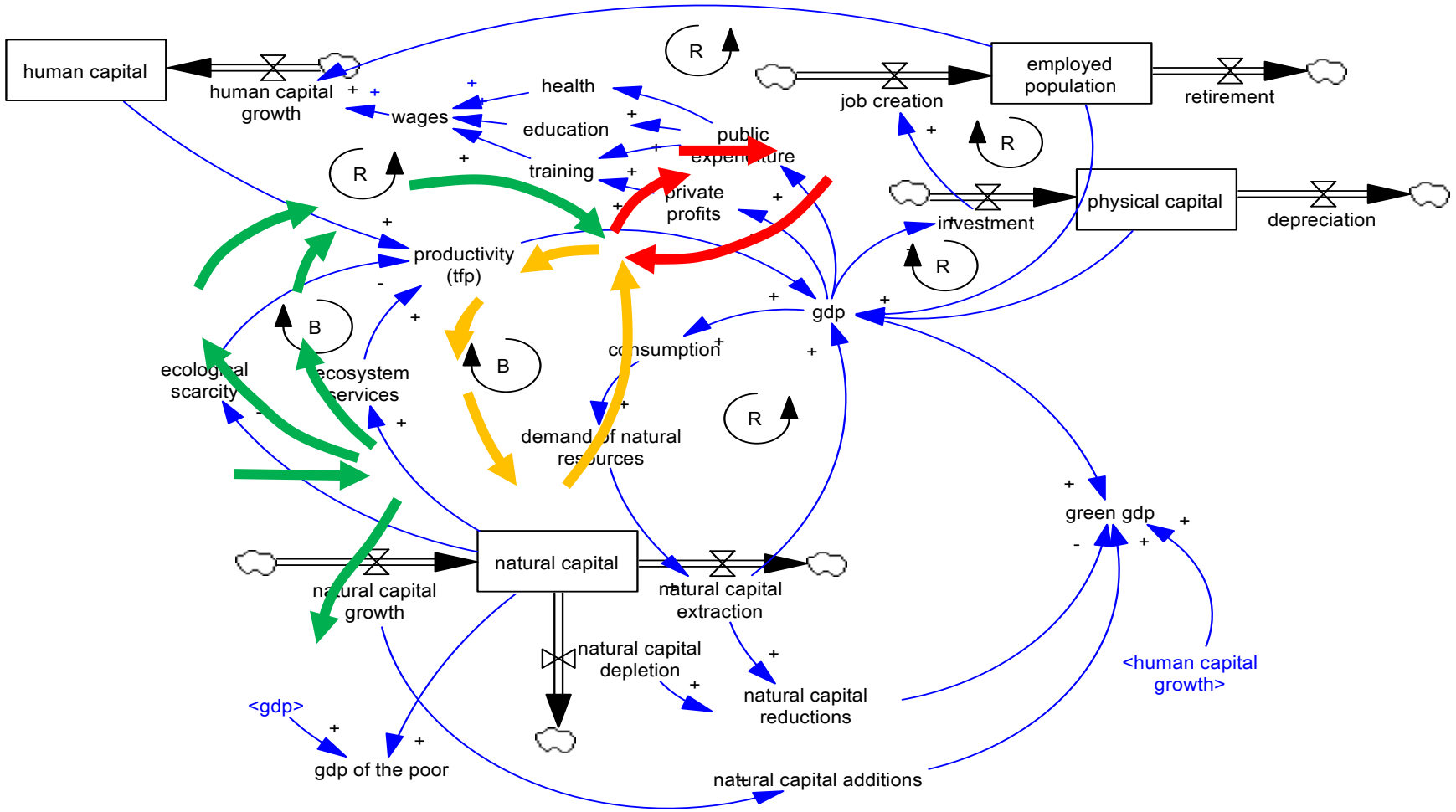
Project Finance Model

- Custom built
- Corality SMART Project Finance Methodology

- How financial viability changes if externalities are integrated as costs
- How IRR, DSCR, LLCR change under material ESG risk scenarios
- What aspects of ESG performance are financially material
- What aspects of ESG externalities financially material

CORALITY
TRAINING ACADEMY

Systems analysis on Venzim



The SAVi Sectors and Scenarios

SAVi currently handles energy, roads, buildings, irrigation, waste water.

Nature-based infrastructure under development.

SAVi compares 2 scenarios:

1. **Asset as planned (base case)**
2. **Asset simulated with enhanced + material ESG performance.**

Material ESG performance indicators/externalities are selected by clients

200 + externalities built in

The SAVi results:

Conventional Extended Cost Benefit Analysis:
Capital and O&M cost and fuel cost (with CC impacts)

SAVi Cost Benefit Analysis:
Capital and O&M cost, fuel cost (with CC impacts), carbon tax, all externalities, valuation of emissions

SAVi+ Cost Benefit Analysis:
Capital and O&M cost, fuel cost (with CC impacts), carbon tax, all externalities, Social Cost of Carbon

SAVi Internal Rate of Return:
How climate + ESG risks affect the project's internal rate of return (IRR)

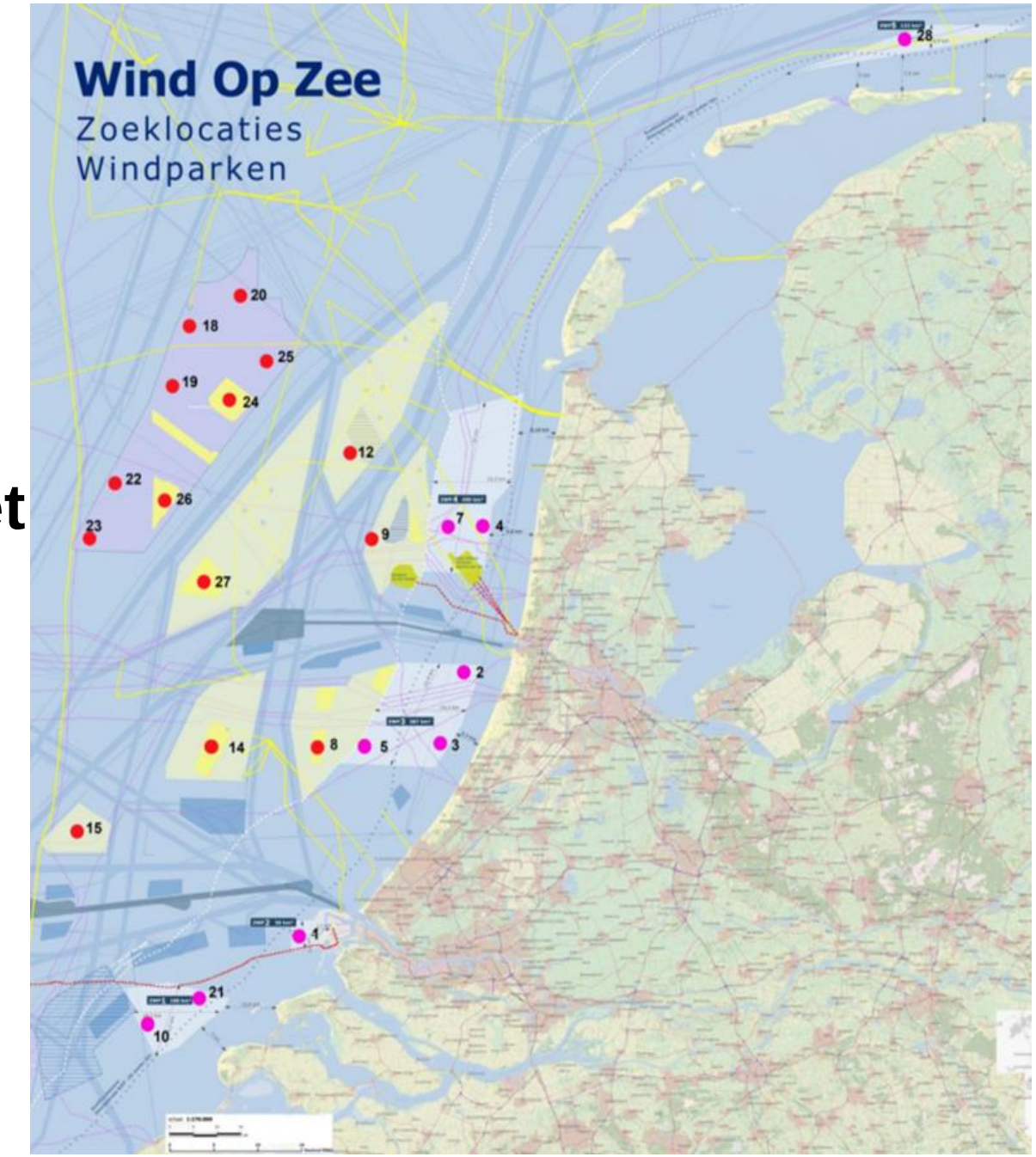
SAVi credit ratios:
How climate + ESG risks affect the project's credit ratios: debt service coverage ratio (DSCR) and loan life coverage ratio (LLCR)

Example of SAVi in use

58, 690 MW offshore Wind Asset

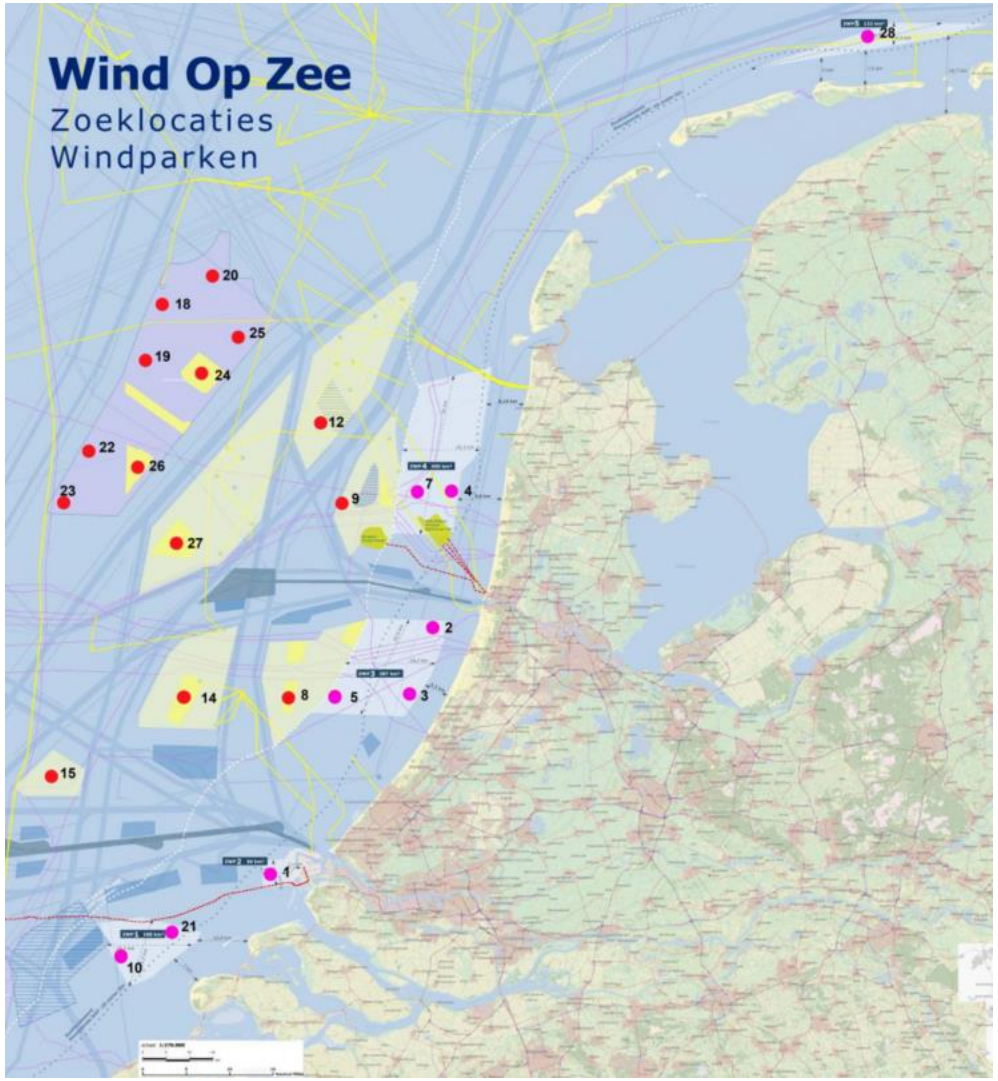
North Sea,

The Netherlands

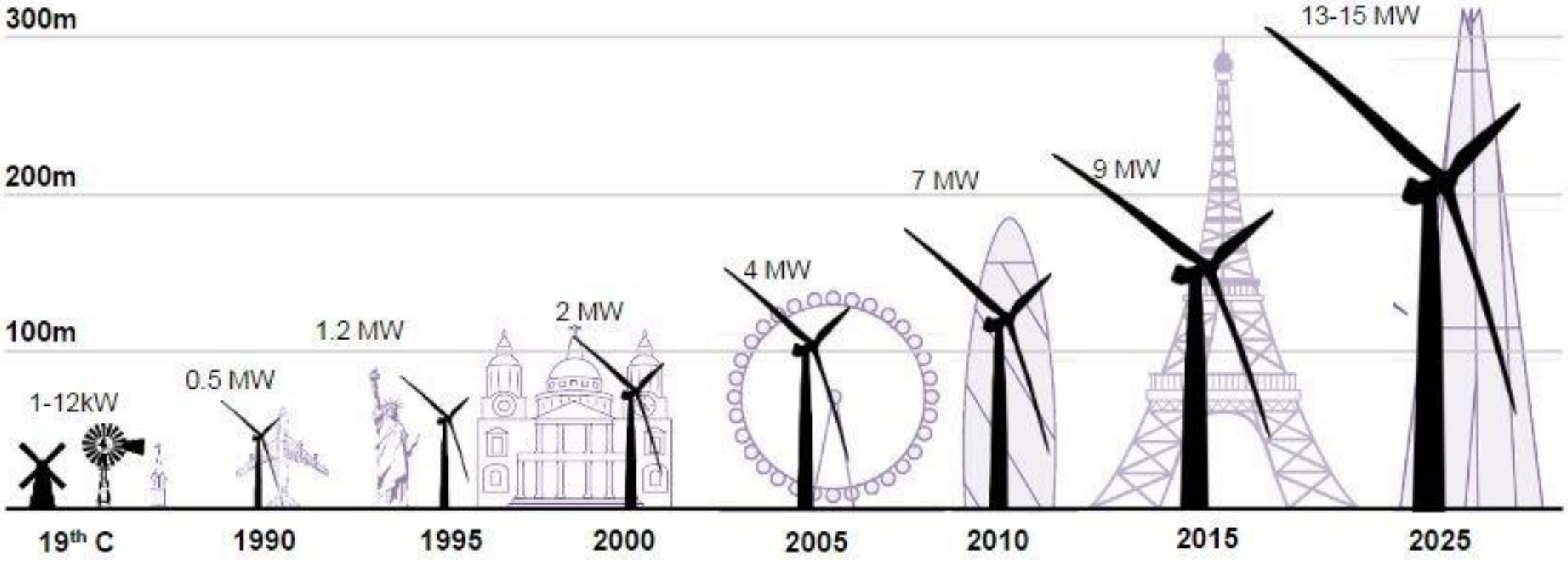


The Nethlands 15,000 MW Offshore Wind Analysis

- Assessment based on 14,000 MW of capacity from offshore wind
  - 4,000 MW within 12-nm zone
  - 10,000 MW outside 12-nm zone
- Total production: 58,690,000 MWh / Year
- Timing of investments
  - Construction period: 2018-2030 (1,166 MW per year)
  - Replacement period (wind): 2038 – 2050 (pole, turbine and blades)
- Discount factor: 5.5%



Evolution of wind turbine heights and output



Sources: Various; Bloomberg New Energy Finance

Bloomberg
New Energy Finance

Scenarios and Externalities

Scenarios 58.000 MW/year

- **Wind offshore**
- **Coal**
- **Natural Gas**
- **Nuclear**
- **Biomass**
- **Hydropower**
- **Solar**
- **Wind onshore**

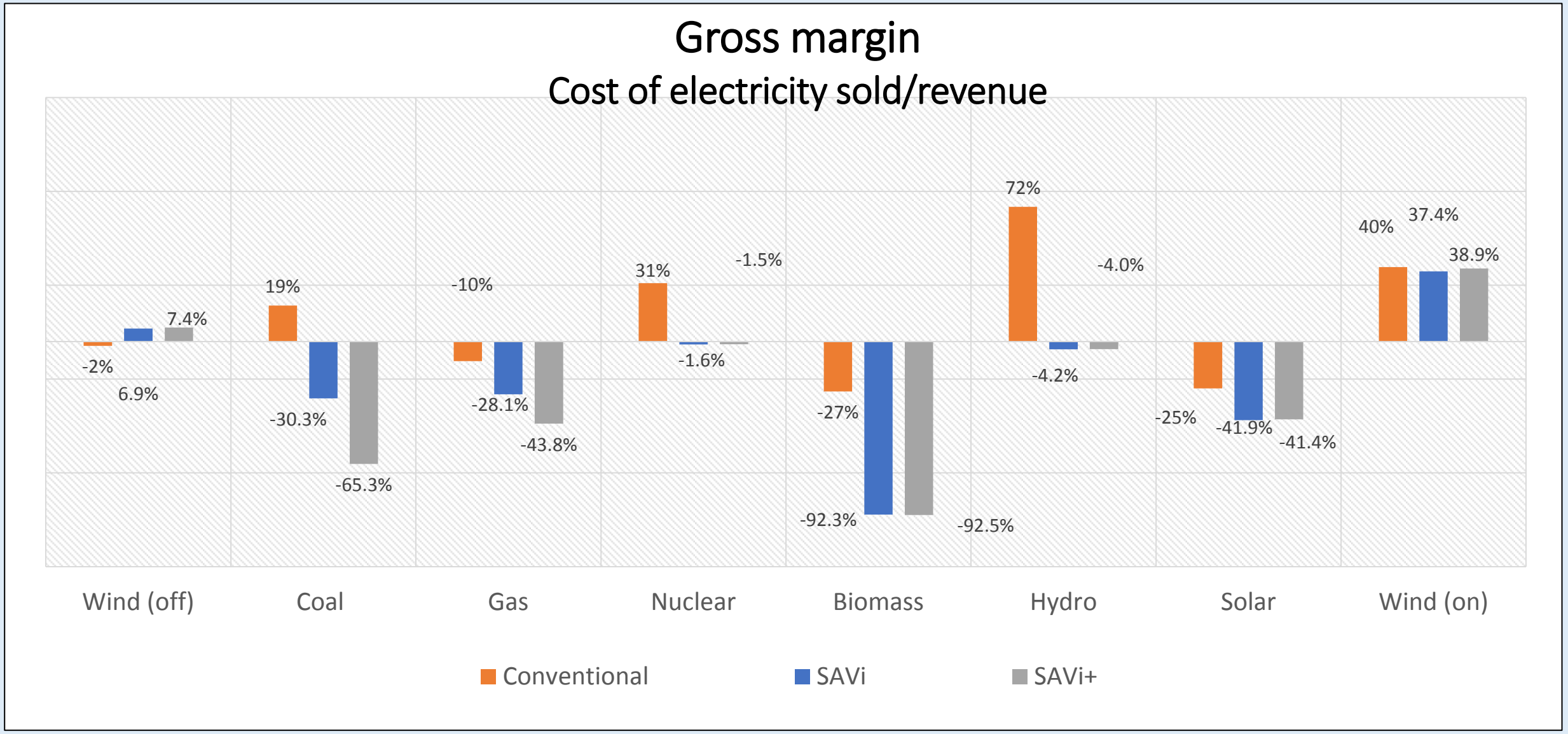
Externalities

- **Social cost of carbon**
- **Valuation of emissions**
- **Labor income**
- **Land use**
- **Defense**
- **Loss of fisheries**
- **Recreation**
- **Sand mining**
- **Seaweed**
- **1.5°c temperature increase**

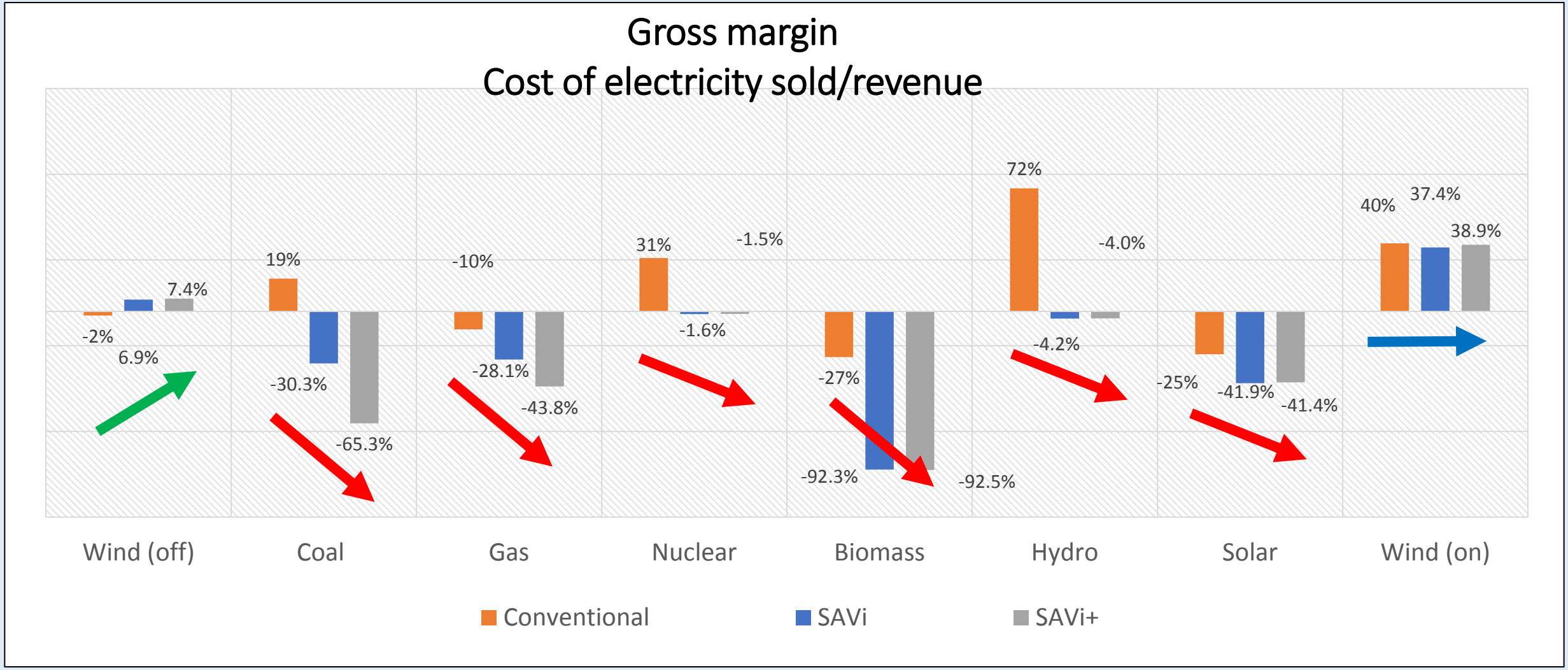
SAVi results: Comparative Cost Benefit Analysis

	Wind (off)	Coal	Gas	Nuclear	Biomass	Hydro	Solar	Wind (on)
Capital and O&M cost	-64,813	-27,872	-10,643	-48,259	-27,872	-36,844	-84,362	-45,314
Fuel costs	-	-25,247	-60,047	-	-58,394	-	-	-
CC impacts on fuel costs	-	-860	-2,141	-	-	-	-	-
Carbon tax	-	-18,287	-8,098	-	-	-	-	-
Subtotal (1)	**-64,813**	**-72,266**	**-80,930**	**-48,259**	**-86,266**	**-36,844**	**-84,362**	**-45,314**
Income spending	1,347	818	1,056	1,059	3,740	999	6,093	1,274
Defense payments	-18	-	-	-	-	-	-	-
Fisheries	-16	-	-	-	-	-	-	-
Sand mining	-33	-	-	-	-	-	-	-
Recreation	-315	-	-	-	-	-	-	-
Real estate	-	-	-	-	-	-	-	-
Land use	4,946	-1,790	-173	-239	-739,448	-30,100	-29,804	-1,534
Waste management	-	-	-	-16,718	-	-	-	-
Social Cost of Carbon	-309	-17,572	-7,989	-158	-183	-106	-890	-498
Valuation of emissions (SA	-	*-108,928*	*-32,575*	*-79*	*-21,518*	-	-	-
Value of externalities	**5,602**	**-18,544**	**-7,106**	**-16,057**	**-735,891**	**-29,206**	**-24,600**	**-758**
Subtotal (1 + 2)	**-59,211**	**-90,810**	**-88,035**	**-64,316**	**-822,156**	**-66,050**	**-108,962**	**-46,072**
Revenues	**63,285**	**63,285**	**63,285**	**63,285**	**63,285**	**63,285**	**63,285**	**63,285**
Costs and Benefits	**4,074**	**-27,524**	**-24,750**	**-1,031**	**-758,871**	**-2,765**	**-45,677**	**17,213**

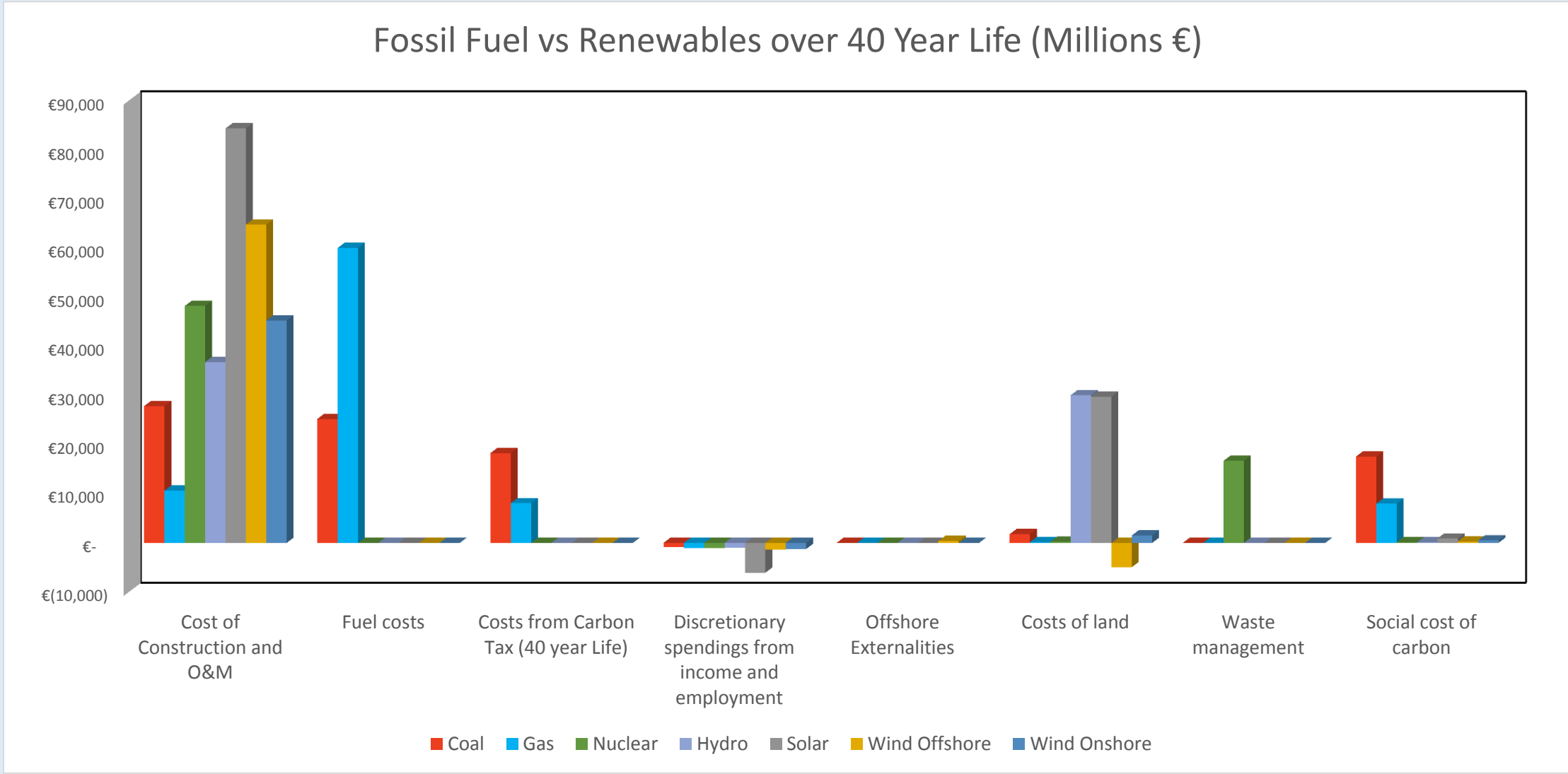
SAVi results: comparative cost benefit assessment



SAVi results: Comparative cost benefits analysis



SAVi results – RWS re-runs comparative assessment



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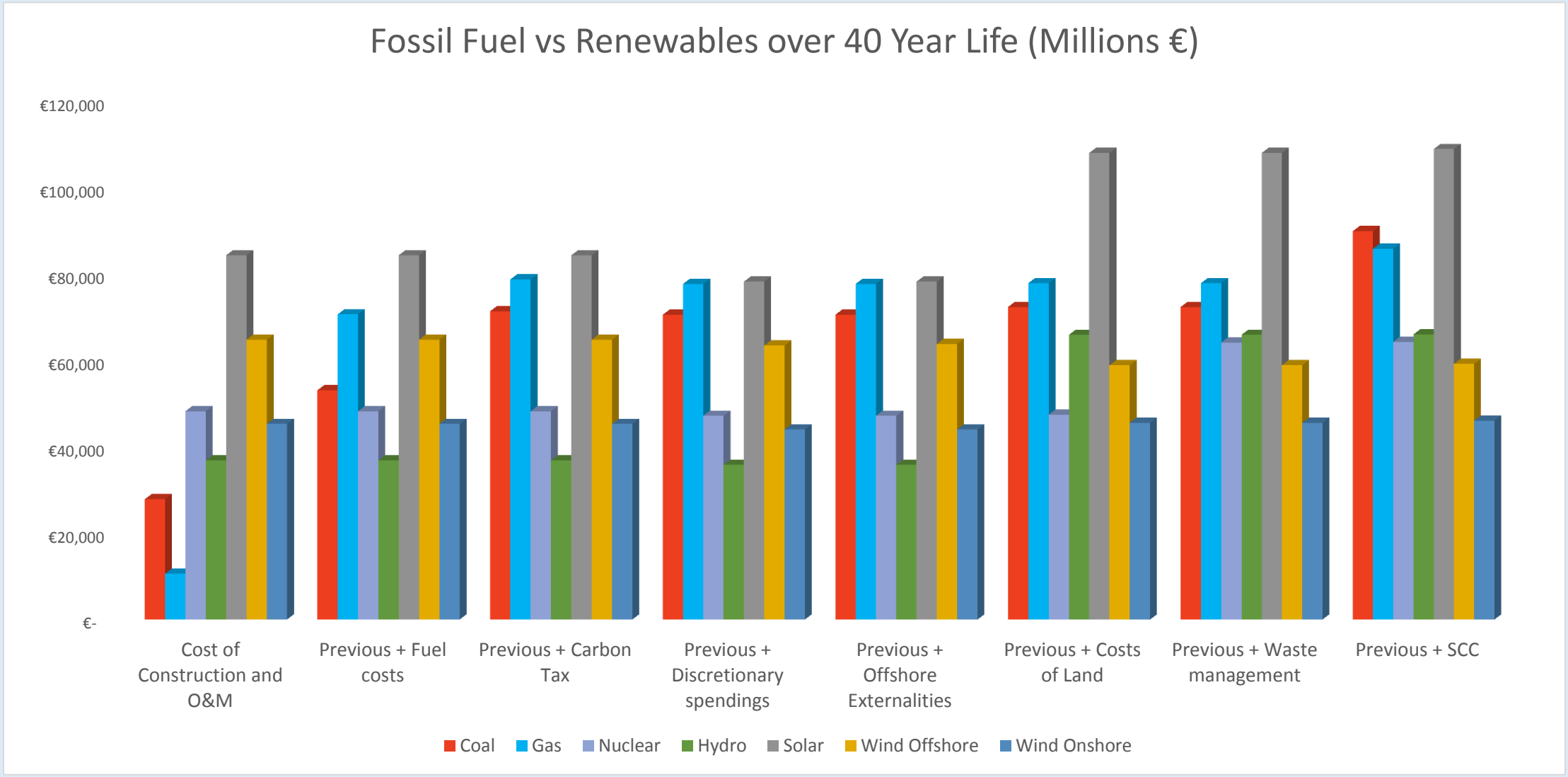


SAVi Results on Internal Rate of Return and Credit Ratios

Externalities:

- Social cost of carbon
- Valuation of emissions
- Labor income
- Land use
- Military base Petten
- Loss of fisheries
- Recreation
- Sand mining
- Seaweed
- Temperature increase 1.5°c

Comparator: coal fired power plant

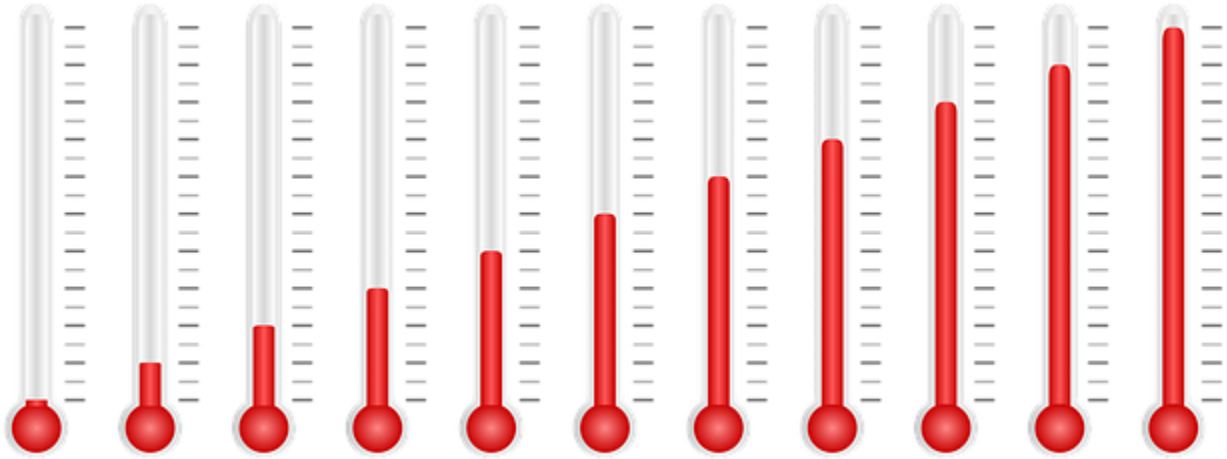
List of project finance variables

- Construction - time
- Construction - capital expenditures
- Construction – contingency costs
- Operation - time
- Operation - fixed costs
- Operation - price of input
- Operation - other variable costs
- Operation – total capacity
- Operation - efficiency (%)
- Operation – operational capex
- Operation - price of output
- Operation - average receipts time
- Operation - average payment time
- Debt - size
- Debt - interest margin
- Debt - upfront fee
- Debt - commitment fee
- Debt - tenor
- Debt - grace period
- Debt – debt sizing based on gearing / DSCR / LLCR
- Debt – repayment: sculpted / annuity based
- Debt – refinancing
- Debt – covenants (DSCR lock up / LLCR lock up)
- Equity - size: initial / additional
- Equity - dividend payout ratio
- Equity - discount rate (equity / project)
- Depreciation – accounting / tax depreciation
- Depreciation – straight line / reducing balance
- Tax – corporate tax rate
- Macro - cost escalation
- Macro - base interest rate
- Macro - exchange rate
- Macro - corporate tax rate
- Macro - other taxes
- Macro – depreciation
- Other – debt service reserve account
- Other – working capital revolver
- Other – interest income

1.5° degrees temperature change

The 1.5° degrees temperature change scenario means the following changes for the coal power plant comparator financial model (no impact for the offshore wind project):

- - 0.5% change in generation: due to insufficient cooling as a result of higher air and water temperatures, the power plant needs to shut down for a certain numbers days
- + 0.56% change in fuel costs: due to burning fuel is less efficient under these conditions



SAVi financial model outputs: Equity Internal Rate of Return

With externalities included the offshore wind project is more attractive

Scenarios	Offshore wind	Coal plant comparator	Difference (wind-coal)
Base case	35.54%	36.58%	- 1.04%
Incl. SAVI+ externalities	35.42%	25.41%	**+ 10.01%**
Above + 1.5° temp increase	35.42%	25.21%	**+ 10.21%**
Above + Carbon tax	35.42%	20.87%	**+ 14.55%**

Under the **base case scenario, the coal power plant comparator has a higher equity internal rate of return (IRR**) than the 4 GW offshore wind project, suggesting that the coal option is more profitable for project sponsors (i.e. shareholders).

However, when the **cost of externalities measured by SAVi,** the physical climate risks (water and air temperature increase) and transitional climate risks (carbon tax of 12.73 EUR / MWh) are included then the wind project has a significantly higher IRR.

SAVi financial model outputs: Debt Service Coverage Ratio

Minimum DSCR – higher for coal due to the lower capex

Scenarios	Offshore wind	Coal plant comparator	Difference (wind-coal)
Base case	2.48x	4.22x	- 1.74x
Incl. SAVI+ externalities	2.47x	3.02x	- 0.55x
Above + 1.5° temp increase	2.47x	3.00x	- 0.53x
Above + Carbon tax	2.47x	2.60x	- 0.13x

Average DSCR – with externalities included the offshore wind project is more attractive

Scenarios	Offshore wind	Coal plant comparator	Difference (wind-coal)
Base case	4.80x	5.37x	- 0.57x
Incl. SAVI+ externalities	4.78x	3.77x	**+ 1.01x**
Above + 1.5° temp increase	4.78x	3.75x	**+ 1.03x**
Above + Carbon tax	4.78x	3.21x	**+ 1.57x**

Savi Financial Model Outputs: Debt Service Coverage Ratio analysis

Minimum DSCR

Our coal power plant comparator has a higher minimum debt service coverage ratio (DSCR) throughout all scenarios assessed. This is due to the lower capex and thus lower debt burden to project cash flows in each quarter over the coal project's life time of 40 years. While the minimum DSCR is lower for the 4 GW offshore wind project, it always stays comfortably higher than the DSCR lockup ratio of 1.15x. Reaching this ratio would raise a red flag for lenders and trigger relevant debt covenants (e.g. cash sweeps, etc.).

Average DSCR

The average debt service coverage ratio (DSCR), indicating the financial robustness of the project during the tenor of the loan, is higher for the coal power plant comparator under the base case scenario. However, when the cost of externalities measured by SAVi, the physical climate risks (water and air temperature increase) and transitional climate risks (carbon tax of 12.73 EUR / MWh) are included then the wind project has a higher average DSCR.

SAVi financial model outputs: Minimum Loan Life Coverage Ratio

Minimum LLCR is higher for coal due to the lower capex

Scenarios	Offshore wind	Coal plant comparator	Difference (wind-coal)
Base case	2.94x	4.98x	- 2.04x
Incl. SAVI+ externalities	2.93x	3.50x	- 0.57x
Above + 1.5° temp increase	2.93x	3.47x	- 0.54x
Above + Carbon tax	2.93x	2.98x	- 0.05x

Similarily to the minimum DSCR, the coal power plant comparator has a higher minimum loan life coverage ratio (LLCR) throughout all scenarios assessed. This is due to the lower capex and thus lower debt burden to project cash flows in each quarter over the coal project's life time of 40 years. **While the minimum LLCR is lower for the 4 GW offshore wind project, it always stays comfortably higher than the LLCR lockup ratio of 1.10x. Reaching this ratio would raise a red flag for lenders and trigger relevant debt covenants (e.g. cash sweeps, etc.).**

SAVI financial model outputs: Equity Net Present Value (EUR million)

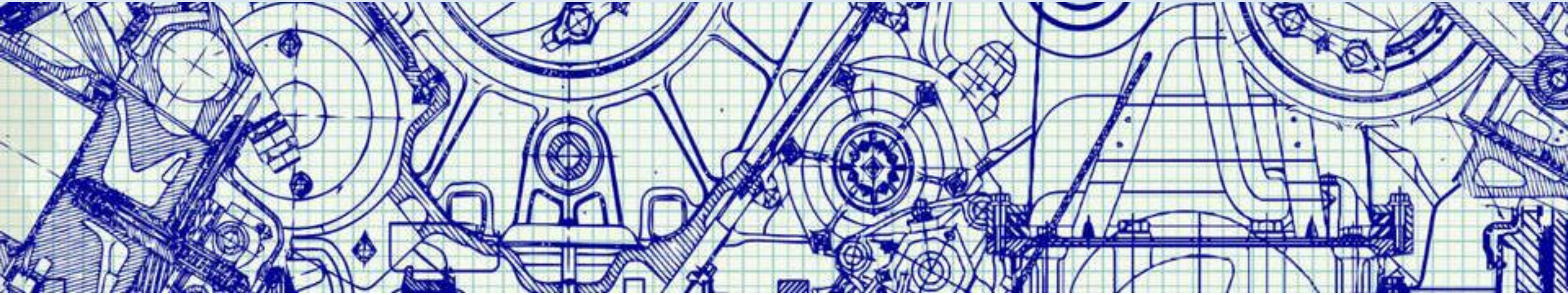
The offshore wind project has a significantly higher equity NPV when externalities are included

Scenarios	Offshore wind	Coal plant comparator	Difference (wind-coal)
Base case	11,896	10,479	+ 1,417
Incl. SAVI+ externalities	11,844	5,712	**+ 6,132**
Above + 1.5° temp increase	11,844	5,736	**+ 6,108**
Above + Carbon tax	11,844	4,053	**+ 7,791**

When assessing the projects using the net present value of equity capital, the 4 GW offshore wind project is more attractive even under the base case scenario. When the cost of externalities measured by SAVi, the physical climate risks (water and air temperature increase) and transitional climate risks (carbon tax of 12.73 EUR / MWh) are included then the wind project's equity NPV becomes even more attractive than the coal comparator.

Seeking collaboration to expand SAVi applications:

- Report on compliance with the FSB Recommendations
- Impact reporting



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