Using META in Worldwatch's Sustainable Energy Roadmaps

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LEDS-LAC Regional Platform

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ESMAP
Energy Sector Management Assistance Program

META

Model for Electricity Technology Assessment (META)

META calculates economic costs of different electricity generation technologies

1. Objective comparison of various investment projects
2. Demonstrate long-term effects of different fuel-cost developments
3. LCOE that includes negative externalities
4. Interpret data and derive policy recommendations

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Sustainable Energy Roadmap

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META Overview

INPUTS

- Design basis
- CAPEX
- O&M
- Fuel Cost
- Externalities
- Commodity Cost & Forecast

CALCULATIONS

- Monte Carlo Simulation
- Transmission System Costs
- Risk Calculation
- Regression Analysis

RESULTS

- Levelized Capital Cost
- Energy Costs
- Externality Costs
- Comparison Among Technologies

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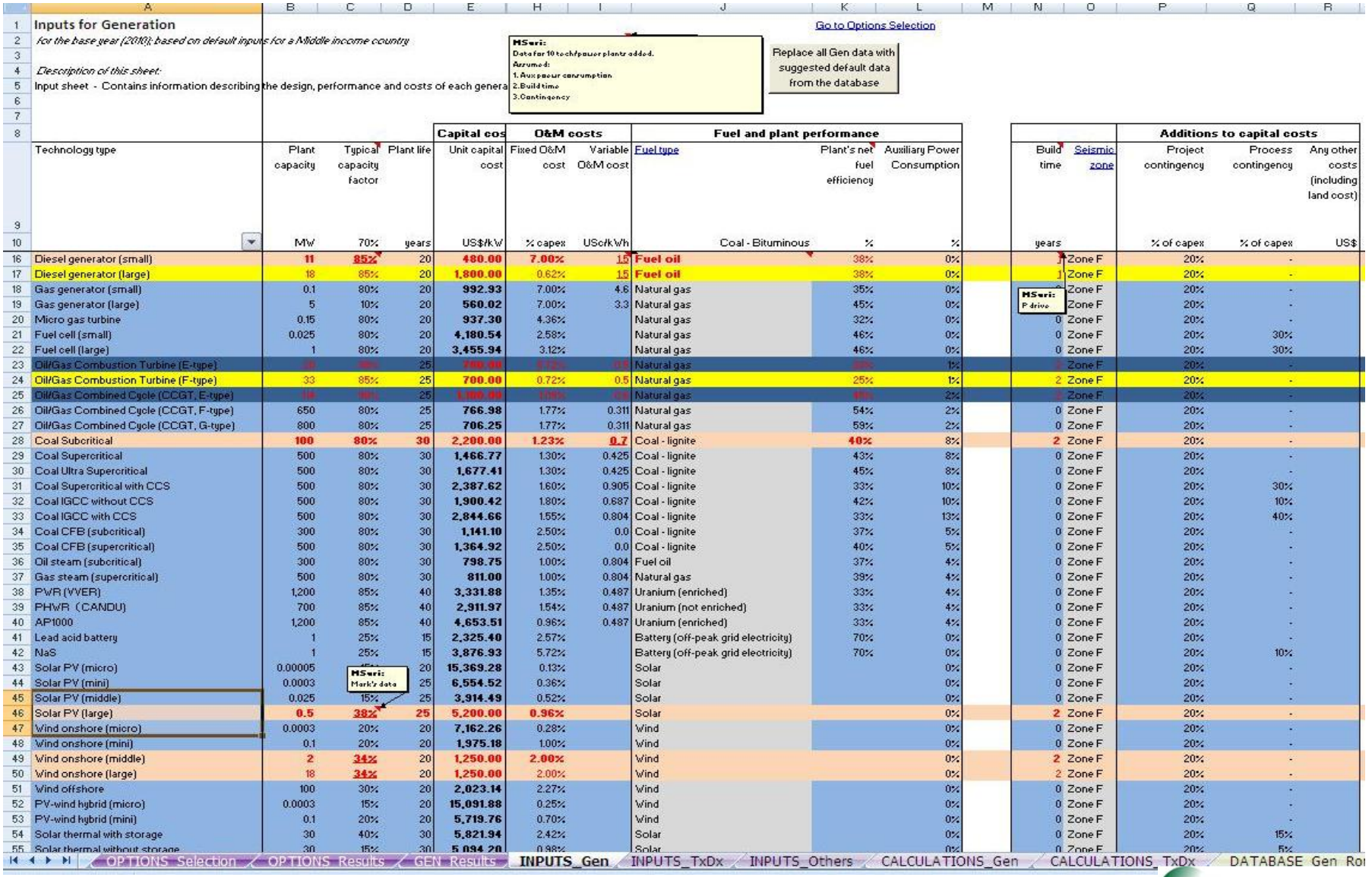
Changing Inputs for Customized META



Inputs for Generation

for the base year (2000); based on default inputs for a Middle income country

Description of this sheet:

Input sheet - Contains information describing the design, performance and costs of each genera

Go to Options Selection

MSuri: Data for 10 tech/power plants added. Assumed: 1. Aux power consumption 2. Build time 3. Contingency

Replace all Gen data with suggested default data from the database

Technology type	Plant capacity	Typical capacity factor	Plant life	Capital cos: Unit capital cost	O&M costs: Fixed O&M cost	O&M costs: Variable O&M cost	Fuel and plant performance: Fuel type	Plant's net fuel efficiency	Auxiliary Power Consumption	Build time	Seismic zone	Additions to capital costs: Project contingency	Process contingency	Any other costs (including land cost)
	MW	70%	years	US$/kW	% capex	USc/kWh	Coal - Bituminous	%	%	years		% of capex	% of capex	US$
Diesel generator (small)	11	85%	20	480.00	7.00%	15	Fuel oil	38%	0%	1	Zone F	20%	-	
Diesel generator (large)	18	85%	20	1,800.00	0.62%	15	Fuel oil	38%	0%	1	Zone F	20%	-	
Gas generator (small)	0.1	80%	20	992.93	7.00%	4.6	Natural gas	35%	0%	0	Zone F	20%	-	
Gas generator (large)	5	10%	20	560.02	7.00%	3.3	Natural gas	45%	0%	0	Zone F	20%	-	
Micro gas turbine	0.15	80%	20	937.30	4.36%		Natural gas	32%	0%	0	Zone F	20%	-	
Fuel cell (small)	0.025	80%	20	4,180.54	2.58%		Natural gas	46%	0%	0	Zone F	20%	30%	
Fuel cell (large)	1	80%	20	3,455.94	3.12%		Natural gas	46%	0%	0	Zone F	20%	30%	
Oil/Gas Combustion Turbine (E-type)	20	85%	25	700.00	0.72%	0.5	Natural gas	25%	1%	2	Zone F	20%	-	
Oil/Gas Combustion Turbine (F-type)	33	85%	25	700.00	0.72%	0.5	Natural gas	25%	1%	2	Zone F	20%	-	
Oil/Gas Combined Cycle (CCGT, E-type)	19	85%	25	1,100.00	1.75%	0.5	Natural gas	45%	2%	2	Zone F	20%	-	
Oil/Gas Combined Cycle (CCGT, F-type)	650	80%	25	766.98	1.77%	0.311	Natural gas	54%	2%	0	Zone F	20%	-	
Oil/Gas Combined Cycle (CCGT, G-type)	800	80%	25	706.25	1.77%	0.311	Natural gas	59%	2%	0	Zone F	20%	-	
Coal Subcritical	100	80%	30	2,200.00	1.23%	0.7	Coal - lignite	40%	8%	2	Zone F	20%	-	
Coal Supercritical	500	80%	30	1,466.77	1.30%	0.425	Coal - lignite	43%	8%	0	Zone F	20%	-	
Coal Ultra Supercritical	500	80%	30	1,677.41	1.30%	0.425	Coal - lignite	45%	8%	0	Zone F	20%	-	
Coal Supercritical with CCS	500	80%	30	2,387.62	1.60%	0.905	Coal - lignite	33%	10%	0	Zone F	20%	30%	
Coal IGCC without CCS	500	80%	30	1,900.42	1.80%	0.687	Coal - lignite	42%	10%	0	Zone F	20%	10%	
Coal IGCC with CCS	500	80%	30	2,844.66	1.55%	0.804	Coal - lignite	33%	13%	0	Zone F	20%	40%	
Coal CFB (subcritical)	300	80%	30	1,141.10	2.50%	0.0	Coal - lignite	37%	5%	0	Zone F	20%	-	
Coal CFB (supercritical)	500	80%	30	1,364.92	2.50%	0.0	Coal - lignite	40%	5%	0	Zone F	20%	-	
Oil steam (subcritical)	300	80%	30	798.75	1.00%	0.804	Fuel oil	37%	4%	0	Zone F	20%	-	
Gas steam (supercritical)	500	80%	30	811.00	1.00%	0.804	Natural gas	39%	4%	0	Zone F	20%	-	
PWR (VVER)	1,200	85%	40	3,331.88	1.35%	0.487	Uranium (enriched)	33%	4%	0	Zone F	20%	-	
PHWR (CANDU)	700	85%	40	2,911.97	1.54%	0.487	Uranium (not enriched)	33%	4%	0	Zone F	20%	-	
AP1000	1,200	85%	40	4,653.51	0.96%	0.487	Uranium (enriched)	33%	4%	0	Zone F	20%	-	
Lead acid battery	1	25%	15	2,325.40	2.57%		Battery (off-peak grid electricity)	70%	0%	0	Zone F	20%	-	
NaS	1	25%	15	3,876.93	5.72%		Battery (off-peak grid electricity)	70%	0%	0	Zone F	20%	10%	
Solar PV (micro)	0.00005		20	15,369.28	0.13%		Solar		0%	0	Zone F	20%	-	
Solar PV (mini)	0.0003		25	6,554.52	0.36%		Solar		0%	0	Zone F	20%	-	
Solar PV (middle)	0.025	15%	25	3,914.49	0.52%		Solar		0%	0	Zone F	20%	-	
Solar PV (large)	0.5	38%	25	5,200.00	0.96%		Solar		0%	2	Zone F	20%	-	
Wind onshore (micro)	0.0003	20%	20	7,162.26	0.28%		Wind		0%	0	Zone F	20%	-	
Wind onshore (mini)	0.1	20%	20	1,975.18	1.00%		Wind		0%	0	Zone F	20%	-	
Wind onshore (middle)	2	34%	20	1,250.00	2.00%		Wind		0%	2	Zone F	20%	-	
Wind onshore (large)	18	34%	20	1,250.00	2.00%		Wind		0%	2	Zone F	20%	-	
Wind offshore	100	30%	20	2,023.14	2.27%		Wind		0%	0	Zone F	20%	-	
PV-wind hybrid (micro)	0.0003	15%	20	15,091.88	0.25%		Wind		0%	0	Zone F	20%	-	
PV-wind hybrid (mini)	0.1	20%	20	5,719.76	0.70%		Wind		0%	0	Zone F	20%	-	
Solar thermal with storage	30	40%	30	5,821.94	2.42%		Solar		0%	0	Zone F	20%	15%	
Solar thermal without storage	30	15%	30	5,094.20	0.98%		Solar		0%	0	Zone F	20%	5%	

MSuri: Mark's data

MSuri: P drive

OPTIONS_Selection | OPTIONS_Results | GEN_Results | INPUTS_Gen | INPUTS_TxDx | INPUTS_Others | CALCULATIONS_Gen | CALCULATIONS_TxDx | DATABASE_Gen

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META Application: Jamaica

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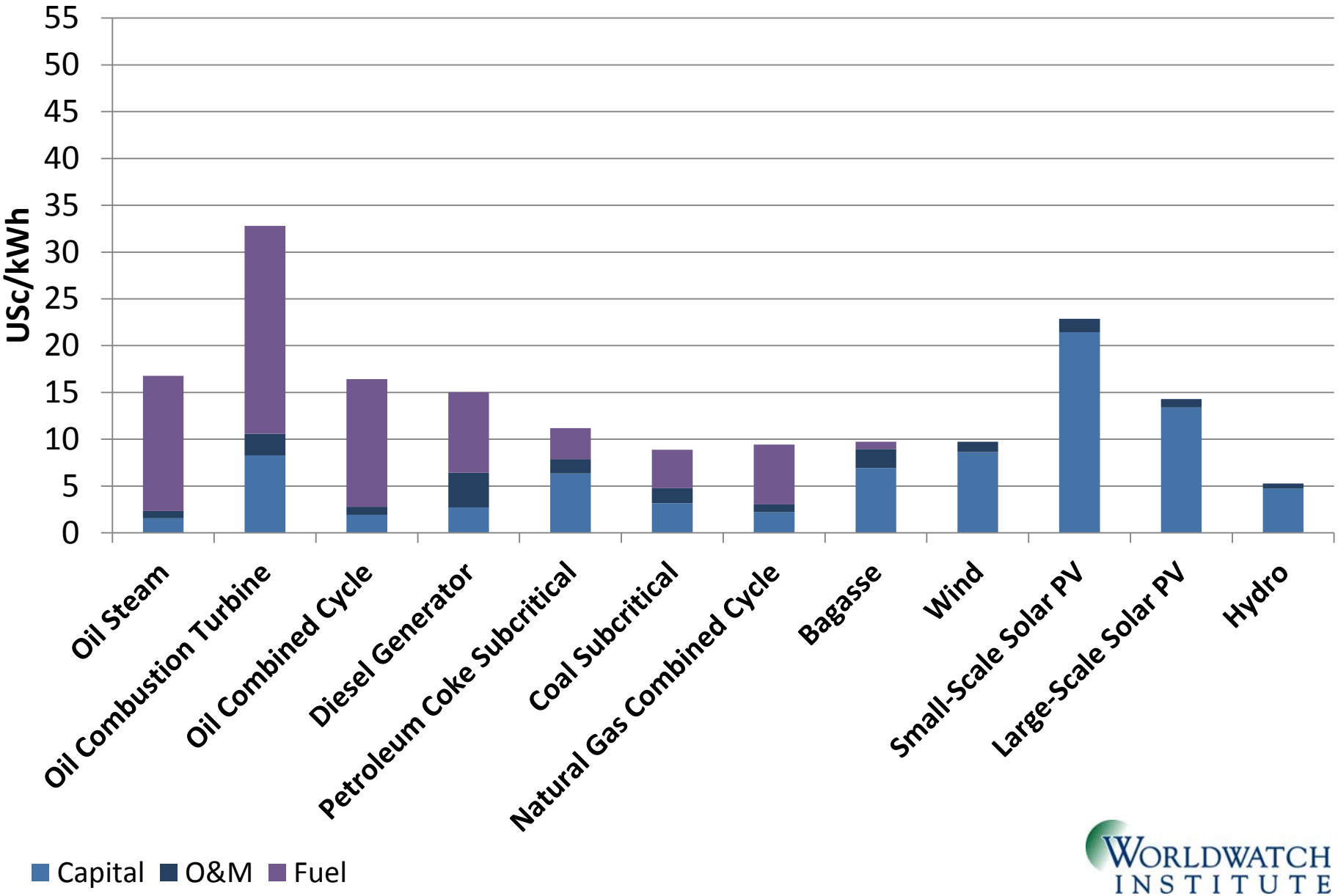
LCOE Without Externalities: Jamaica



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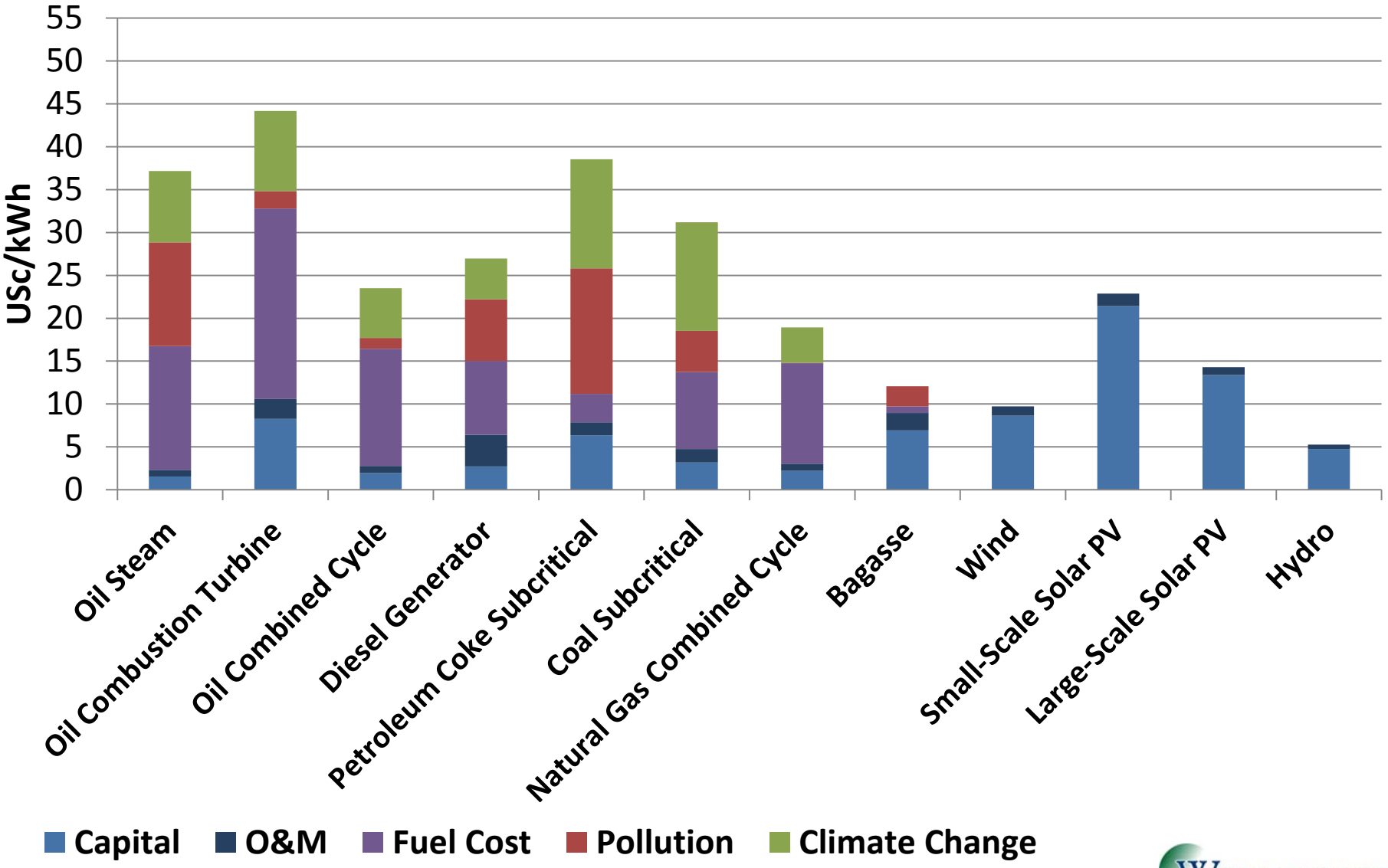
LCOE With Externalities (LCOE+): Jamaica



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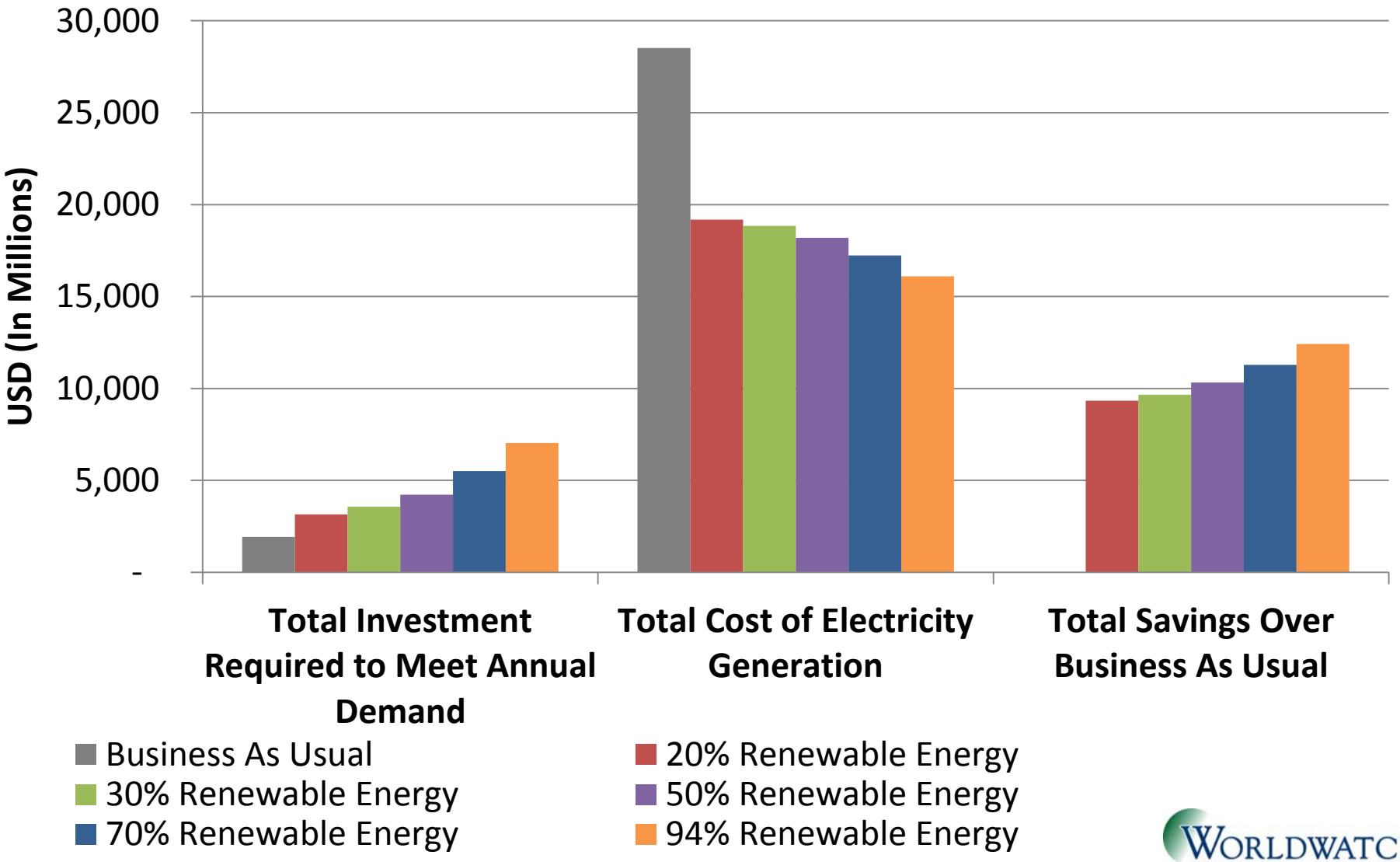
Savings from High RE Penetration: Jamaica



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Key Outcomes from Jamaica Analysis

1. Switching to highly renewable system can decrease average electricity costs by 67% by 2030

2. USD $15 billion saved in fossil fuel imports by 2030

3. 45 million tons of CO2-equivalent can be saved by building no new fossil-fired generation and expanding RE penetration up to 94%

4. Approximately 4,000 new jobs created by switching to high penetrations of RE*

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Conclusions

1. Versatile tool that shows the fiscal, environmental and social benefits of a renewable energy based system
2. LCOE+ modelling and analysis is important for policy planning as it showcases the often neglected negative externalities that are real costs of energy choices
3. META analysis allows for high-level analysis as well as detailed examination of various pathways to achieve RE targets
4. Can be used to strengthen arguments for low-emission development by showing cost and emissions savings over time vs. BAU

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Thank You!!

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