Sustainable Asset Valuation Tool (SAVi) – Case Study

Financing Sustainable Cities

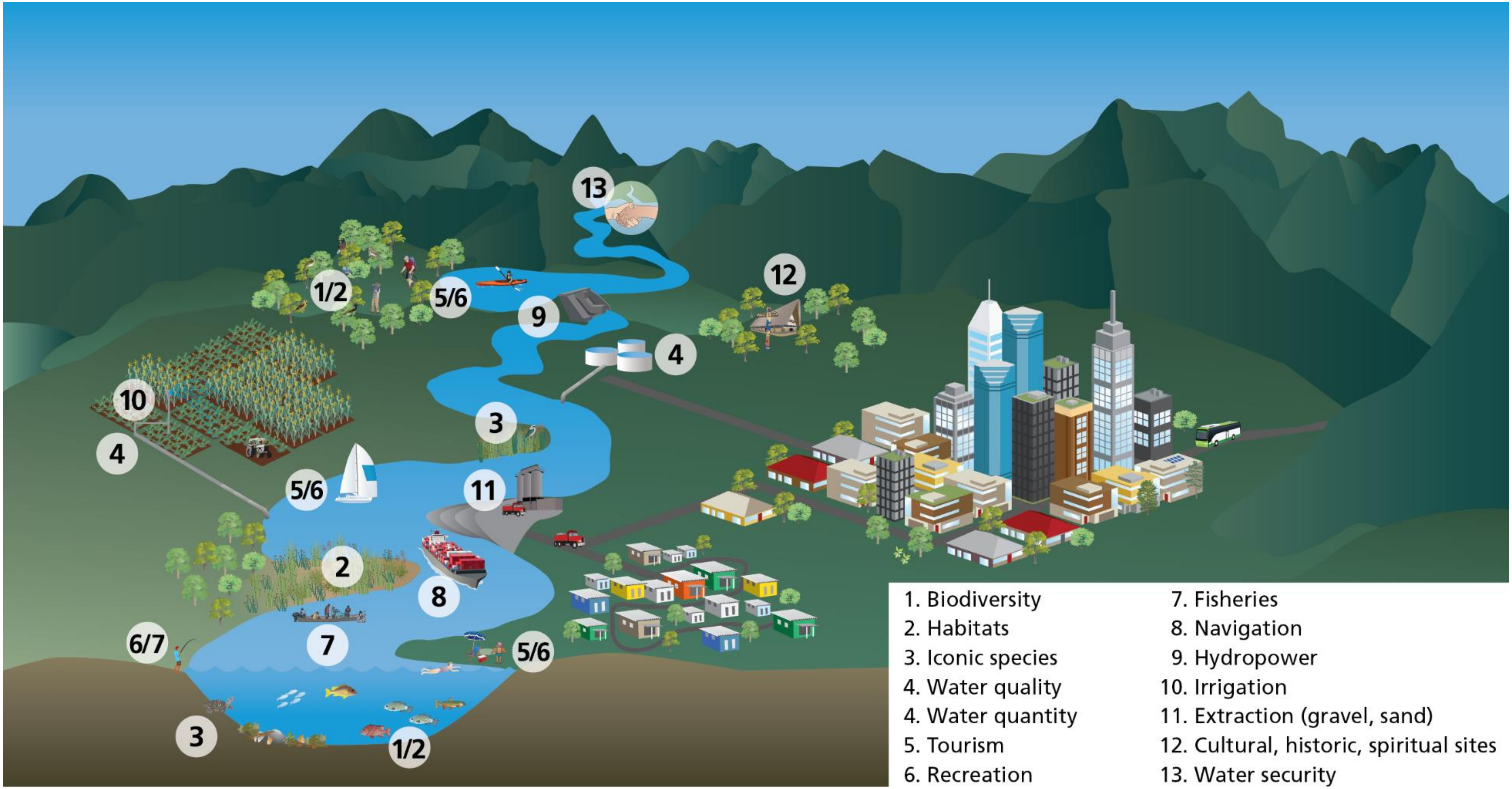
November 2017

David Uzsoki

IISD
International Institute for Sustainable Development

Financing sustainable infrastructure

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



13
1/2
5/6
9
12
4
10
3
4
5/6
11
2
8
7
6/7
5/6
3
1/2
1. Biodiversity
2. Habitats
3. Iconic species
4. Water quality
4. Water quantity
5. Tourism
6. Recreation
7. Fisheries
8. Navigation
9. Hydropower
10. Irrigation
11. Extraction (gravel, sand)
12. Cultural, historic, spiritual sites
13. Water security

Sustainable Asset Valuation Tool (SAVi)

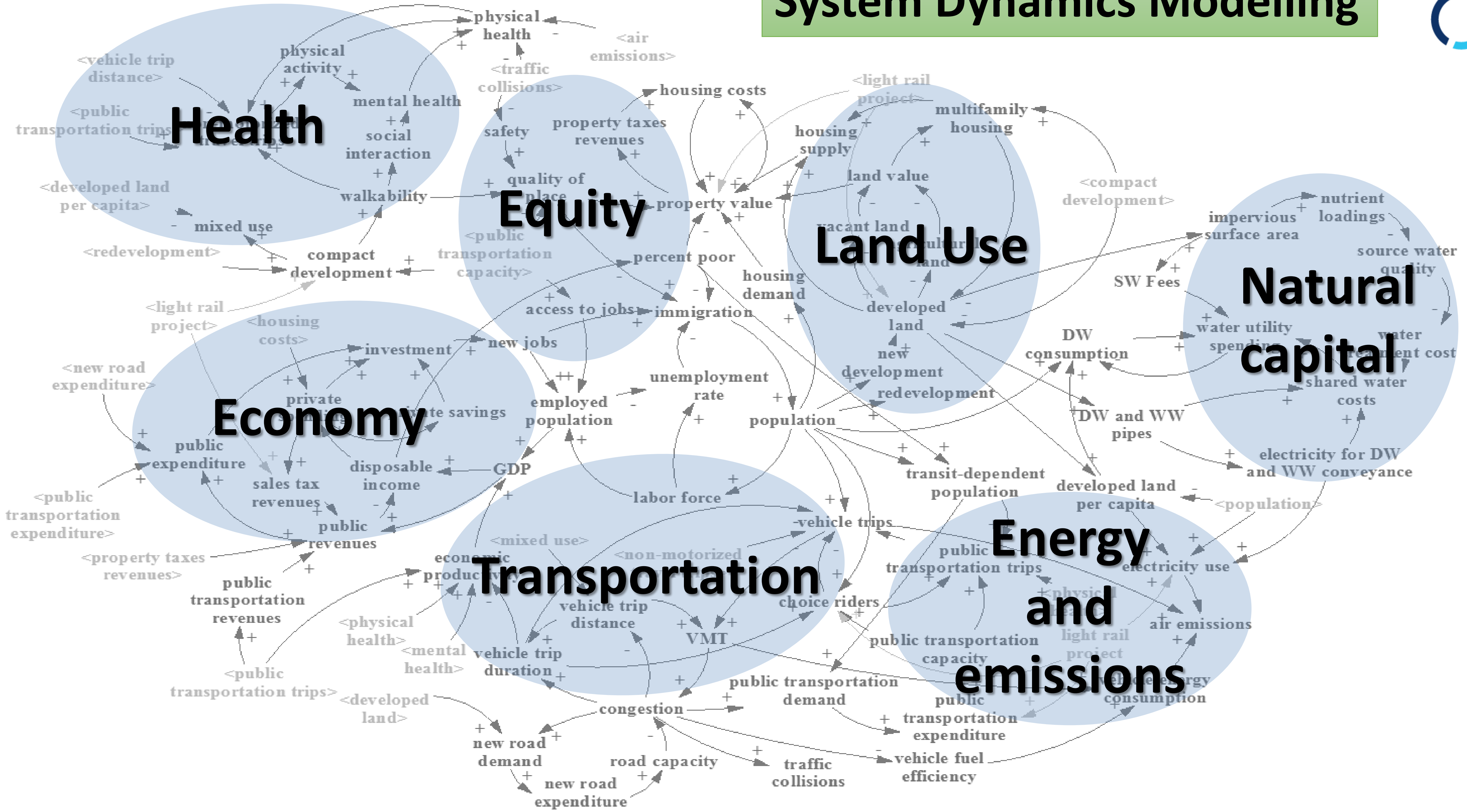
THE CHALLENGE

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

Row	C	D	E	F	G	H	I	J	K	L	M
3		Integrity Ok	Signal Ok								
39	Total turbines	Num #	500								
40											
41	Load factor	%	47.30%								
42											
43											
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
46											
47											
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
52											
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%
56											

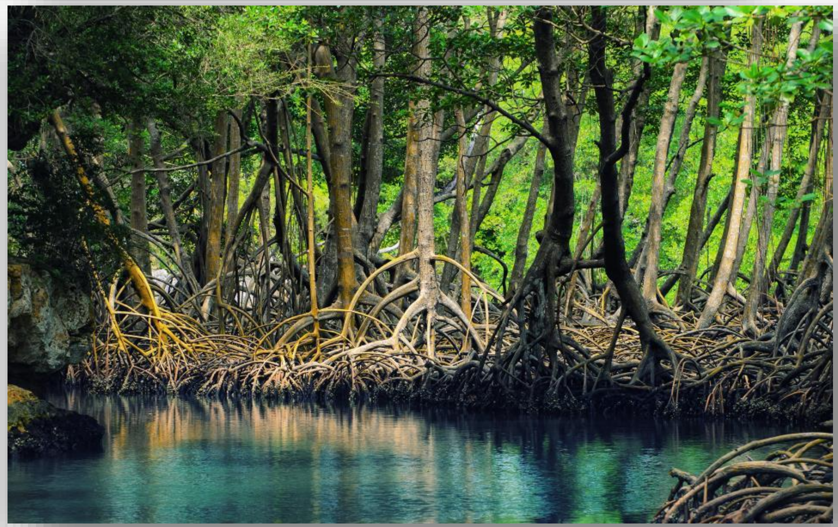
Revenue

Price (Nominal)

Row	C	D	E	F	G	H	I	J	K	L	M
59	Selected case	*Selection*	High case								
60											
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
68											

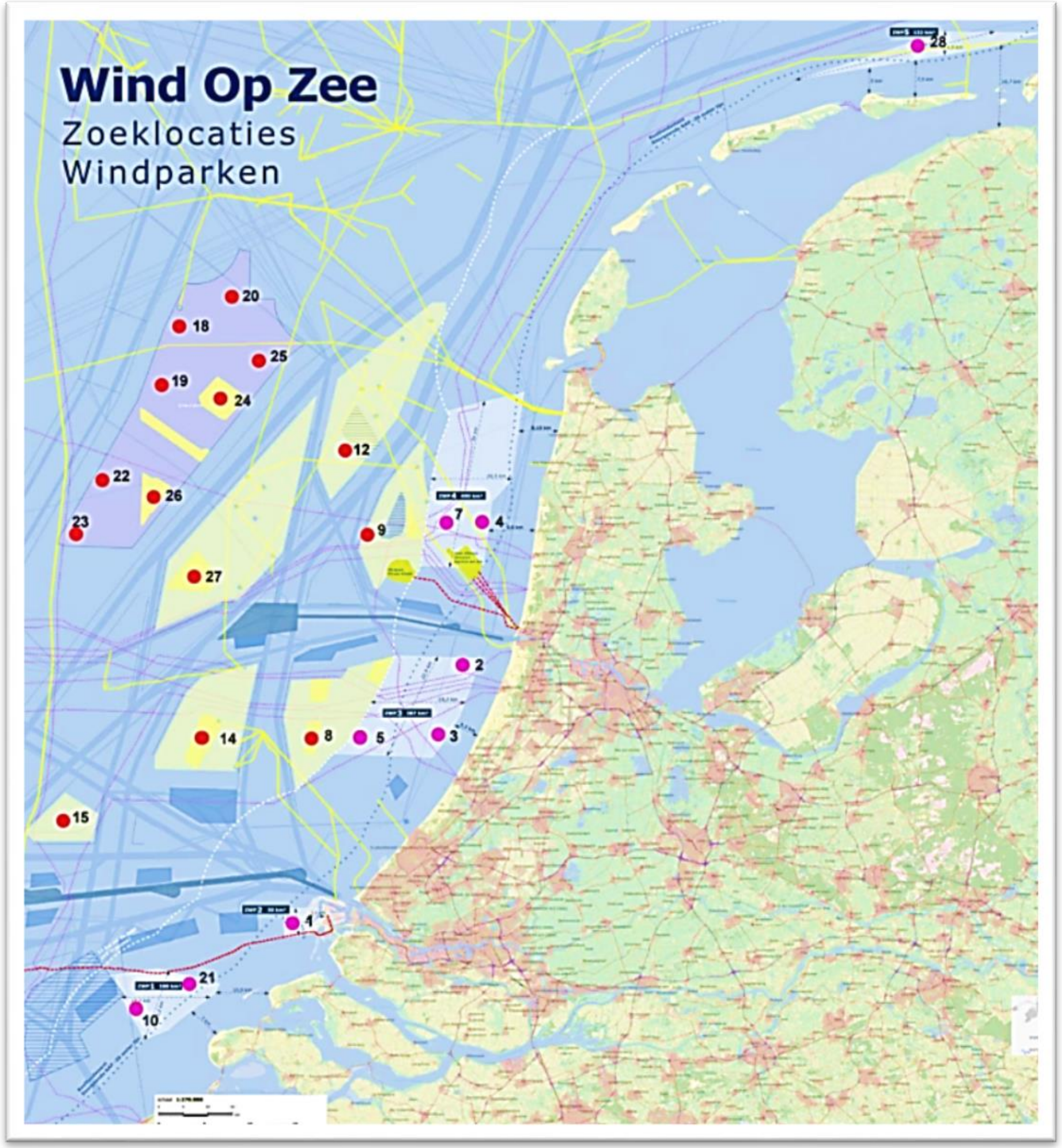
... | Names | Inputs | IFS | Scenario | Cons | Ops | D&T | Debt | Equity | Timing | Checks | Copy

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	Comparative Assessment – Offshore Wind vs:	Scenario Analysis	Financial Feasibility
Project Costs	Coal	Conventional	Net Present Value (NPV)
Project Benefits	Gas	SAVi+	Internal Rate of Return (IRR)
Positive and Negative Externalities	Nuclear	Climate Change Risk: 1.5°C temp. increase	Gross Margin
Levelized Costs of Electricity	Biomass	Transitional Risk: Carbon Tax	Debt Service Coverage Ratio (DSCR)
	Hydro		Loan Life Coverage Ratio (LLCR)
	Solar		
	Onshore Wind		

Externalities quantified

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

- **Valuation of emissions:** Valuation of $PM_{2.5}$, 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.

Thank you!

David Uzsoki
Infrastructure Finance Specialist
International Institute for Sustainable Development
duzsoki@iisd.org