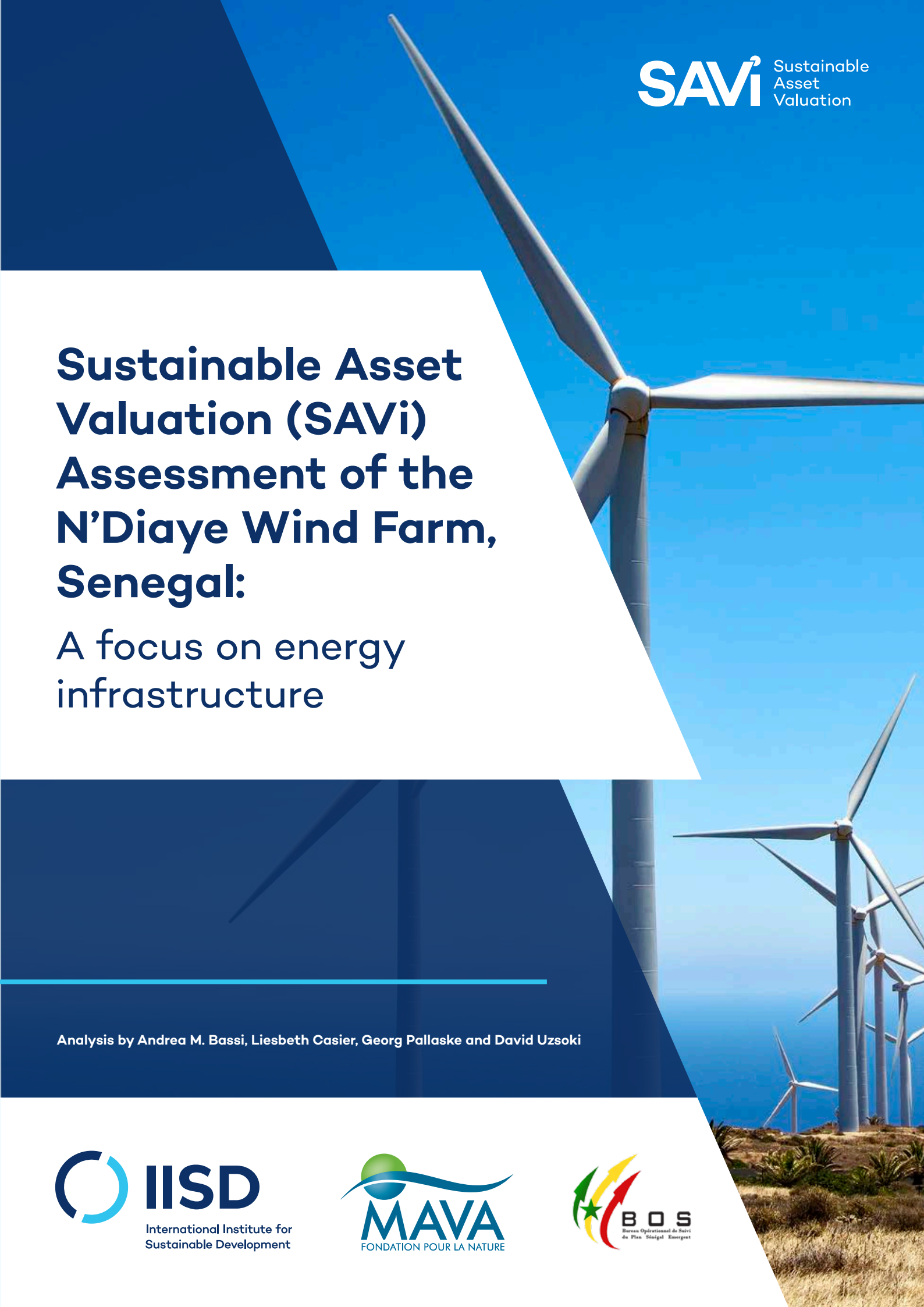
SAVi Sustainable Asset Valuation

Sustainable Asset Valuation (SAVi) Assessment of the N'Diaye Wind Farm, Senegal:

A focus on energy infrastructure



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IISD International Institute for Sustainable Development

MAVA FONDATION POUR LA NATURE

BOS Bureau Opérationnel de Suivi du Plan Sénégal Emergent

The Scope of This SAVi Assessment

The Bureau Operationel du Suivi (BOS) of the Plan Emergent Senegal requested IISD to use SAVi to calculate the costs of risks and externalities of the N'Diaye wind farm project. The construction phase of the wind farm commenced in January 2019. When fully operational, the wind farm will generate 158.7 MW of electricity, which will be fed into the electricity grid.

The SAVi assessment consists of:

- A valuation of externalities related to the project.
- A simulation of three scenarios: business-as-usual, a climate-risk scenario and a scenario that includes climate risks coupled with externalities.
- A comparison of the levelized cost of electricity (LCOE) of the wind farm with two project alternatives: coal-fired and heavy fuel oil (HFO-) fired electricity generation.
- A comparison of carbon dioxide emissions and employment creation for all three electricity generation options.
- An assessment of the impacts of externalities and climate risks on traditional project finance indicators.

Comparison of Energy Technologies

This SAVi assessment compares an onshore wind farm project with the other two electricity generation technologies used in Senegal—coal-fired and HFO-fired technologies.

Costs of Climate Risks

Physical and transitional climate risks were factored in across all three technologies:

- **The physical climate risk:** The impact of the change in air temperature on the efficiency of power generation.
- **The transitional climate risk:** The impact of the imposition of a carbon tax.

Externalities

The analysis takes the following externalities into account:

Discretionary spending of labour income: Valuation of the additional income spent in the domestic economy as a result of the employment created by the project.

Cost of land use from agriculture production: Valuation of the opportunity cost of land use for power generation at the expense of agriculture production.

Cost of noise pollution: Valuation of cost of noise pollution during the construction phase.

Cost of impacts on birds and wildlife: Valuation of bird and wildlife kills as a consequence of the construction and operation of a wind farm.

Cost of accidents: Valuation of human lives lost due to accidents related to the project (construction, road transport during maintenance, etc.).

Cost of electrification: Valuation of investment needed for electrification of neighbouring villages.

Social cost of carbon: Valuation of the carbon dioxide emissions generated throughout the lifetime of the project.

Risk Scenarios

The Scenarios

Scenario 0: Business-as-usual (BAU)	BAU (capital investment, operation and maintenance [O&M] costs, fuel costs, financing costs)
Scenario 1: Climate risk	BAU + the physical and transitional climate risk
Scenario 2: Climate risk and externalities	BAU + the physical and transitional climate risk + valuation of externalities

SAVi Results

Employment creation and emissions across the different technologies

	Onshore wind farm	HFO-fired electricity generation	Coal-fired power plant
Employment (FTE/year)	66.0	15.0	11.0
Emissions life cycle (million tonnes)	0.1	2.2	6.1

SAVi estimates that the wind project creates the most jobs, with 66 full-time equivalent (FTE) jobs per year, compared to 15 for HFO and only 11 for a coal power plant. The emissions over the life cycle of the energy projects are highest for coal with 6.1 million tonnes carbon dioxide compared to 0.1 million tonnes carbon dioxide for the wind energy project.

Why Use SAVi?

SAVi calculates the environmental, social and economic risks and externalities that impact the financial performance of infrastructure projects. These variables are typically ignored in traditional financial analyses.

SAVi is a simulation tool that is customized to individual infrastructure projects. It is built on project finance and systems dynamics simulation.

Visit the SAVi webpage:
iisd.org/savi

The SAVi integrated cost–benefit analysis calculates the LCOE in CFA/MWh. It demonstrates that HFO-fired electricity generation is the least attractive option across all indicators, with a total LCOE of CFA 155,728 per MWh (USD 267 per MWh). It also reveals that, when taking into account climate risks and externalities, the LCOE of the onshore wind farm project amounts to CFA 43,266 per MWh (USD 74 per MWh) while the LCOE from coal-fired electricity generation increases to CFA 52,998 per MWh (USD 91 per MWh). The calculated externalities, notably the social cost of carbon, have an even larger impact on the LCOE of coal-fired electricity generation than the climate risks. Consequently, electricity generated by wind power becomes comparatively more affordable.

SAVi's integrated cost–benefit analysis (in CFA/MWh)

LCOE breakdown by cost position (CFA/MWh)	Onshore wind farm	HFO-fired electricity generation	Coal-fired power plant
PROJECT-RELATED COSTS			
Capital investment	23,461	11,746	9,990
Project preparation	4.1	6	4.1
O&M	7,497	611	5,364
Fuel cost	0	126,580	11,692
Cost of financing	7,510	1,966	1,652
Project-related taxation	4,865	4,750	4,750
Subtotal (1)	**43,337**	**145,659**	**33,452**
CLIMATE RISKS			
Climate impacts	0	3,308	306
Carbon tax	0	2,514	7,040
Subtotal (2)	**0**	**5,822**	**7,346**
EXTERNALITIES			
Planning and construction phase			
Discretionary spending from labour income*	(365.2)	(110.3)	(82.8)
Cost of land use from agriculture production	42.7	65.5	45.9
Cost of noise pollution	0.4	0.5	0.4
Operating phase			
Cost of impacts on birds and wildlife	1.3	0.7	0.5
Cost of accidents	1.7	0	0
Cost of electrification	0.9	1.3	0.9
Social cost of carbon	363	4,459	12,355
Discretionary spending from labour income*	(115)	(169.4)	(119)
Subtotal (3) project externalities	**(70)**	**4,247**	**12,201**
Total LCOE, including externalities and climate risks	43,266	155,728	52,998

**Note: Positive externalities are indicated as negative value, as they reduce the LCOE by generating social or environmental benefits.*

SAVi assessment on the internal rate of return (IRR) and net present value (NPV)

	Onshore wind farm		HFO-fired electricity generation		Coal-fired power plant	
	IRR (%)	NPV (USD million)	IRR (%)	NPV (USD million)	IRR (%)	NPV (USD million)
Scenario 0: BAU	12.17%	156.95	Negative	(943.67)	23.53%	305.54
Scenario 1: Climate risk	12.17%	156.95	Negative	(1,010.30)	19.59%	236.86
Scenario 2: Climate risk and externalities	12.19%	157.38	Negative	(1,060.14)	13.27%	129.64

SAVi assessment on credit ratios

	Onshore wind farm		HFO-fired electricity generation		Coal-fired power plant	
	Min. DSCR (x)	Min. LLCR (x)	Min. DSCR (x)	Min. LLCR (x)	Min. DSCR (x)	Min. LLCR (x)
Scenario 0: BAU	1.73x	2.00x	(6.98x)	(6.97x)	3.20x	3.58x
Scenario 1: Climate risk	1.73x	2.00x	(7.55x)	(7.54x)	2.66x	2.96x
Scenario 2: Climate risk and externalities	1.73x	2.00x	(7.97x)	(7.96x)	1.83x	1.97x

Note: LLCR: loan life coverage ratio; DSCR: debt service coverage ratio

Under a conventional financial assessment (Scenario 0), coal-fired electricity generation has a higher expected IRR (23.53 per cent) compared to the wind farm project (12.17 per cent). This is mainly due to the capital expenditures of the renewable alternative being more than double than those of coal. Also, the NPV is more favourable for coal-fired electricity generation compared to the wind farm project.

Under Scenario 1, the climate risk scenario, the financial performance of coal-fired electricity generation is less attractive. This is due to the additional costs of the carbon tax as well as sub-optimal electricity generation under higher air temperatures. When both climate risks and externalities are included in Scenario 2, the NPV of the wind farm project outperforms coal-fired electricity generation. The HFO option performs financially very weakly compared to the other technologies. This is the result of the high cost and inefficiency of burning HFO to generate electricity.

We wish to also point out that the costs of externalities, calculated and included in Scenario 2, do not change the cash flows or the profitability of the wind farm project. The financial performance indicators under Scenario 2 therefore reflect the "societal value" of the three technologies, demonstrating again that the wind farm project brings better societal value than fossil fuel-based electricity generation.

About SAVi

SAVi is an assessment methodology that helps governments and investors steer capital towards sustainable infrastructure. SAVi's features are:

SIMULATION

SAVi combines the outputs of systems thinking and system dynamics simulation (built using Vensim) with project financing modelling (built with Corality Smart).

VALUATION

Cost of Risk: SAVi places a financial value on economic, social and environmental risks. It then shows how these risks affect the financial performance of infrastructure projects and portfolios, across their life cycles. These types of 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 analysis enables policy-makers and investors to appreciate the second-order gains and trade-offs of infrastructure investments, which may otherwise not be apparent under a traditional valuation.

Costs of Emerging Risks: SAVi shows how externalities today can transform into direct project risks tomorrow. Such valuations help stakeholders make decisions in favour of sustainable infrastructure.

CUSTOMIZATION

SAVi is customized to individual investment projects and portfolios. SAVi can therefore value the cost of risks along with a range of wider externalities that are directly material to each asset.

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