



Sustainable Asset Valuation Tool (SAVi) – Case Study

Financing Sustainable Cities

November 2017

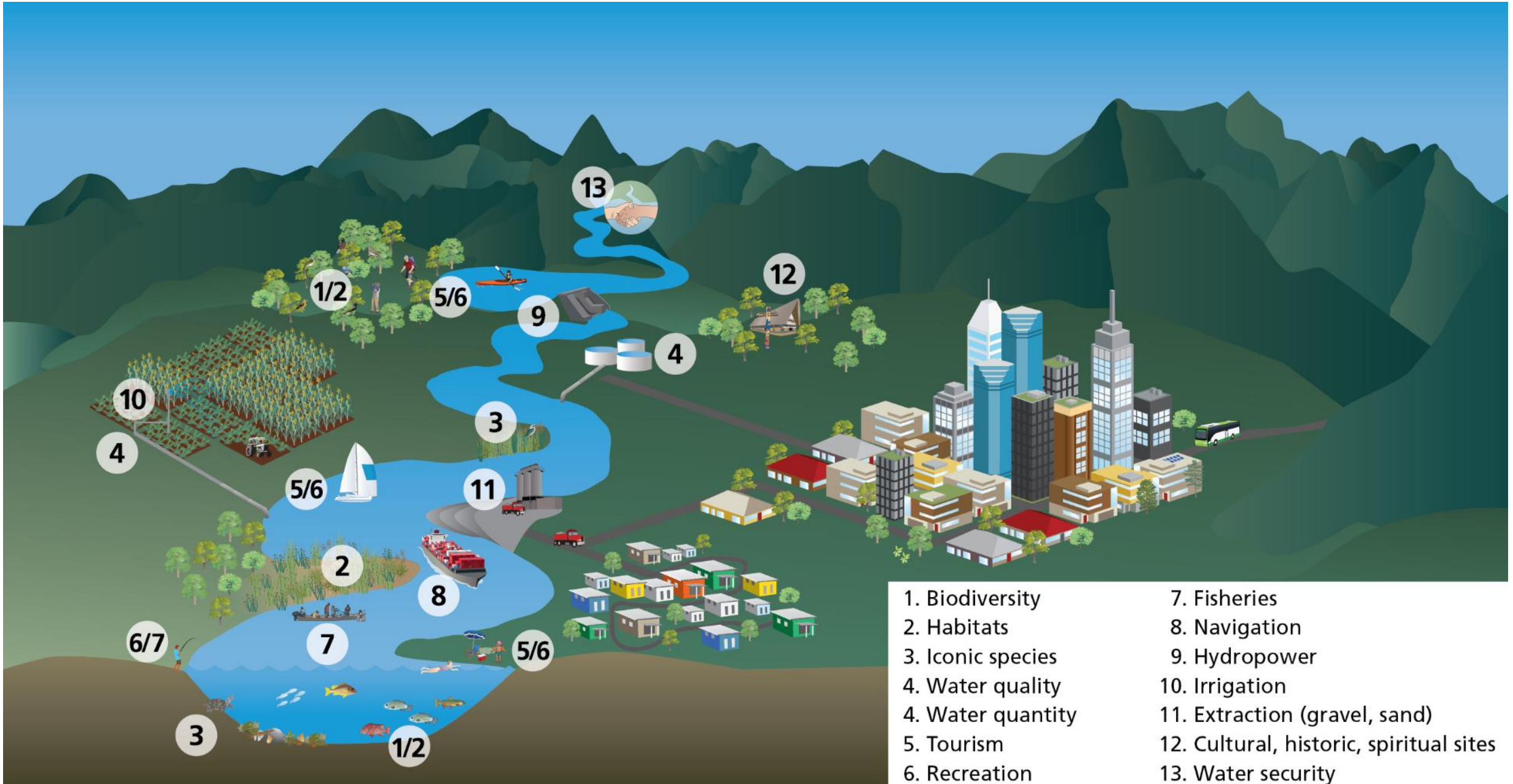
David Uzsoki

Financing sustainable infrastructure



By 2050 more than 66% of the global population will be in cities







Sustainable Asset Valuation Tool (SAVi)

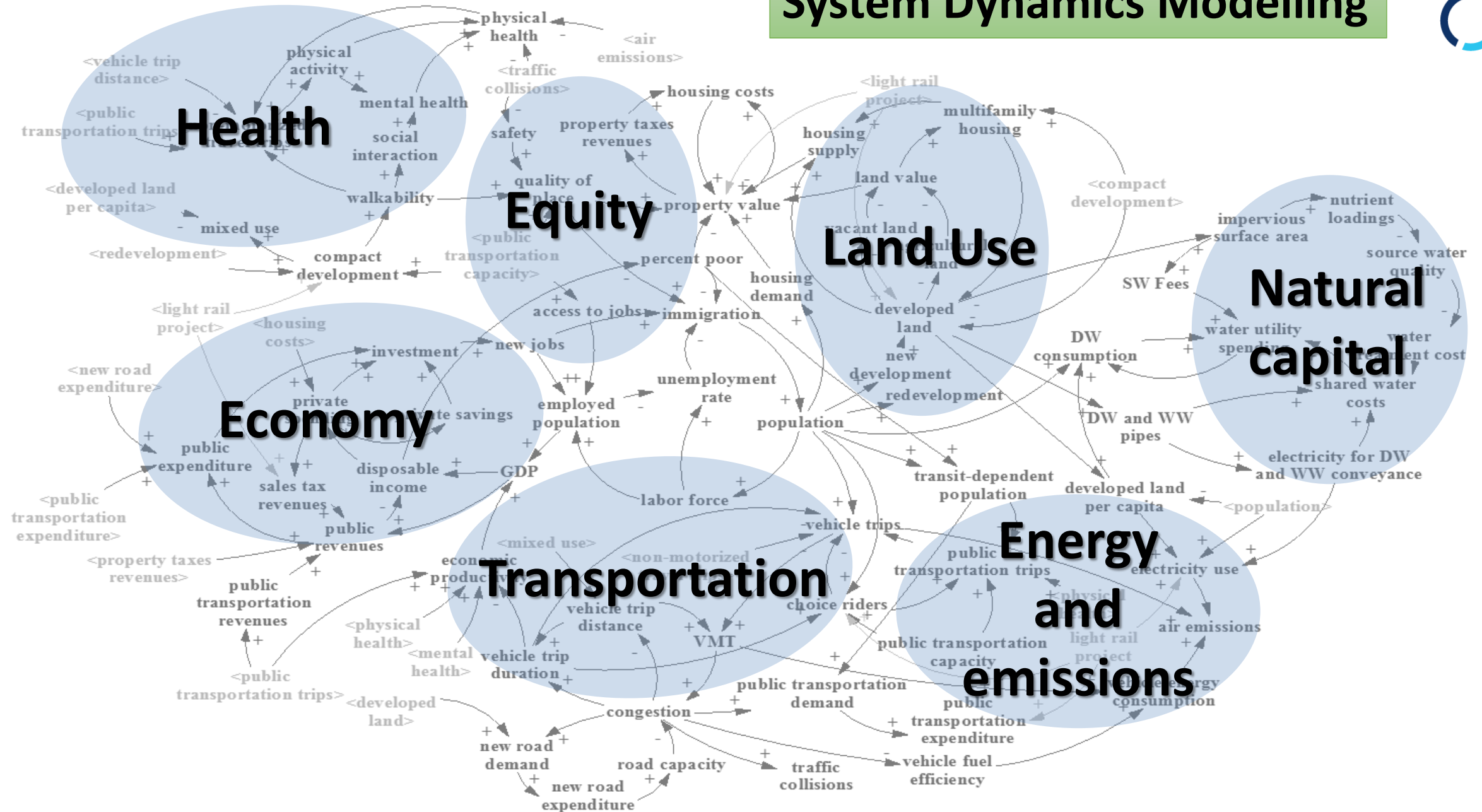
THE CHALLENGE

Conventional cost-benefit analysis and project finance valuation methodologies ignore a range of material risks, intangibles and externalities.

THE SOLUTION

IISD has developed the Sustainable Asset Valuation (SAVi) tool to assess the environmental, social and economic risks and co-benefits of infrastructure projects.

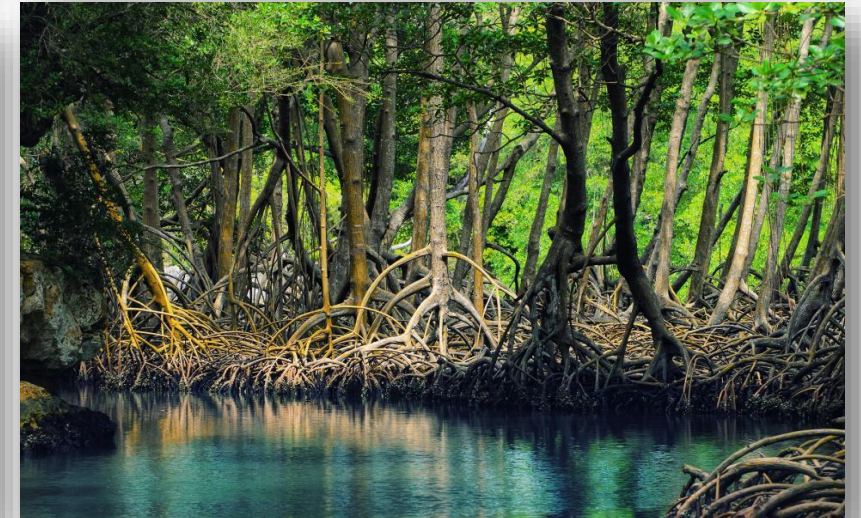
System Dynamics Modelling



Project Finance Modelling

Assumptions											
Financial Feasibility Assessment											
		Integrity Ok	Signal Ok								
39	Total turbines	Num #	500								
41	Load factor	%	47.30%								
44	Period	Op Year		Op Yr 1	Op Yr 2	Op Yr 3	Op Yr 4	Op Yr 5	Op Yr 6	Op Yr 7	Op Yr 8
45	Turbines operational	Num #		72.00	218.00	364.00	500.00	500.00	500.00	500.00	500.00
48	Period	Op Year		Op Yr 1	Op Yr 2	Op Yr 3	Op Yr 4	Op Yr 5	Op Yr 6	Op Yr 7	Op Yr 8
49	Generation per Turbine	MWh p.a.		33,148	33,148	33,148	33,148	33,148	33,148	33,148	33,148
50	Sensitivity flex	%	-	-	-	-	-	-	-	-	-
51	Applied	MWh p.a.		33,148	33,148	33,148	33,148	33,148	33,148	33,148	33,148
53	Overall Efficiency	%		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
54	Sensitivity flex	%	-	-	-	-	-	-	-	-	-
55	Overall Efficiency	%		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
57	Revenue										
58	Price (Nominal)										
59	Selected case	Selection	High case								
61	Period			2018	2019	2020	2021	2022	2023	2024	2025
62	Base case	EUR / MWh		54.00	54.00	54.00	63.00	63.00	63.00	63.00	63.00
63	High case	EUR / MWh		168.90	168.90	168.90	168.90	168.90	168.90	168.90	168.90
64	Low case	EUR / MWh		44.00	44.00	44.00	53.00	53.00	53.00	53.00	53.00
65	Selected	EUR / MWh		168.90	168.90	168.90	168.90	168.90	168.90	168.90	168.90
66	Sensitivity flex	%	-	-	-	-	-	-	-	-	-
67	Price	EUR / MWh		168.90	168.90	168.90	168.90	168.90	168.90	168.90	168.90

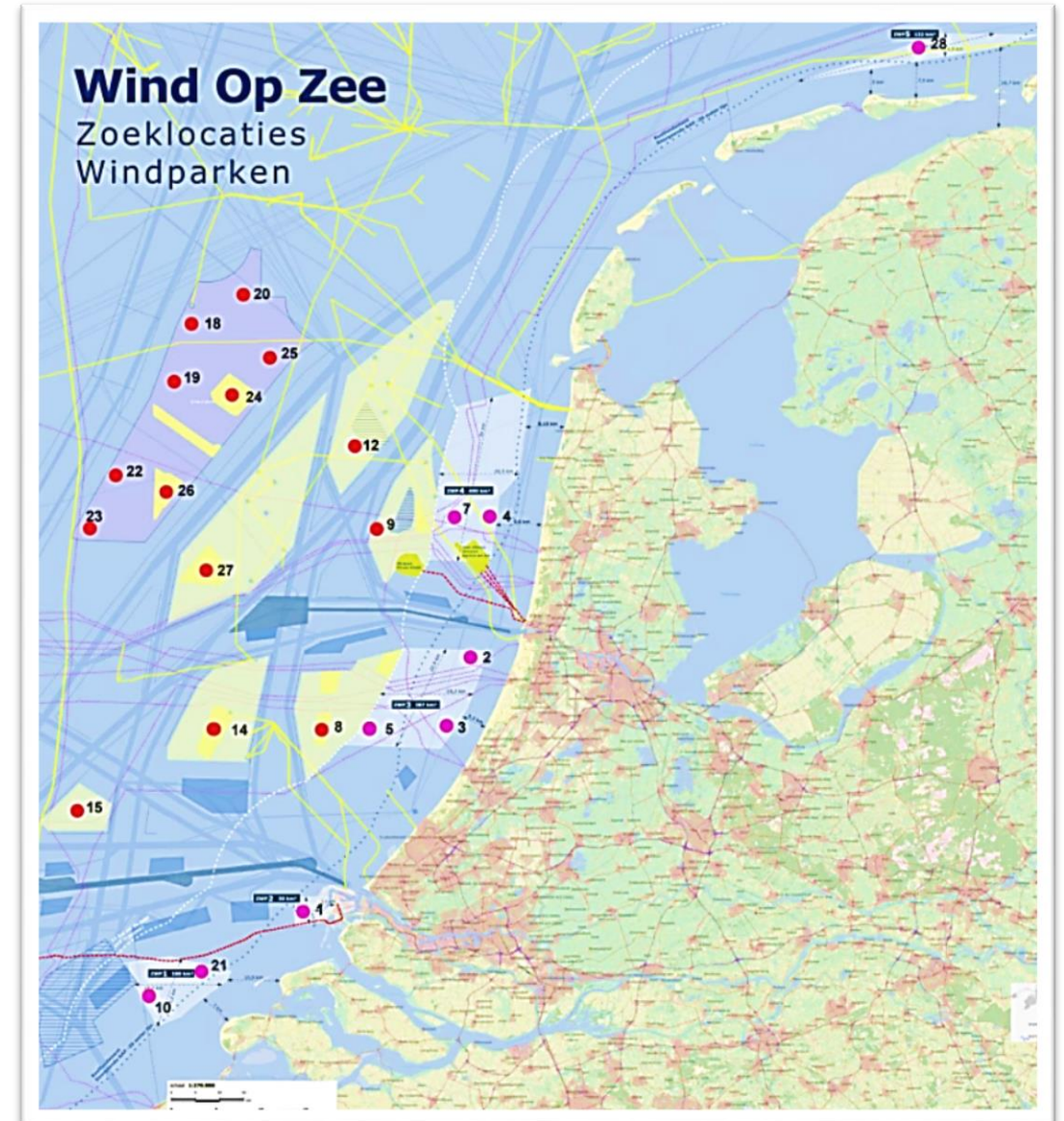
Sustainable Asset Valuation Tool (SAVi)



SAVi Pilot – North Sea offshore wind asset



- Planned capacity: assessment based on **14,000 MW 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**
- Project timing:
 - Construction period: **2018-2030** (1,166 MW per year)
 - Replacement period (wind): 2038 – 2050 (pole, turbine and blades)



Conducted Analysis with SAVi



Extended CBA

Project Costs

Project Benefits

Positive and Negative Externalities

Levelized Costs of Electricity

Comparative Assessment – Offshore Wind vs:

Coal

Gas

Nuclear

Biomass

Hydro

Solar

Onshore Wind

Scenario Analysis

Conventional

SAVi+

Climate Change Risk:
1.5°C temp. increase

Transitional Risk:
Carbon Tax

Financial Feasibility

Net Present Value (NPV)

Internal Rate of Return (IRR)

Gross Margin

Debt Service Coverage Ratio (DSCR)

Loan Life Coverage Ratio (LLCR)

Externalities quantified



Externalities below are aggregated and referred to as the **SAVi+ evaluation**:

- **Valuation of emissions:** Valuation of $\text{PM}_{2.5}$, SO_2 , and NO_x emissions based on health impacts
- **Labor income:** Income spending from additional employment created, average income per worker and share of income (discretionary) spent locally
- **Land use:** Opportunity costs of land used for power generation is calculated based on the productivity per hectare of agriculture land and the land required for power generation capacity
- **Military base Petten:** Additional payments to adjust and maintain operations at the military base
- **Loss of fisheries:** Extra costs for fisheries due to loss of efficiency
- **Recreation:** Less profits from recreational activities due to negative impact on tourist satisfaction & spending behavior
- **Sand mining:** The construction of wind farms will constrain the ability to harvest sand and cause extra costs for additional mileage and partial unavailability of supplies
- **Seaweed:** Seaweed is an additional source of revenue in the case of offshore wind farms

Scenarios used in the SAVi Analysis



Scenarios	Assumptions
Scenario 1	Conventional cost benefit analysis, which incorporates the capital, operation and maintenance expenditures and fuel costs
Scenario 2	Conventional cost benefit analysis
	The SAVi+ evaluation
Scenario 3	Conventional cost benefit analysis
	The SAVi+ evaluation
	The impact of a temperature increase of 1.5°C
Scenario 4	Conventional cost benefit analysis
	The SAVi+ evaluation
	The impact of a temperature increase of 1.5°C
	Carbon tax



Extended Cost Benefit Analysis: Levelized Cost of Electricity Generation



Table below illustrates the results (all values expressed in EUR/MWh) of 4 scenarios for the projected levelized cost of electricity (LCOE) of the North Sea offshore wind asset. We have also compared the LCOE of the offshore wind asset to the LCOE of the other energy technologies that can be used by the government of The Netherlands.

Scenarios	Wind (off)	Coal	Gas	Nuclear	Biomass	Hydro	Solar	Wind (on)
Scenario 1: Conventional CBA	82.63	64.40	76.53	62.34	99.27	47.41	63.04	57.09
Scenario 2: Conventional CBA, SAVi+	75.28	186.22	112.25	80.43	959.15	80.39	77.49	57.36
Scenario 3: Conventional CBA, SAVi+, 1.5°C temp increase	75.28	187.13	114.51	80.43	959.15	80.39	77.49	57.36
Scenario 4: Conventional CBA, SAVi+, 1.5°C, carbon tax	75.28	199.03	119.78	80.43	959.15	80.39	77.49	57.36

Financial Feasibility Assessment

Equity Internal Rate of Return (IRR)



Table below illustrates the projected IRR of the North Sea offshore wind asset and the coal plant comparator. Scenarios 2,3,4 demonstrate that the North Sea offshore wind asset has a more attractive IRR

Scenarios	IRR Offshore wind	IRR Coal plant comparator	Difference in IRR
Scenario 1: Convention assessment (CA)	35.54%	36.58%	- 1.04%
Scenario 2: CA, SAVi+	35.42%	25.41%	+ 10.01%
Scenario 3: CA, SAVi+, 1.5°C temp. increase	35.42%	25.21%	+ 10.21%
Scenario 4: CA, SAVi+, 1.5°C, carbon tax	35.42%	20.87%	+ 14.55%

Under Scenario 1, the coal power plant comparator has a higher equity IRR than the North Sea offshore wind asset, suggesting that the coal option is more profitable for project sponsors (i.e. shareholders).

However, under Scenarios 2,3,4 when the **costs of externalities** measured by SAVi, the physical climate risks (water and air temperature increase) and transitional climate risks (carbon tax of EUR 12.73 / MWh), are included, the North Sea offshore wind asset has a significantly higher IRR.

Financial Feasibility Assessment

Average Debt Service Coverage Ratio (DSCR)



Table below illustrates the average DSCR of the North Sea offshore wind asset and the coal power plant comparator. Scenarios 2,3,4 demonstrate that the North Sea offshore wind asset has a higher average DSCR, indicating that the project revenues can comfortably cover debt payments.

Scenarios	DSCR Offshore wind	DSCR Coal plant comparator	Difference in DSCR
Scenario 1: Convention assessment (CA)	4.80x	5.37x	- 0.57x
Scenario 2: CA, SAVi+	4.78x	3.77x	+ 1.01x
Scenario 3: CA, SAVi+, 1.5°C temp. increase	4.78x	3.75x	+ 1.03x
Scenario 4: CA, SAVi+, 1.5°C, carbon tax	4.78x	3.21x	+ 1.57x

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.

The background of the slide features a low-angle shot of a city skyline with several tall skyscrapers under a blue sky with light clouds. In the foreground, there is a green lawn with several large, leafy trees. Overlaid on the bottom left of the image is a semi-transparent blue box containing contact information. In the center of the image, the words 'Thank you!' are written in a large, black, sans-serif font, enclosed within a semi-transparent white rectangular box.

Thank you!

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