A Realistic Energy Mix including RE And Balancing Climate

PRESENTED BY: Valentine Fagan , MSc(Eng)

September 25, 2012

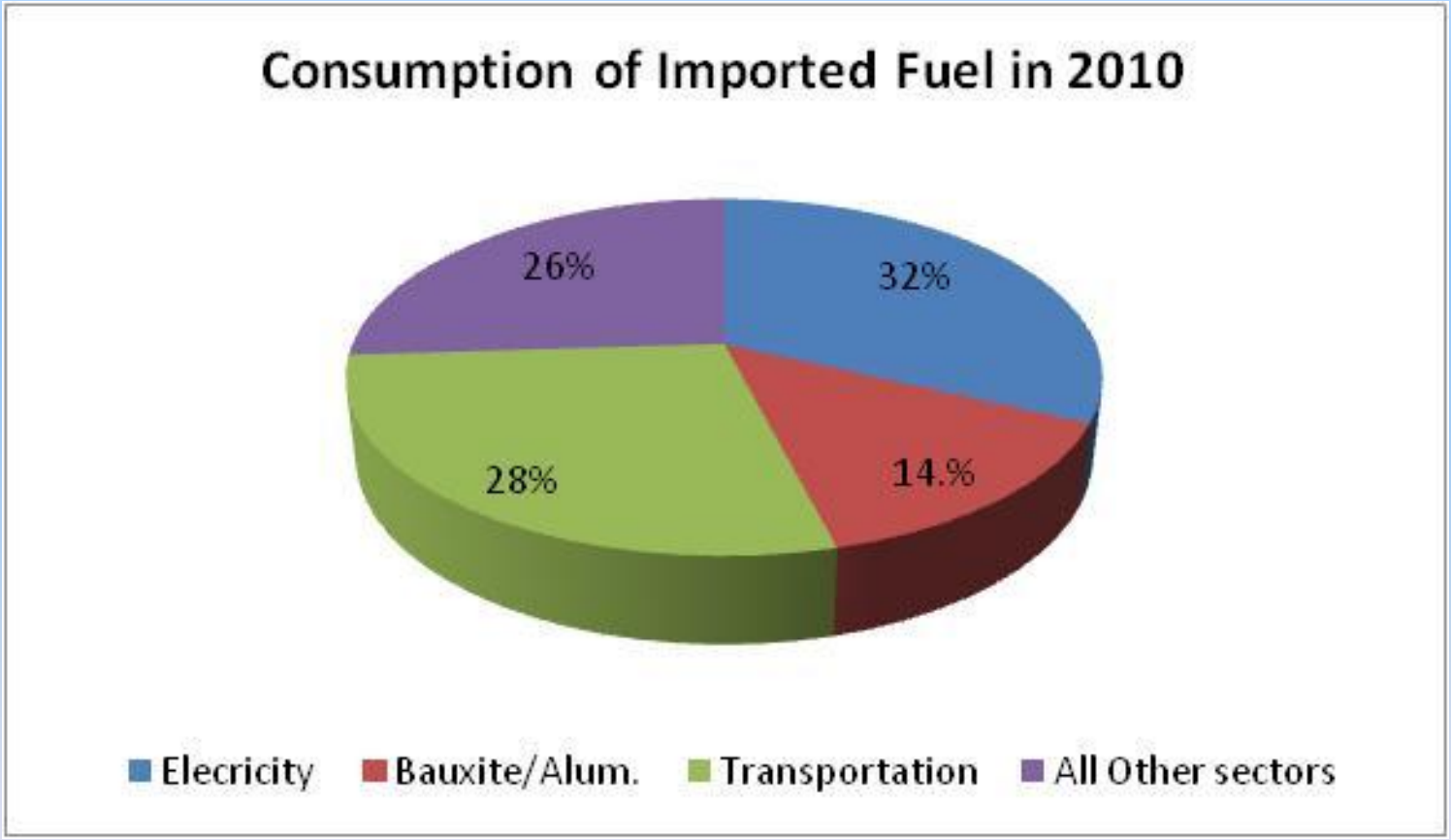
Background

Over 95% of Jamaica's electricity produced with fuel oil

- Oil accounts for the greatest portion of electricity cost.
- Volatile fuel market – continuous fluctuation in prices
- High energy price is a barrier to economic and social well being
- Significant investment and time needed for fuel diversification projects.
- It is important that all stakeholders work together to reduce the cost of energy through the diversification from expensive fuel oil into a sustainable energy mix including ,renewables and other alternative fuel choices.
- Firm decision are needed on way forward to achieve diversification.

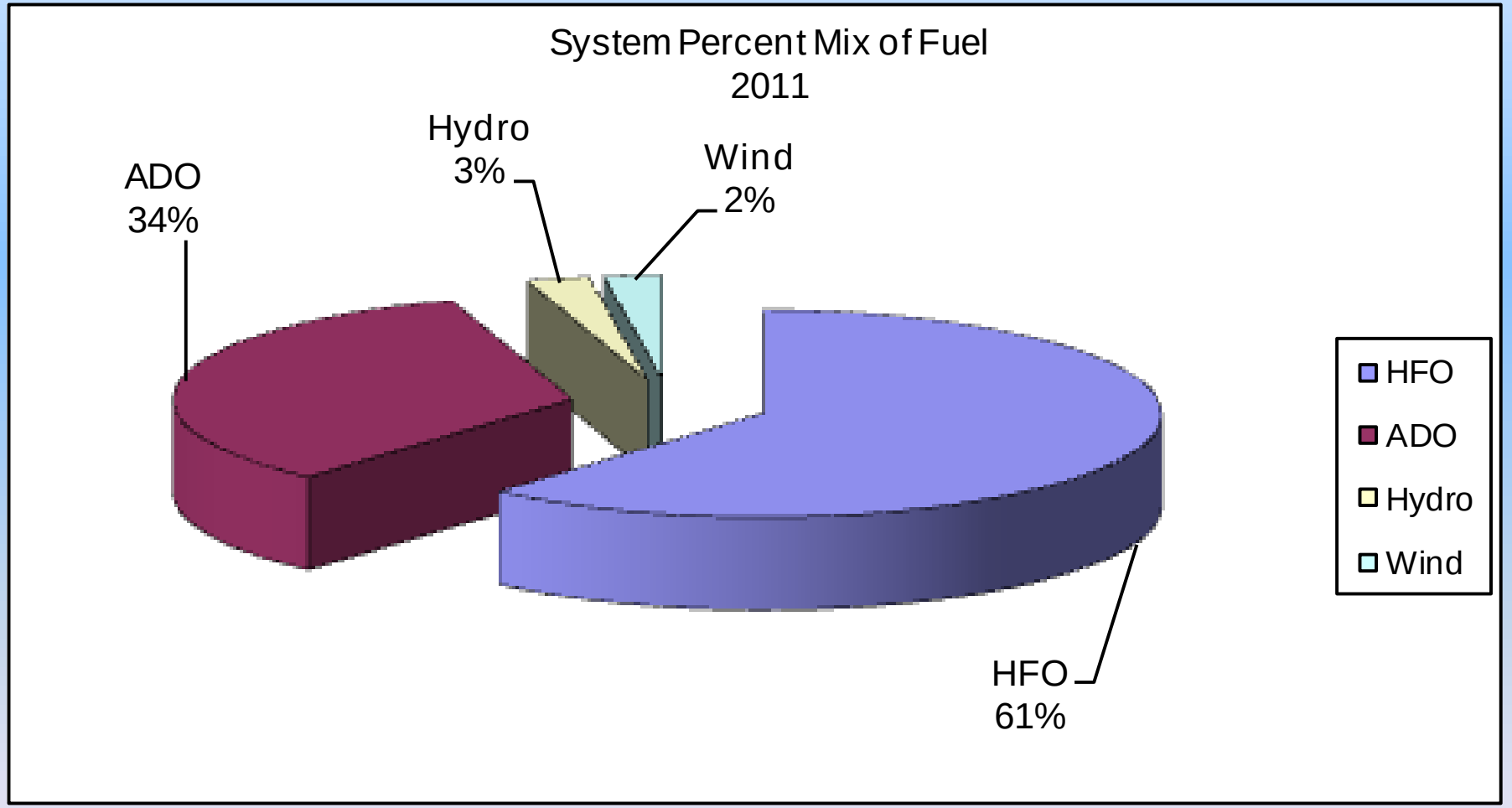
The Existing System

Electric Sector a Major Fuel User



Source: PIOJ ESS Report 2010

Unsustainable Heavy Dependence on Imported Fuel



Over 95% of electricity is produced by Imported fuel oil

- Only 5% produced by Renewable Source

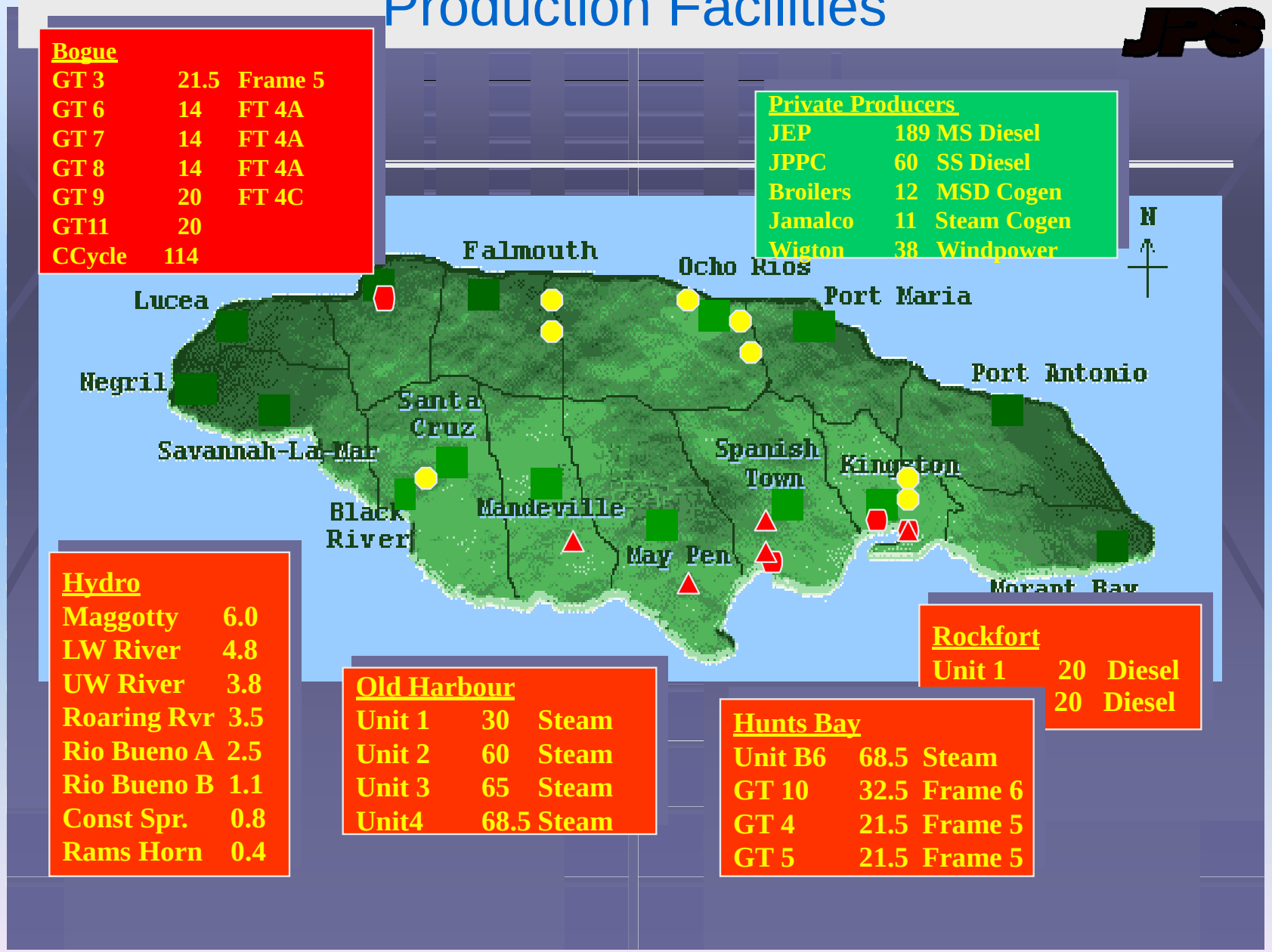
Majority Contribution from Aging Oil Dependent Units:

	MW	%	Average Age	Avg. Heat Rate (kJ/kwh)
Oil-Fired Stm	292	34%	40	13000
LS Diesel	40	5%	27	9000
Oil-Fired CC	114	13%	9	9000
Oil-Fired GT	158	19%	25	16000
Private Producers	250	29%	15	8600
Total	**854**			

Installed Capacity (Firm) – 809 MW

- Peak Demand – 650 MW
- System Losses – 23%
- System Heat Rate – 10,200 kJ/kWh

Production Facilities



Bogue

GT 3	21.5	Frame 5
GT 6	14	FT 4A
GT 7	14	FT 4A
GT 8	14	FT 4A
GT 9	20	FT 4C
GT11	20	
CCycle	114	

Private Producers

JEP	189	MS Diesel
JPPC	60	SS Diesel
Broilers	12	MSD Cogen
Jamalco	11	Steam Cogen
Wigton	38	Windpower

Hydro

Maggotty	6.0
LW River	4.8
UW River	3.8
Roaring Rvr	3.5
Rio Bueno A	2.5
Rio Bueno B	1.1
Const Spr.	0.8
Rams Horn	0.4

Old Harbour

Unit 1	30	Steam
Unit 2	60	Steam
Unit 3	65	Steam
Unit4	68.5	Steam

Rockfort

Unit 1	20	Diesel
	20	Diesel

Hunts Bay

Unit B6	68.5	Steam
GT 10	32.5	Frame 6
GT 4	21.5	Frame 5
GT 5	21.5	Frame 5

Fuel is largest component of Price

	JPS Performance Matrix							
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Exchange Rate	61.31	62.35	65.77	68.88	72.54	88.06	87.65	86.03
Fuel Cost/bbl (US$)	40.24	55.24	67.22	71.89	101.03	70.74	88.6	119.34
Heat Rate (kJ/kWh)	10,805	10,986	10,175	10,627	10,214	10,178	10,187	10,121
Net Generation (GWh)	3,717	3,878	4,046	4,079	4,123	4,214	4,137	4,137
Sales (GWh)	2,976	3,055	3,121	3,131	3,179	3,204	3,187	3,216
Losses(GWh)	742	823	926	947	944	1,010	950	921
Losses %	19.9%	21.2%	22.9%	23.2%	22.9%	23.97%	22.96%	22.30%
Profit(US $M)	(2.31)	23.19	30.03	(7.48)	6.04	42.22	39.88	34.35
Fuel Cost (US cents/kWh)	**8.00**	**11.64**	**13.00**	**15.18**	**20.63**	**14.54**	**18.15**	**23.82**
Energy Cost(US cents/kWh)	**8.66**	**9.49**	**10.46**	**9.94**	**10.46**	**10.23**	**11.42**	**12.05**
Tariff (US cents/kWh)	**16.66**	**21.14**	**23.46**	**25.12**	**31.09**	**24.77**	**29.57**	**35.86**
Return on Equity(ROE)	**0.7%**	**5.8%**	**7.1%**	**-2.1%**	**1.6%**	**10.6%**	**10.1%**	**9.3%**
Return on Assets(ROA)	**-0.3%**	**3.9%**	**3.9%**	**-0.9%**	**0.7%**	**4.5%**	**4.1%**	**3.3%**
Return on Capital Employed (ROCE)	**-0.3%**	**9.0%**	**6.1%**	**-2.8%**	**0.6%**	**7.6%**	**7.4%**	**6.4%**

Distribution of Tariff by Operations Category

	Expenses as a Percentage of Total Tariff							
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Generation:	**64.3%**	**69.9%**	**69.3%**	**74.2%**	**76.8%**	**71.3%**	**72.3%**	**76.1%**
Fuel	48.0%	55.1%	55.4%	60.4%	66.4%	58.7%	61.4%	66.4%
IPP Cost	11.7%	9.8%	9.9%	9.5%	6.8%	9.3%	7.6%	7.0%
Gen.O&M	4.6%	5.0%	4.0%	4.3%	3.6%	3.3%	3.3%	2.7%
Customer Operations	5.7%	3.0%	5.5%	5.7%	5.1%	5.2%	5.8%	4.9%
Commercial Services	3.0%	5.1%	2.6%	2.7%	1.2%	1.3%	2.6%	2.3%
Admin., Finance,Depreciation,Taxes etc	27.4%	18.3%	18.4%	18.3%	16.3%	16.9%	15.1%	13.8%
Total Expense	100.5%	96.4%	95.9%	101.0%	99.4%	94.7%	95.8%	97.0%
Profit	**-0.5%**	**3.6%**	**4.1%**	**-1.0%**	**0.6%**	**5.3%**	**4.2%**	**3.0%**
Total Tariff	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

System Energy & Demand Forecast

Generation Expansion Forecast Demand

Year	Net Generation (MWh)	Net Gen Growth Rate	Load Factor (%)	Net Peak (MW)	Peak Growth Rate (%)
2009	4,213,983		75%	644	
2010	4,137,352	-1.8%	74%	638	-0.95%
2011	4,113,322	-0.6%	75%	625	-2.09%
2012	4,102,216	-0.3%	73%	636	1.76%
2013	4,108,780	0.2%	74%	634	-0.27%
2014	4,190,955	2.0%	74%	647	2.00%
2015	4,316,684	3.0%	74%	666	3.00%
2016	4,446,184	3.0%	74%	686	3.00%
2017	4,624,032	4.0%	74%	714	4.00%
2018	4,808,993	4.0%	74%	742	4.00%
2019	5,001,353	4.0%	74%	772	4.00%
2020	5,201,407	4.0%	74%	803	4.00%
2021	5,409,463	4.0%	74%	835	4.00%

JPS Budget & PLanning Forecast Demand

Year	Net Generation (MWh)	Net Gen Growth Rate	Load Factor (%)	Net Peak (MW)	Peak Growth Rate (%)
2009	4,213,983		75%	644	
2010	4,137,352	-1.8%	74%	638	-0.95%
2011	4,113,322	-0.6%	75%	625	-2.09%
2012	4,102,216	-0.3%	73%	636	1.76%
2013	4,108,780	0.2%	74%	634	-0.27%
2014	4,164,659	1.4%	75%	635	0.10%
2015	4,227,129	1.5%	75%	646	1.81%
2016	4,290,536	1.5%	74%	656	1.50%
2017	4,354,894	1.5%	75%	666	1.52%
2018	4,420,217	1.5%	75%	676	1.50%
2019	4,486,520	1.5%	75%	686	1.48%
2020	4,553,818	1.5%	74%	697	1.60%
2021	4,622,126	1.5%	73%	725	4.00%

Key Challenges to Economic and Reliable Supply

- High Dependency on expensive Imported Oil
  - Fuel oil prices have increased three fold from 2004-2011(US$40 to -$119/bbl)
  - 95% of production is from Fuel Oil
  - Fuel accounts for over 60% of total cost of electricity
- Aging Energy Production Assets
  - Average age of base load plant 40 years
  - Low efficiency of conversion of high cost oil
  - Net gen. grew by 11.3% and Sales grew by only 8.1% over the period 2004 to 2011; Increasing illegal abstraction.
- Currently no feasible base load fuel available in sufficient quantity in Jamaica
- Large investment capital required to install new plants
- Long lead time before commercial operations
- Small system size increases unit investment costs and limits options

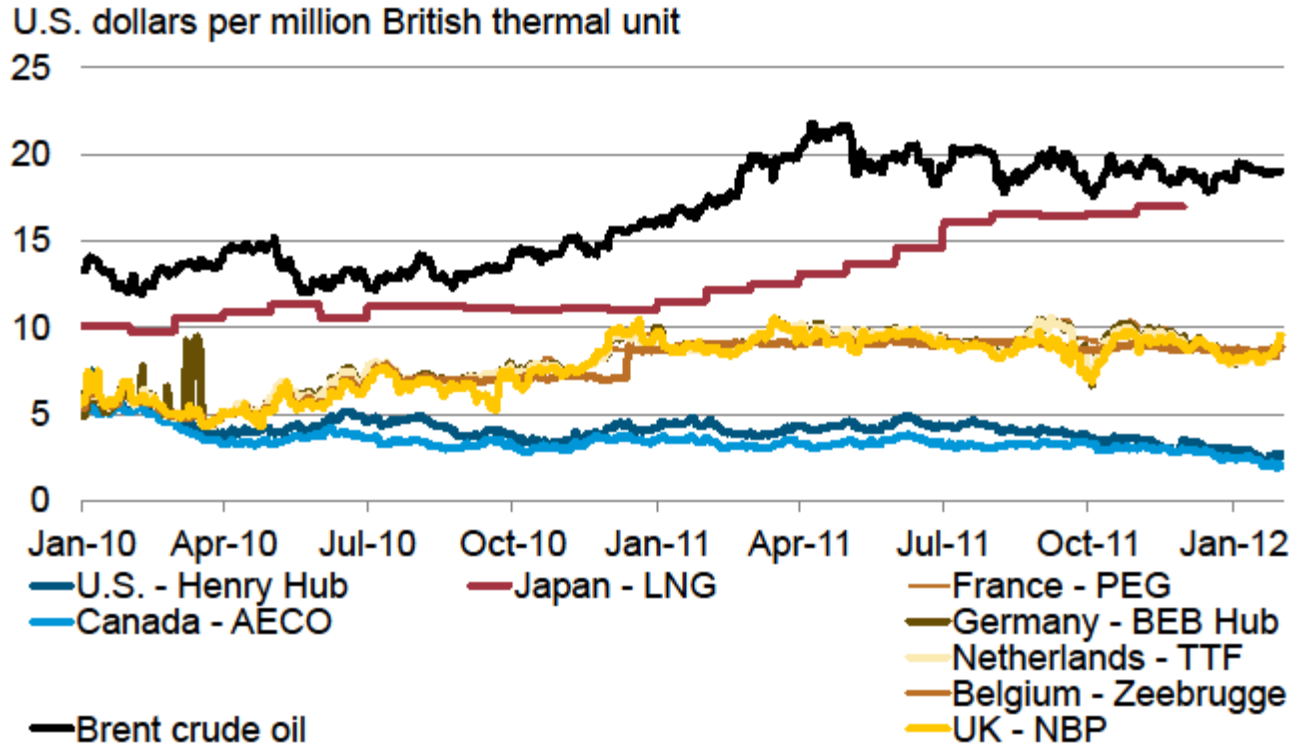
Fuel and Technology Options for Jamaica

- Liquid Fuels
- Natural Gas
- Coal
- Petroleum coke (Petcoke)
- Renewable Technologies
  - Solar PV
  - Hydro
  - Biomass

Fuel Oil

- Fuel oil readily stored and transported.
- Relatively low infrastructure costs.
- It can be used in flexible generation technologies.
- Volatile fuel market -Most forecasts predict considerable increase in oil prices. Prices impacted by geopolitics
- Currently more than 95% of generation in JPS is produced by fuel oil. This is not a desired situation given the high level of uncertainty of oil prices.
- Oil accounts for the greatest portion of Jamaica electricity cost.

Global spot natural gas and crude oil prices with average monthly LNG prices in Japan



Source: EIA based on Bloomberg

Natural Gas

- World natural gas reserves are becoming abundant.
- US LNG import facilities are being converted to export terminals and facilities could be available by 2015
- Driven mostly by long-term contracts – changing market boosting short-term sales/contracts
- Costs of liquefying, transporting & regasifying LNG and local gas delivery infrastructure have to be considered.
- Jamaica will have to invest in gas delivery infrastructure

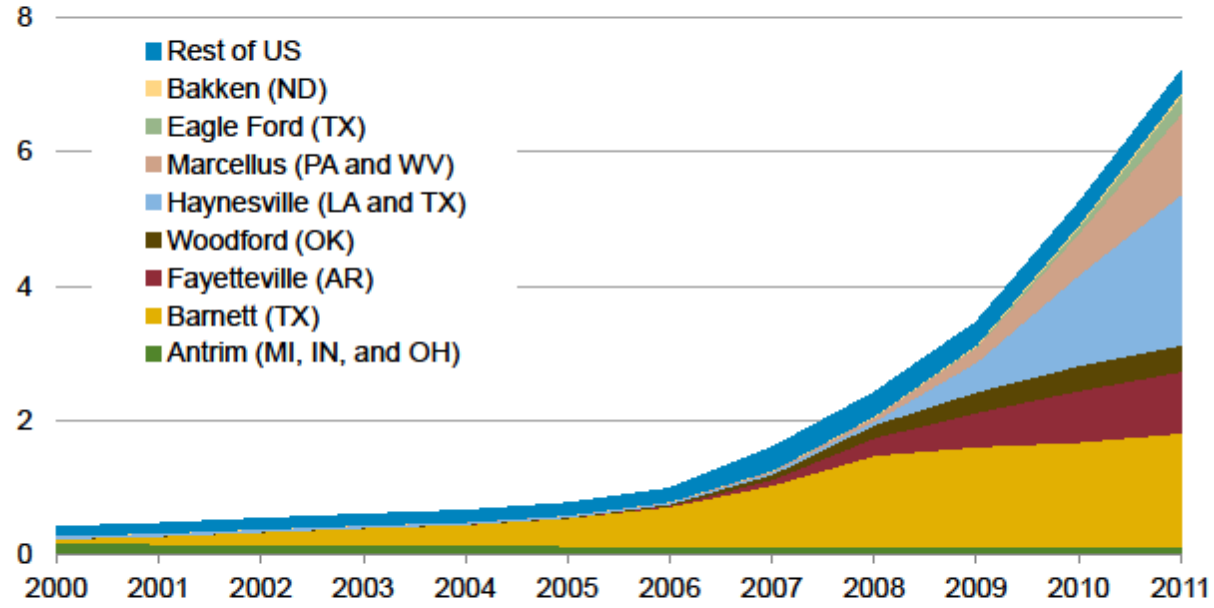
Natural Gas

Due to economic, environmental and technological changes, natural gas has become the fuel of choice for power generation.

- Natural gas is a clean burning energy source - emits lower levels of potentially harmful byproducts
- The shift from coal to natural gas for power generation is expected to continue, and will influence prices
- Viable sources of NG includes: Trinidad, Qatar, USA, Nigeria
- Future Sources: Colombia, Venezuela

Since 2000, U.S. shale gas production has increased 17-fold and now comprises about 30 percent of total U.S. dry production

annual shale gas production (dry)
trillion cubic feet

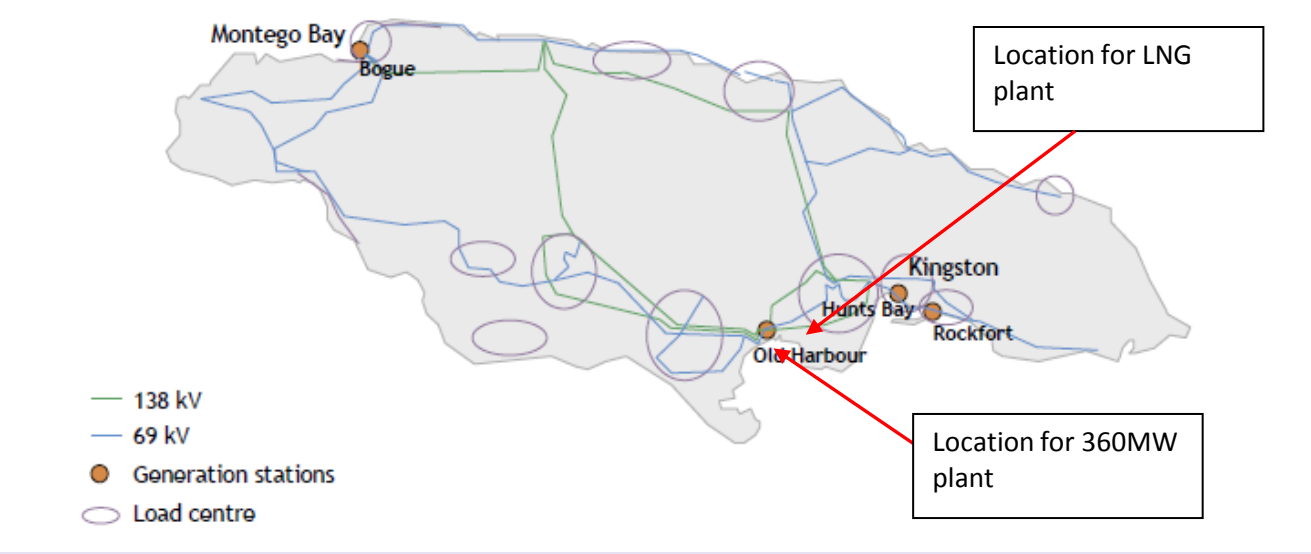


Sources: Lippman Consulting, Inc. gross withdrawal estimates as of November 2011 and converted to dry production estimates with EIA-calculated average gross-to-dry shrinkage factors by state and/or shale play. Note: 2011 is annual rate for first 11 months.

Gas Supply & Infrastructure

Gas supply and infrastructure key components to success of project:

- LNG supply procurement and Infrastructure developments
- LNG vessel / LNG terminal / pipeline



Coal

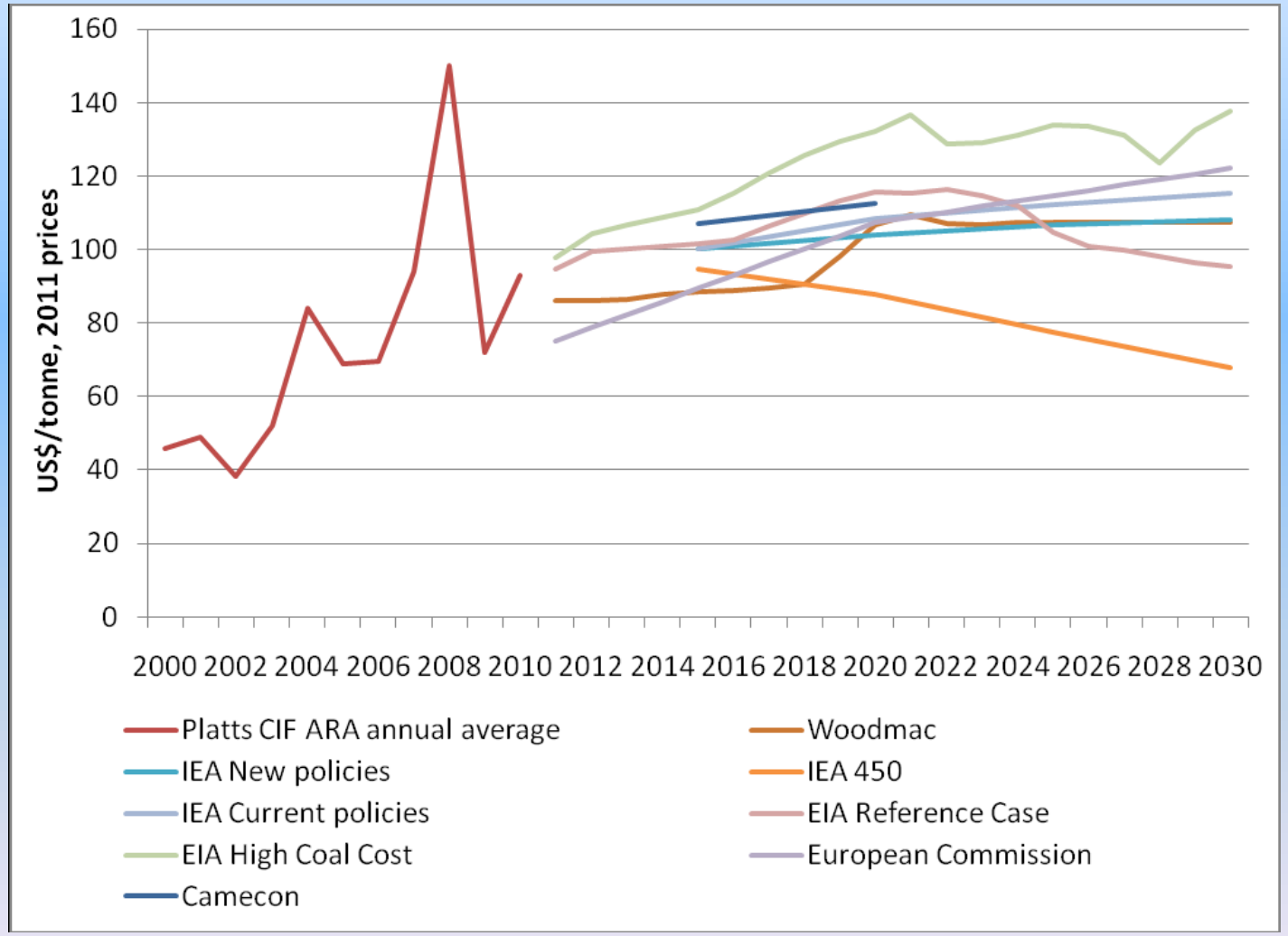
- Coal is abundant and widely used in power generation
- Coal presents serious environment challenges
- Jamaica is in excellent proximity to reliable coal supplies from major suppliers in Colombia, Venezuela and the USA.
- Good supply of suitable ships in Caribbean pool to handle the requirements of a new coal plant.
- Compared to most fuels, price outlook for coal tends to be stable.

Coal Cont'd.

- Price determination includes many variables: expectations by the buyer, seller and mine production/inventory level, delivery infrastructure

Origin	Nautical Miles	Transit Time @ 13.5 knots
Colombia	438	1 day 8 hrs
Venezuela	579	1 day 18 hrs
Mobile	1115	3 days 10 hrs
New Orleans	1155	3 days 13 hrs
Durban	7049	21 days 18 hrs
Richards Bay	7133	22 days 00hrs
Indonesia	10464	32 days 07hrs

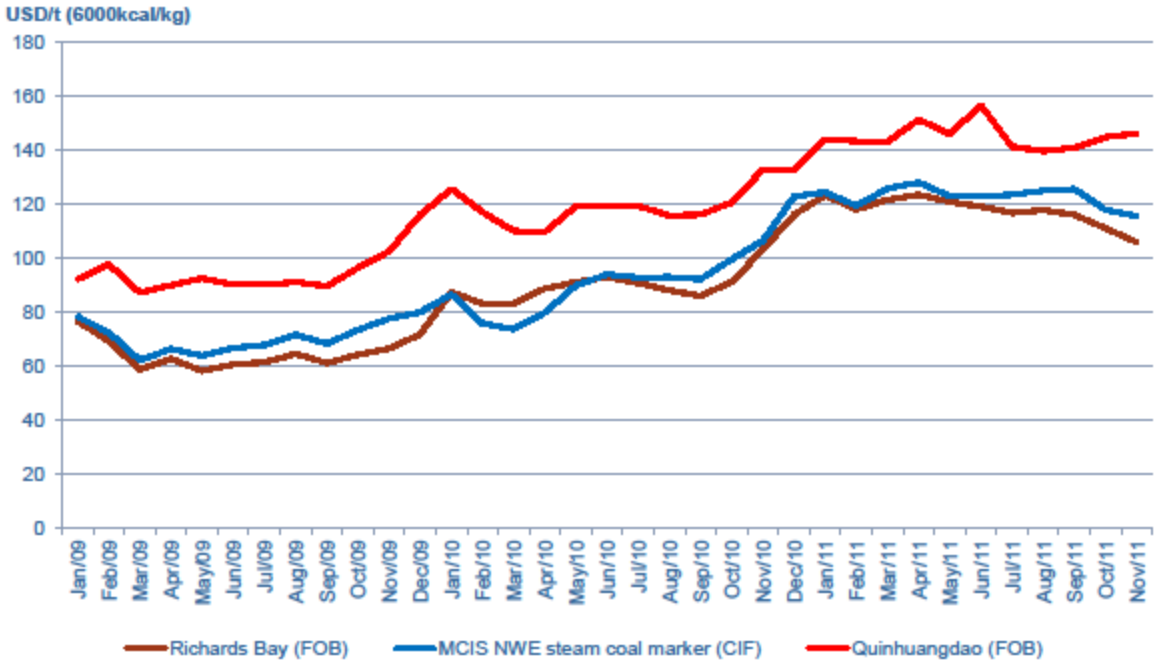
Coal Price Projections



Source: IEA WEO 2010, Wood Mackenzie, Cambridge Econometrics, European Commission (2009), EIA AEO 2010, Platts International Coal Report.

Coal Prices

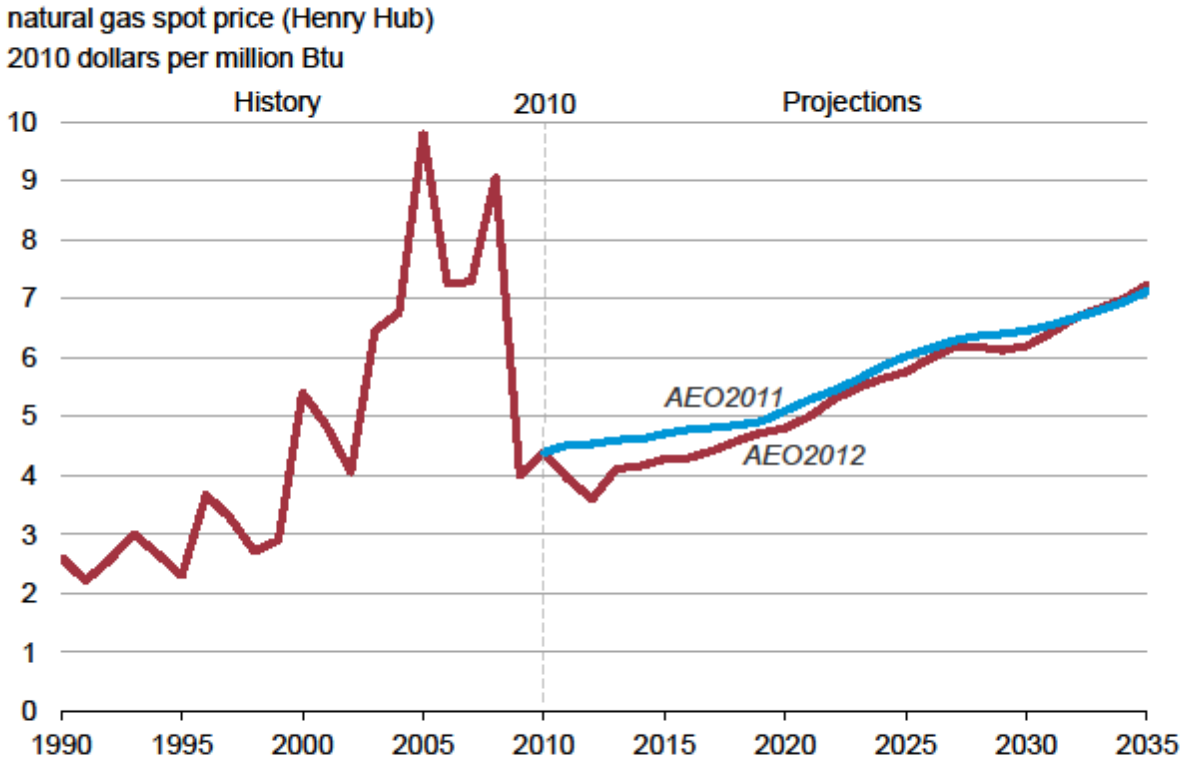
Prices on the rise since 2009



Source: McCloskey.

International Energy Agency

Natural gas price projections are lower than in *AEO2011*, consistent with recent market developments



Sources: EIA, Annual Energy Outlook 2012 Early Release and EIA, Annual Energy Outlook 2011

Petroleum Coke

- Petroleum Coke(Petcoke) is a by product of delayed coker operations.
- After virtually all light and medium weight hydrocarbons removed from crude oil-a heavy residual oil remains.
- Residue high in carbon content and low in hydrogen
- Remaining solid material is sold as petroleum coke and has high heating value, sulfur content range (0.5-5.5%).

Petroleum Coke (Petcoke)

- The production of pet coke continues to climb
  - new production planned for Venezuelan area. Venezuela shipping about 2.5M tons per annum.
  - Quality moderately sulfur at 4.0-4.5%, low ash, 1.0% max but typically 0.5%, 4-5% sulfur and 14,000 Btu/lb heat content.
- It is possible to build combustion units fired with 100% petroleum coke using CFB technology
- Limestone used as sorbent for sulfur is abundant in Jamaica

Fuel -Potential Sources

Renewables

- **Advantages**
  - Environmentally safe
  - Low operating cost
  - Can operate as a distributed system, solar energy is abundant
  - Fairly good wind resource identified in specific areas
  - Reduces the dependence on fossil fuel imports.
- **Disadvantages**
  - Reduces the stability of supply
  - High Capital Expenditure
  - Large land area required about 10 acres per MW for solar pv
  - High risk venture due to resource unpredictability
  - Low capacity factor
  - Inadequate tariff

RIVERS	PARISH	Potential Output (MW)	Feasiblity Studies Available	Greatest Potential for Development
Back Rio Grande (BRG	Portland	50.5	Yes	
BRG Upper (Incremental)	Portland	6.0	Yes	
Great River	Hanover/St.James	8.0	Yes	Yes
Laughlands Great River	St. Ann	5.6	Yes	Yes
Rio Cobre	St. Catherine	1.0		
Negro River 2	St. Thomas	0.9		
Negro River 3	St. Thomas	1.0		
Yallahs River	St. Thomas	2.6		
Wild Cane River	St. Thomas	2.5		
Morgans River	Westmoreland	2.3		
Green River		1.4		
Spanish River (Alternative I)	Portland	4.0	Yes	
Spanish River (Alternative II)	Portland	2.6	Yes	
Rio Grande	Portland	3.9		
Dry River	St. Mary	0.8		
Martha Brae River	Trelawny	5.4	Yes	Yes
Total Identified		**98.5**		
Plants with Greatest Potential for Development	**19MW**			

Critical Factors Affecting Cost of Generation.

- Fuel costs
- Capital Cost
- Generation O&M cost
- Finance Cost, Taxes
- Depreciation Expense
- Profitability Expectations
- Environmental Mitigation Cost

Critical Factors Affecting Generation Addition Decision.

- Timing of power demand
- Type of new plant technology
- Characteristics of existing plants
- Fuel type
- Size of plant
- Location

Plant Cost

Technology	Fuel	Capacity (kW)	Nominal Heat Rate (Btu/kWh)	Capital Cost (US$/kW)	Fixed O&M ($/kW-	Variable O&M ($/MWh)
Advance Pulverised Coal	Coal	360,000.00	8,800.00	3,167.00	35.67	4.25
Advance Pulverised Coal with CCS	Coal	360,000.00	8,800.00	5,099.00	76.62	4.25
Natural Gas Combine Cycle	Gas	360,000.00	7,050.00	978.00	14.39	3.43
Hydroelectric	Hydro	100,000.00	n/a	3,076.00	13.44	-
Onshore Wind	Solar	100,000.00	n/a	2,438.00	13.03	-
Photovoltaic	Solar	7,000.00	n/a	6,050.00	26.04	-

Source: 2010 Department of Energy Infromation Administration

Source: Department of Energy Information Administration-Updated Capital Cost Estimates for Electricity Generation Plants

ENVIRONMENTAL IMPACT

		EMISSIONS			
Technology	**Fuel Type**	**SO2 (lb/MMBtu)**	**NOx (lb/MMBtu)**	**CO_2 (lb/MMBtu)**	**Particulate Matter (lb/MMBtu)**
Advanced Pulverized Coal	Coal	0.1	0.06	206.00	6.8
Advanced Pulverized Coal with CCS*	Coal	0.02	0.06	20.60	6.8
Natural Gas Combine Cycle	Natural Gas	0.001	0.0075	117.00	0.0002

		Emissions per Annum-360MW @ 85% Capacity Factor			
Technology	**Fuel Type**	**SO2 (tons)**	**NOx (tons)**	**CO_2 (tons)**	**Particulate Matter (tons)**
Advanced Pulverized Coal	Coal	1,407	844	2,899,026	95,696
Advanced Pulverized Coal with CCS*	Coal	281	844	289,903	95,696
Natural Gas Combine Cycle	Natural Gas	9	69	1,077,304	2

Economic Assumptions For Comparison

Description	Rate
Leverage	70%
Interest Rate	11%
Loan Cost	2%
Loan Term	10 years
Equity Return	16.5%
Insurance Cost(% of Construction Cost	1.1%
Plant Life-LNG, Coal	25, 30

Real Fuel and Tecnology Options for Generation Expansion

Fuels	Price($/Unit)	Heating Value(MMBtu)	Price ($/MMBtu)	Source	
LNG	8.50-12.50/Mcf	1.034	8.22-12.10	Trinidad, USA, Qatar, Nigeria	
Coal	75/ton	25	$3.00	Colombia	
Petcoke	69/ton	28	$2.46	Venezuela	
Technology	Capital Cost ($/kW)	Plant Size (Gross-MW)	Heat Rate (Btu/kWh)	Fixed O&M ($/kW-yr)	Var. O&M (c/kWh)
CCGT-LNG	$1,510	120	6,870	$12.86	$2.53
Steam-Coal	$3,750	120	10,500	$29.59	$5.00
Steam-Petcoke	$3,750	100	10,500	$29.59	$5.00

Technology	Implementation
CCGT-LNG	2-3 years
Steam-Coal	5-6 years
Steam- Petcoke	5-6 years

Generation All in Cost
base on Jamaica Plant size

	360 MW @ $8.5/MMBtu LNG	360 MW @ $12.5/MMBtu LNG	360 MW @ $75/ton Coal	100MW @ $69/ton Petcoke
- Capacity Charge ($/MWh)	32.54	32.54	104.53	101.79
- Energy Charge ($/MWh)	2.61	2.61	5.15	5.15
- Fuel Charge ($/MWh)	54.95	80.81	31.50	28.98
All in Generation Cost ($/MWh)	90.10	115.96	141.18	135.92
All in Generation Cost (Usc/kWh)	9.01	11.60	14.12	13.59
Capacity Charge ($/kW-mo)	22.43	22.43	72.07	70.18

Cost of Transmission, Distribution, Collection etc must be added for overall Electricity Tariff

Generation All In Cost
using EIA data

	LNG 650 MW	Coal 650 MW	Coal 650 MW with CCS
- Capacity Charge ($/MWh)	24.15	89.70	146.82
- Energy Charge ($/MWh)	3.43	4.25	9.05
- Fuel Charge ($/MWh)	57.95	26.40	26.40
All in Generation Cost ($/MWh)	85.54	120.35	182.27
All in Generation Cost (Usc/kWh)	8.55	12.04	18.23
Capacity Charge ($/kW-mo)	16.65	61.84	101.22

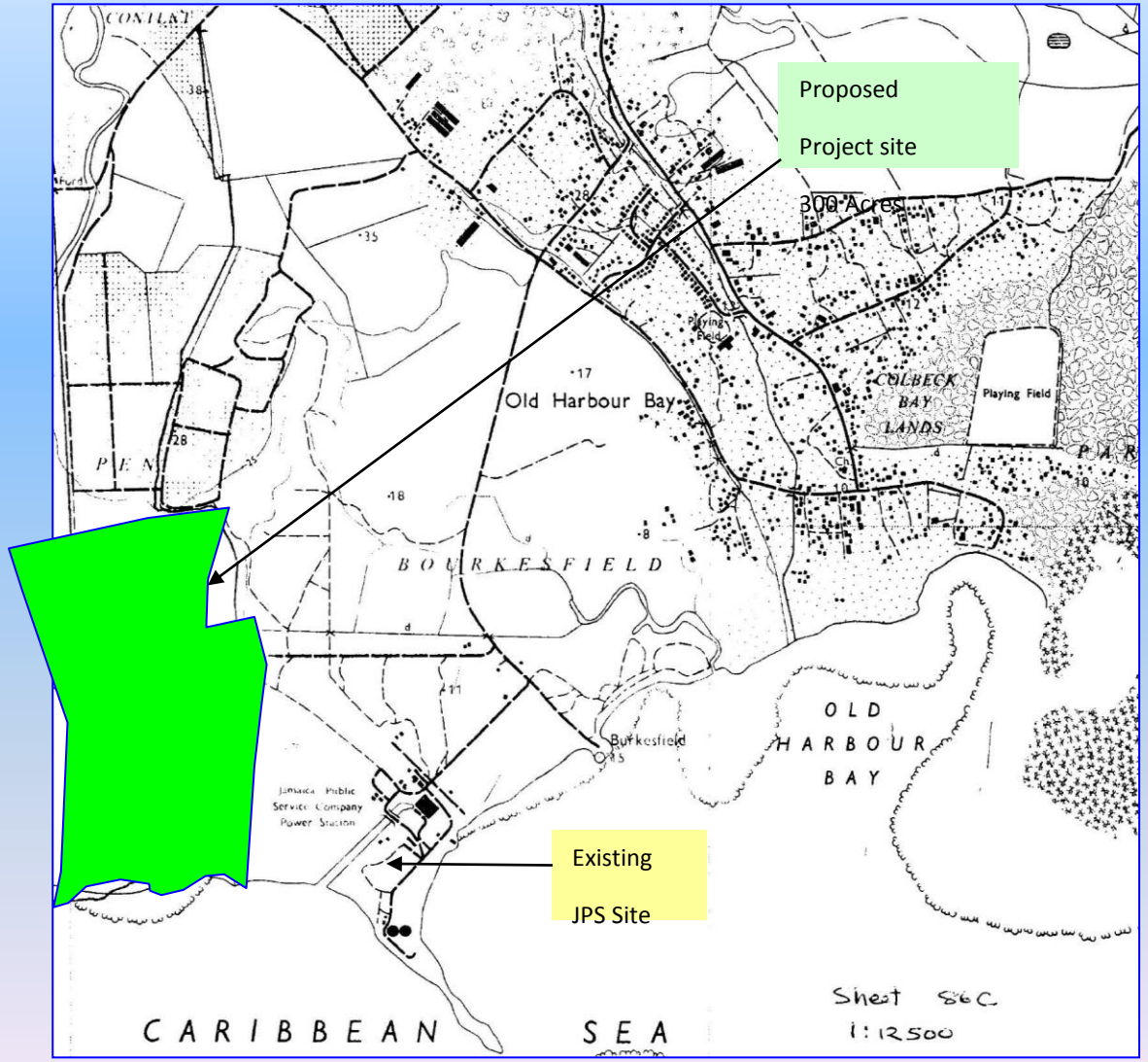
Source: Department of Energy Information Administration-Updated Capital Cost Estimates for Electricity Generation Plants

Technology Option Cost

IPPs, Newc 480 MW CC, and existing Old Harbour Cost of Energy Comparison

	Old Harbour	LNG CCGT	ADO CCGT	LNG MSDiesel	Fuel Oil MSDiesel with fuel abatement
Capacity (MW)	194	360	360	360	360
Capacity Price US$/kW/Mth	6.30	24.79	24.79	21.53	29.41
Fixed O&M /kW-mth	2.06	4.44	4.44	3.38	3.38
Total Fixed Cost $/kW/Mth	8.36	29.23	29.23	24.91	32.79
Fixed Charge(US$/kWh)	0.02	0.0435	0.0435	0.0371	0.049
Variable O&M US$/kWh	0.005	0.0022	0.0022	0.0163	0.016
Fuel Cost US $/kWh	0.214	0.058	0.178	0.063	0.123
Total Energy Cost (C/kWh)	23.50	10.36	22.38	11.66	18.80
Fuel Price $/bbl	103.35		146.99		103.50
Base Fuel Cost US$/MMBTU*	16.67	8.50	25.13	8.50	16.67

Plant Location



37

Renewable Options Analysis

Levelized Cost of Renewable Options

Assumptions	
Debt	70.00%
Equity	30.00%
Lending Rate	11.00%
Retyurn on Equity	16.50%
Weighted Avg. Cost of Capital	12.65%
Discount Rate	**12.00%**
Period Hours	**8760**

Technology		Wind	Hydro	PV Solar
Plant Life Time	Years	30	30	30
Capacity	MW	1.0	6.3	1.0
Plant Capital Cost	$/kW	3200	5247	3000
Plant Total Cost	K$	3,200.0	33,056.1	3,000.0
WACC	%	12.65%	12.65%	12.65%
Annual Capital Cost	K$	416	4,302	390
Plant Capacity Factor	%	30.00%	48.00%	20.00%
Available Energy	MWh	2,628	26,490	1,752
Capacity Cost/Kwh	$/KWh	0.16	0.16	0.22
Fixed O&M Rate(%of Capital Cost/yr	$/Yr	0.30%	0.50%	0.05%
Fixed O&M Cost	K$	9.60	165.28	1.50
Fixed O&M	$/KWh	0.0037	0.0062	0.0009
Variable O&M Cost	K$	2.63	185.43	1.75
Variable O&M	$/KWh	0.001	0.007	0.001
Total Production Cost	K$	428.71	4653.03	393.71
Total Energy Production Cost	$/KWh	0.163	0.176	0.225
Renewable Levelized Energy Tariff	c/KWh	16.31	17.57	22.47
OUR Renewable Energy Tariff	c/kWh	10.12	10.12	10.12

Renewable Energy Projects

At current costs : Tariff (c/kWh): Wind 16.31, Hydro 17.57, Solar PV 22.47

- The OUR renewable Tariff of US$0.102/kWh is uneconomic and will hinder renewable projects development
- OUR tariff needs to be modified to reflect the reality of the system marginal cost.
- Solar PV capital cost must be reduced to around $2220/kW to compete with wind and hydro projects
- Renewables will not provide firm power due to variation of out put due to intermittency of source.
- 1MWh of renewable generation will displace approximately 2.4 bbl of imported fuel
- Renewable will have positive environmental impact 1 MWh of renewable energy will displace 1500 lbs of Carbon Dioxide from fossil fuel.

Expansion Scenarios

We have considered five (5) scenarios.
These include:

1. LNG only scenario where all new plants will burn LNG
2. LNG, Petcoke Coal scenario a mixed fuel
3. LNG, Petcoke scenario a mix-fuel
4. A Coal, Petcoke scenario
5. Continue as existing (“Do Nothing”)

The Recommended Expansion Plan

Year	Size	Technology	Fuel Type	Site
2015-2016	3x 120 MW	CCGT	LNG	Old Harbour
2016-2017	Convert JEP 124 MW & 65MW 6.3MW 15MW	Medium Speed Diesel Hydro Wind	LNG	Old Harbour West Kingston, Maggotty Munro
2018	1x120MW	CCGT	LNG	Hunts Bay
2021	1x 120MW	CCGT	LNG	Bogue
2024	1x 120MW	CCGT	LNG	TBD

Required Investment Plan

Phase One (US$'000)						
Capacity MW	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
360MW	43,344	226,992	250,441	82,500		
120MW				76,951	82,160	39,695
Total	43,344	226,992	250,441	159,451	82,160	39,695

Phase Two (US$'000)						
Capacity MW	2019	2020	2021	2022	2023	2024
120MW	76,951	82,160	39,695			
120MW				76,951	82,160	39,695
Total	76,951	82,160	39,695	76,951	82,160	39,695
Grand Total Phase 1 & 2						1,199,495

Required Investment (LNG, Petcoke)

Phase One (US$'000)						
Capacity MW	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
360MW	43,344	226,992	250,441	82,500		
120MW				76,951	82,160	39,695
Total	43,344	226,992	250,441	159,451	82,160	39,695

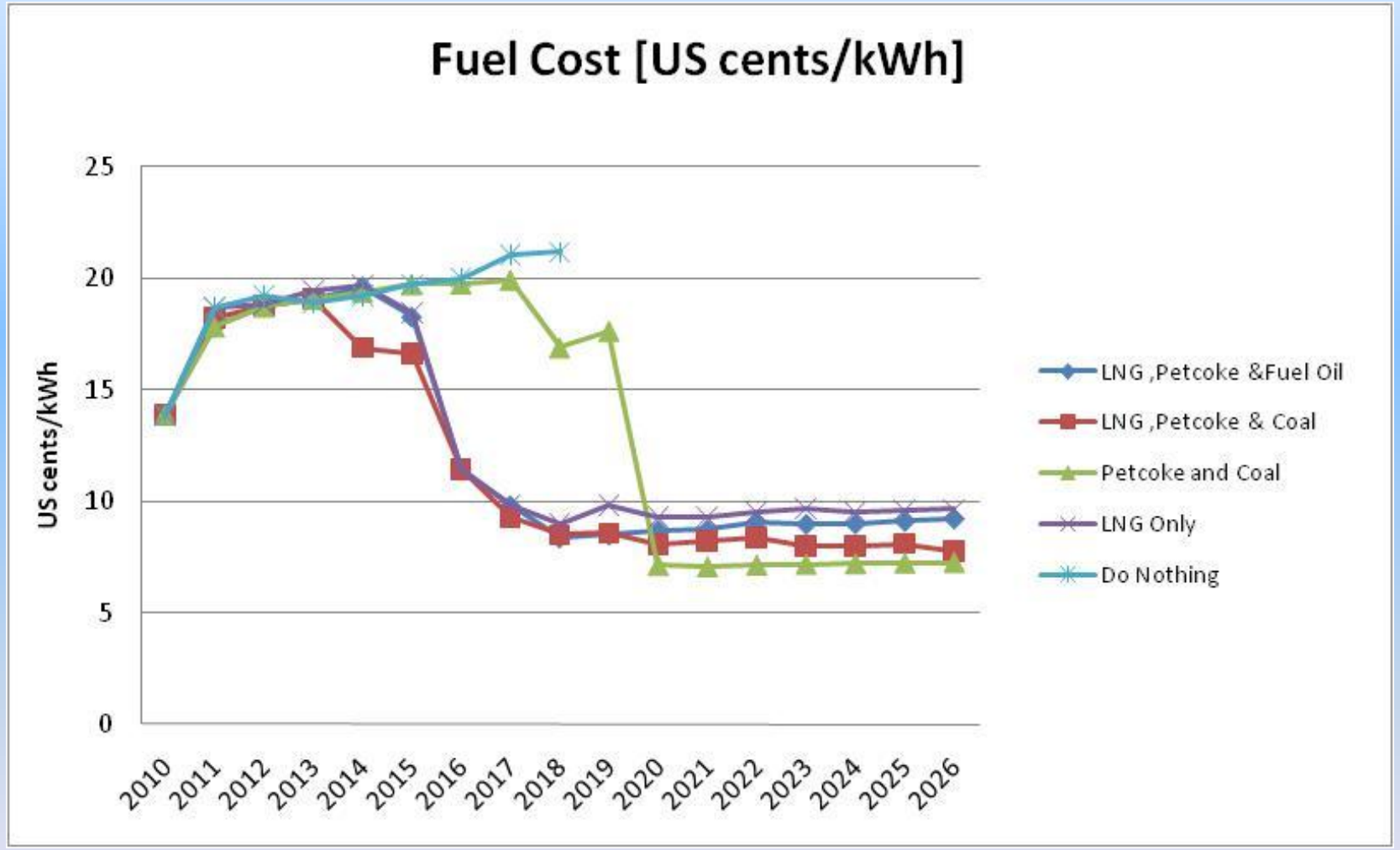
Phase Two (US$'000)						
Capacity MW	2015	2016	2017	2018	2019	2020
120MW	84,917	88,716	97,446	109,725		
120MW				76,951	82,160	39,695
Total	84,917	88,716	97,446	186,676	82,160	39,695
Grand Total Phase 1 & 2						1,381,693

Required Investment (LNG, Petcoke, Coal)

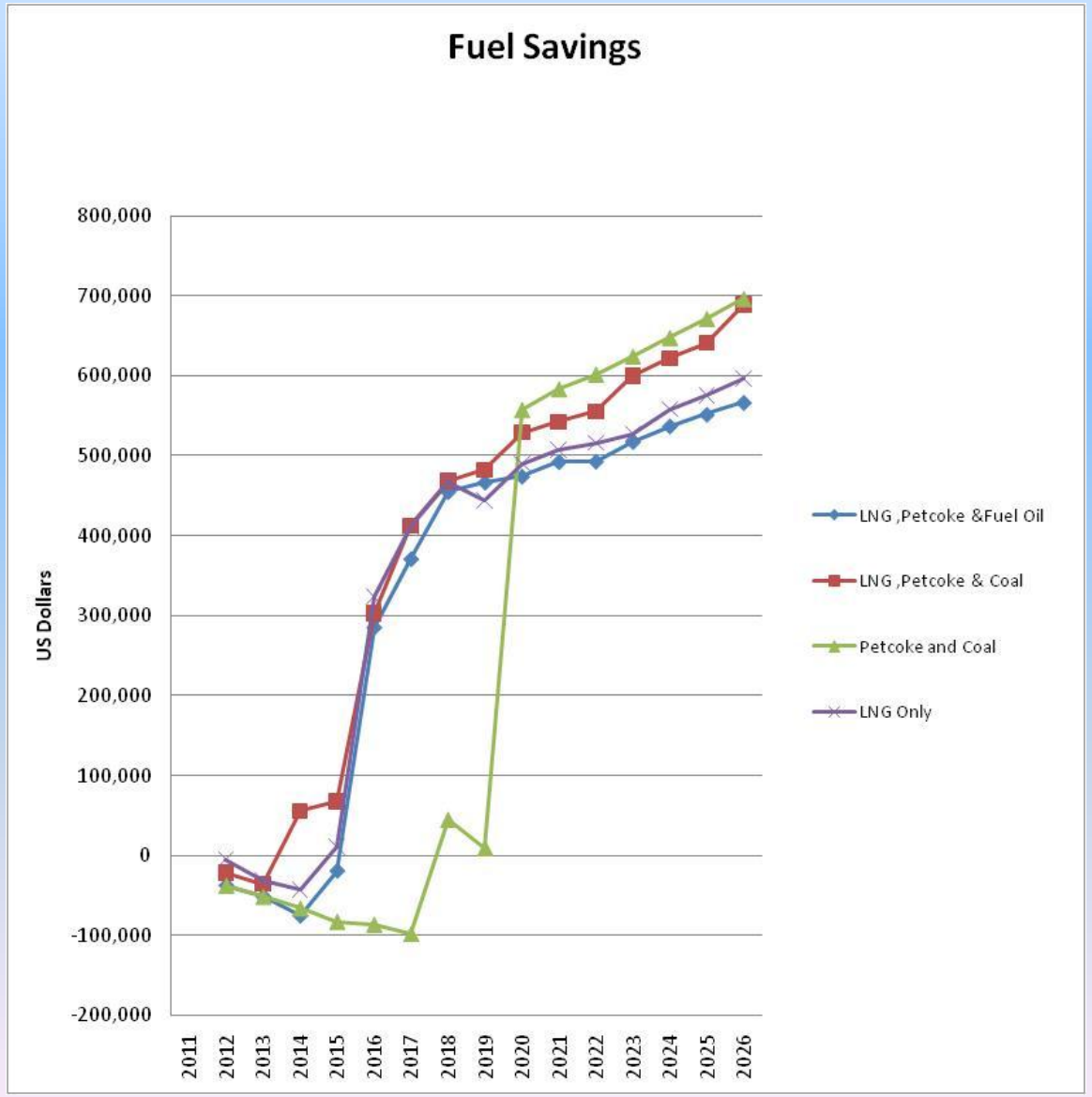
Phase One (US$'000)						
Capacity MW	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
360MW	43,344	226,992	250,441	82,500		
120MW				76,951	82,160	39,695
Total	43,344	226,992	250,441	159,451	82,160	39,695

Phase Two (US$'000)						
Capacity MW	2015	2016	2017	2018	2019	2020
120MW	84,917	88,716	97,446	109,725		
120MW			101,901	106,543	116,935	131,670
Total	84,917	88,716	199,347	216,268	116,935	131,670
Grand Total Phase 1 & 2						1,639,936

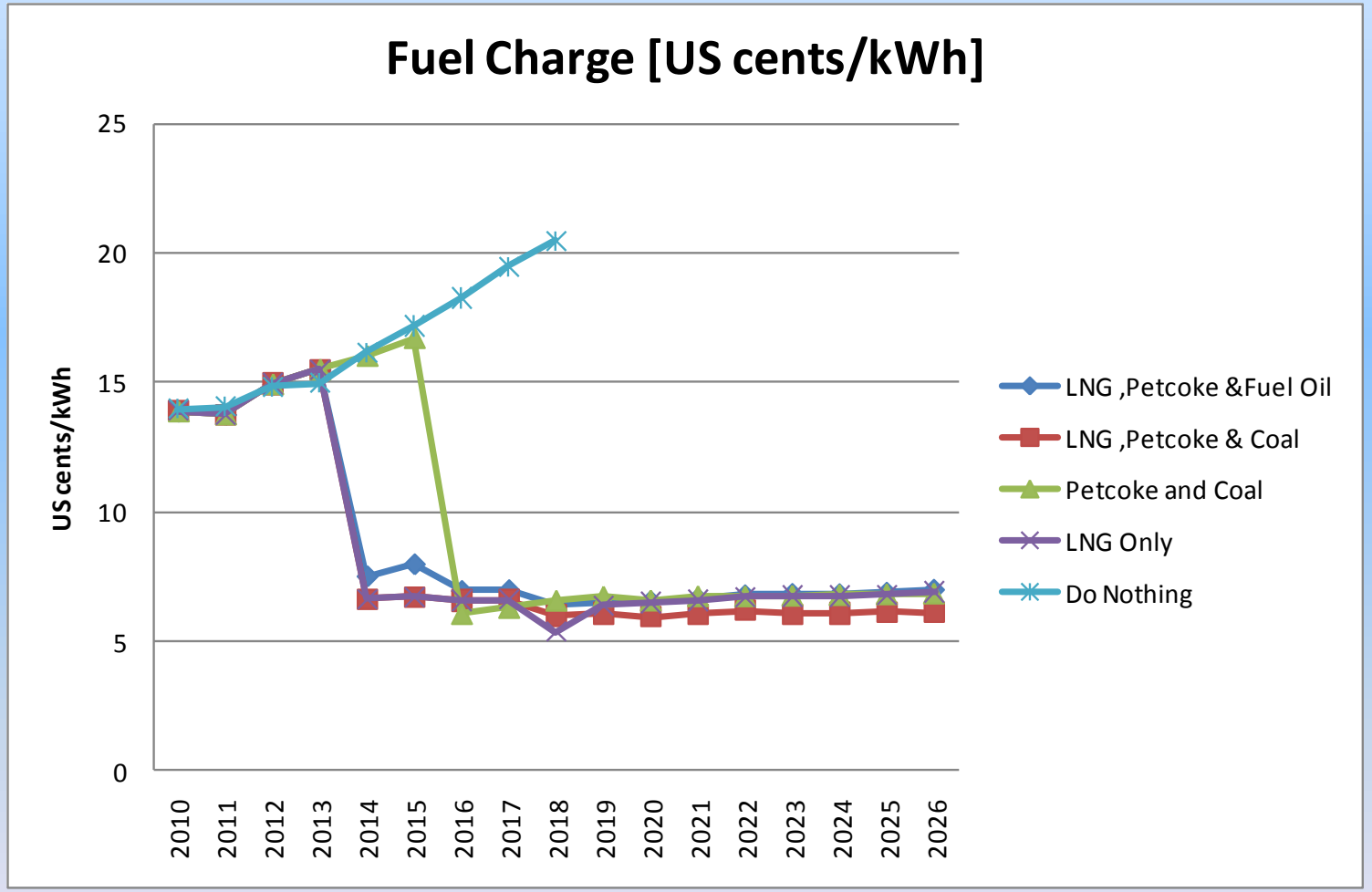
Fuel Charge/kWh-Fuel Options



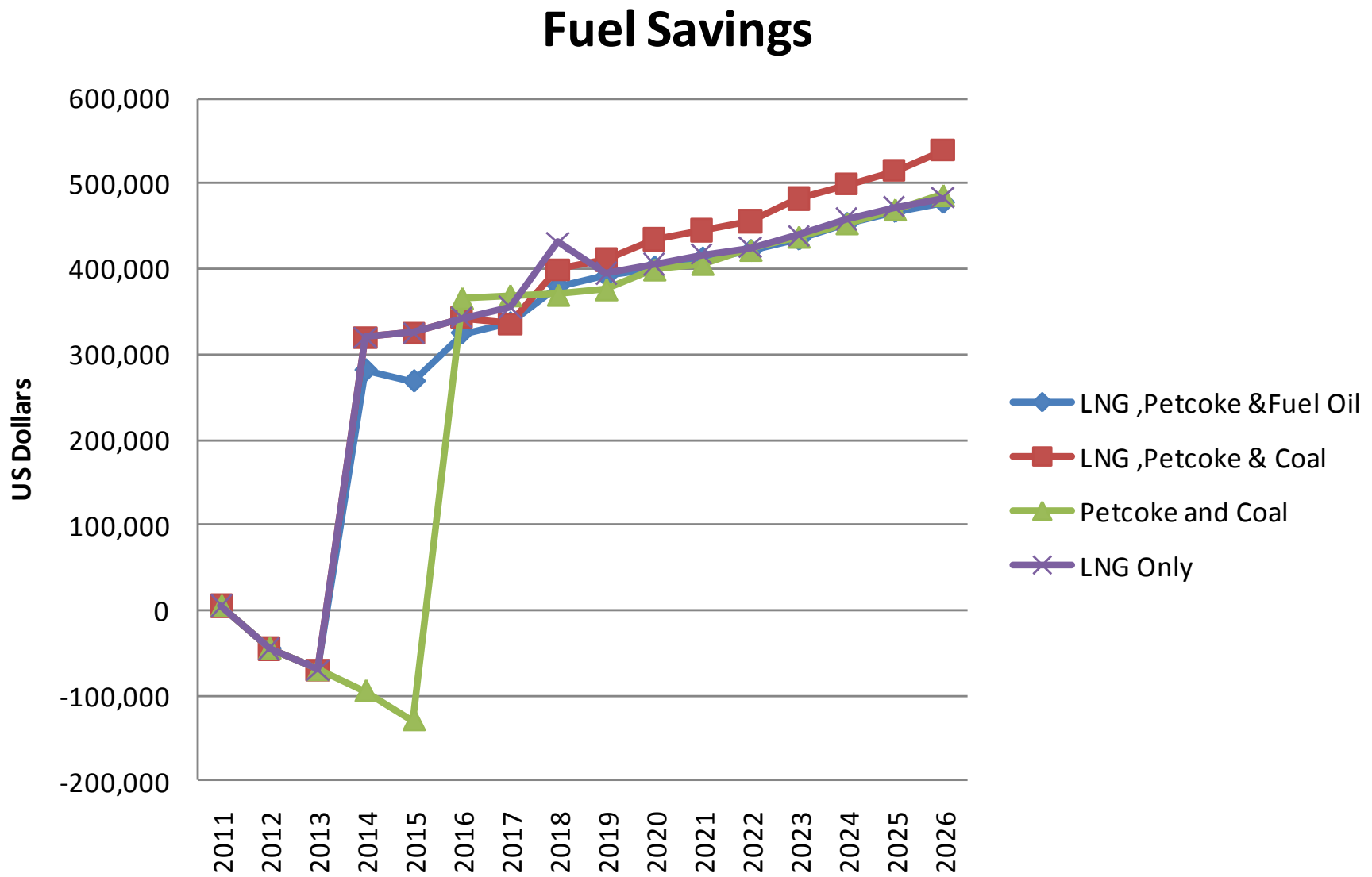
Fuel Cost Savings



Fuel Charge/kWh-Fuel Options



Fuel Cost Savings

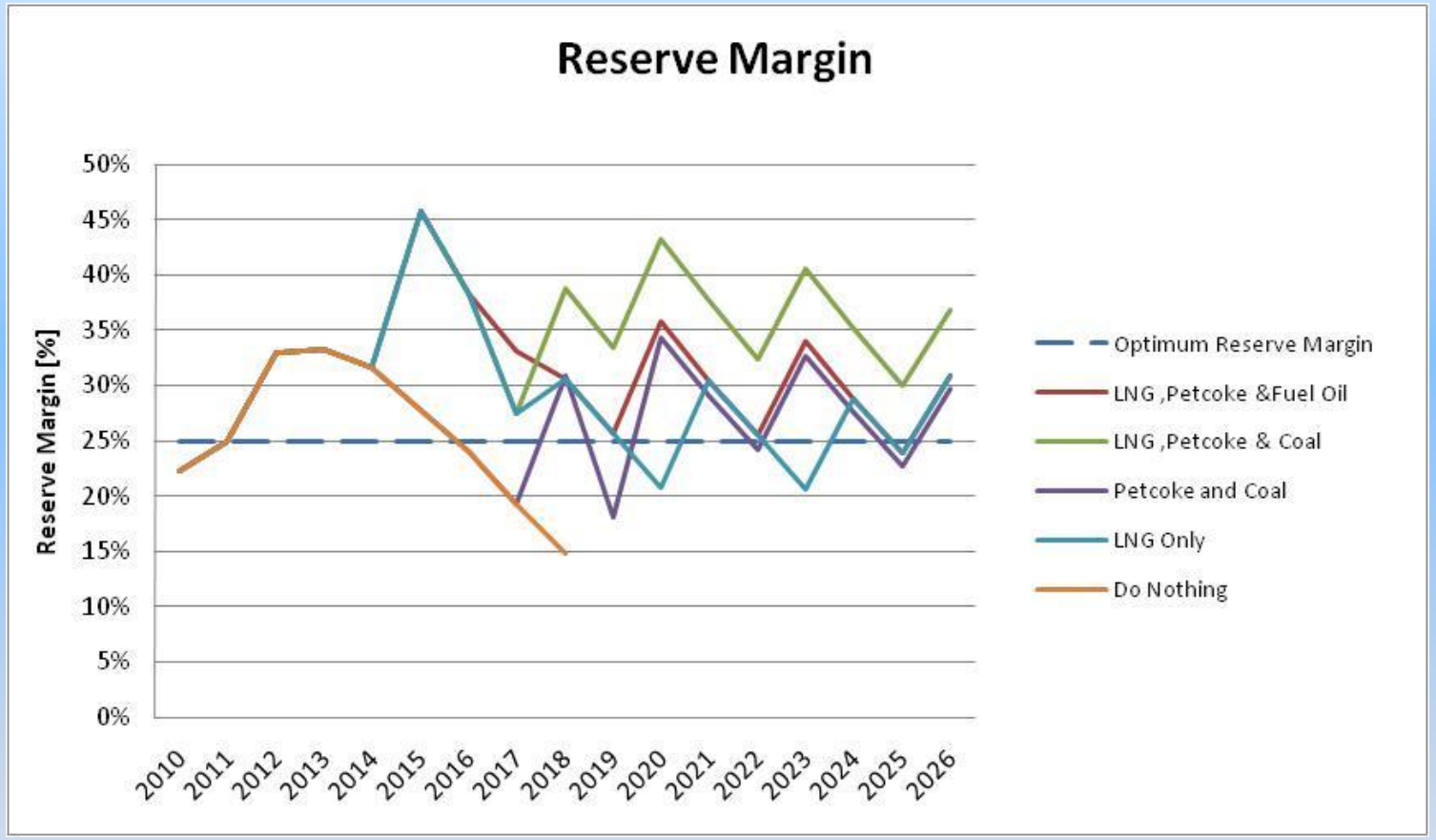


5 - Do Nothing Scenario

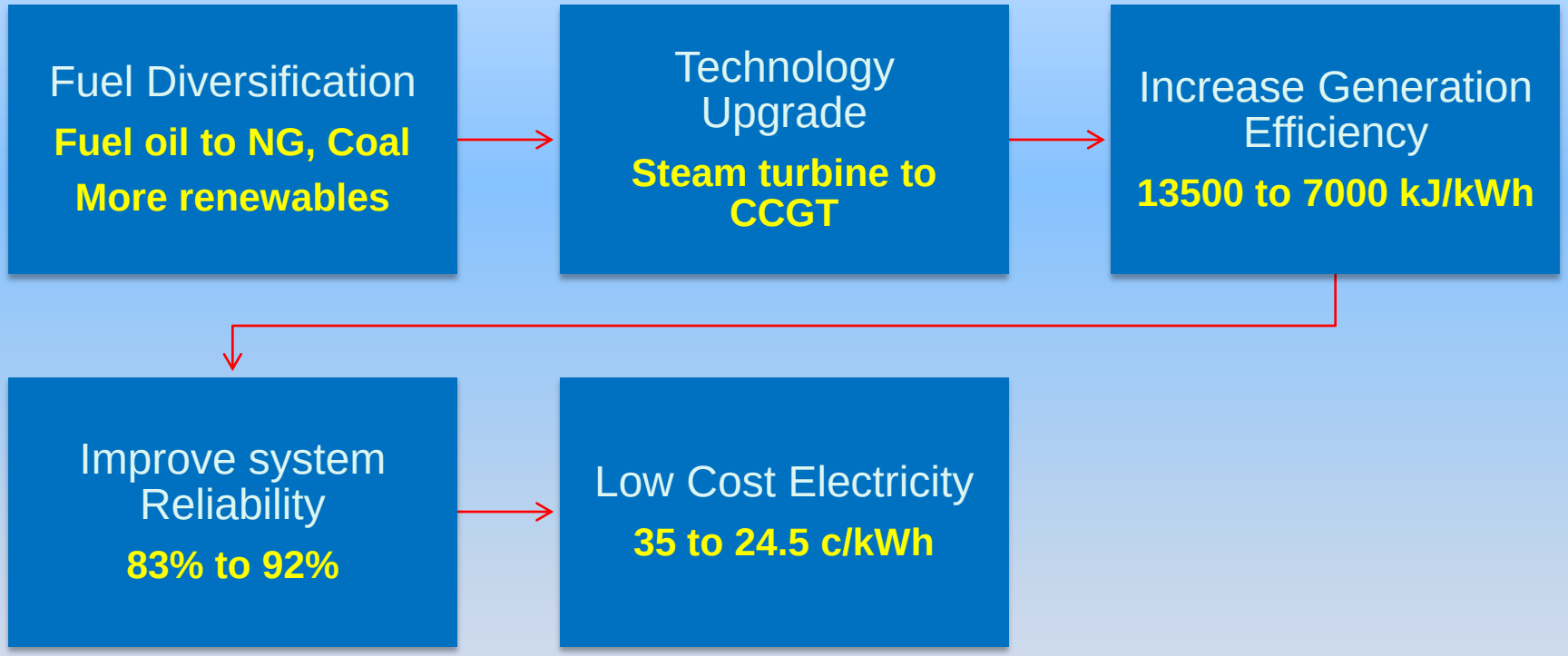
- Continue to operate existing Steam Units and Gas Turbines on HFO and ADO.
- Maintain engines with higher O&M expenditure. No new equipment in mix beyond JEP barges
- No change to fuel mix with HFO and ADO
- JEP – 65MW in late 2012
- Renewables –Munro 15MW and Maggotty 6.3MW in 2014

	2011	2012	2014	2016
System Heat Rate (kJ/kWh)	10,131	10,016	9,600	10,002
Fuel Cost (c/kWh)	18.70	19.24	19.25	20.02

RESERVE MARGINS



Fuel Diversification Creates Benefits



Key Take-away Points

- Investments in new plants will be required to meet demand and to replace units that are currently old and inefficient.
- The solution that will suit all stake holders requires both a reduction in fuel cost as well as production efficiency
  - **Enables the company to provide lower cost to customers while benefiting from efficiency gains, low environment impact**
- It is widely accepted that Jamaica needs to limit its dependency on fuel oil by diversifying its energy source
  - **Natural Gas is a viable option relative to fuel oil.**
  - **Coal & Petcoke are competing alternatives but present environmental challenges**

Key Take-away Points Cont'd

- Apart from fuel there are other factors which comprise the generation cost
- The "All In Generation Cost" for LNG is less than that of Coal and Petcoke.
- The environmental impact of Natural Gas is significantly less than that of Coal.
- The cost to mitigate against the environmental impact of coal will increase the generation cost by approximately 50%.
- Fuel diversification creates long term benefits.
- Firm decisions are required from policy makers for projects to go forward