Caribbean Energy Sector Macro-related Challenges

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I. Overview

Executive Summary

- The 2014 Caribbean Forum identified energy-related challenges in the Caribbean as a critical area for future policy work given the size of the energy bill.
- In response to the issues raised, the IMF attempted to analyze the macroeconomic impact of high and volatile energy prices, and explored the adequacy and costs of proposed energy strategies, and their consistency with debt suitability in the region.
- Our findings suggest that energy sector policies and reform could have a measurable impact on growth outcomes and significant implications for external competitiveness through its impact on the REER.
- Despite the dramatic shift in the global energy market with oil prices falling more than 50 percent over the past 12 months, energy sector challenges need to be carefully addressed. This is largely because:
  - ✓ A lower oil price environment does not alter relative competitiveness of the Caribbean. In-country cost reductions are critical for competitiveness gains.
  - ✓ The outlook for oil price developments is highly uncertain. Vulnerability to future shocks remains very high.
  - ✓ Volatility of energy costs continues to create uncertainty and dampen investment appeal.

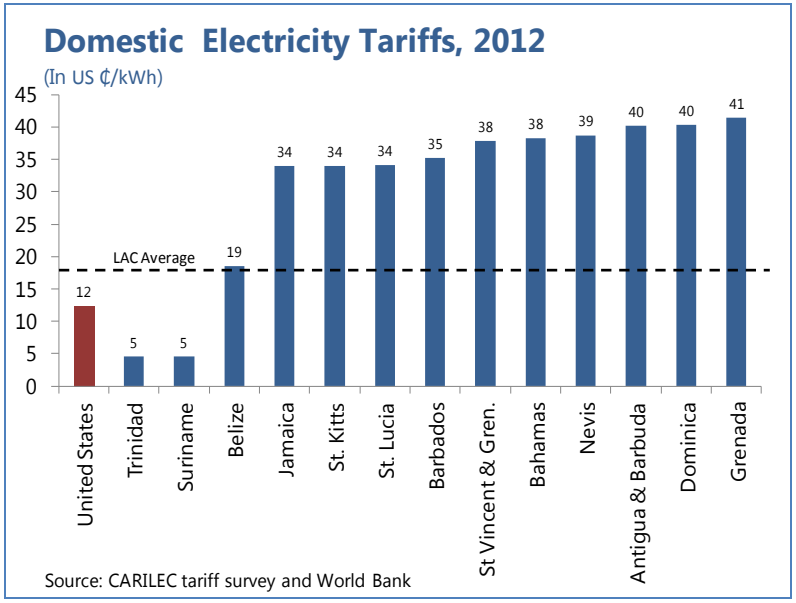
Executive Summary

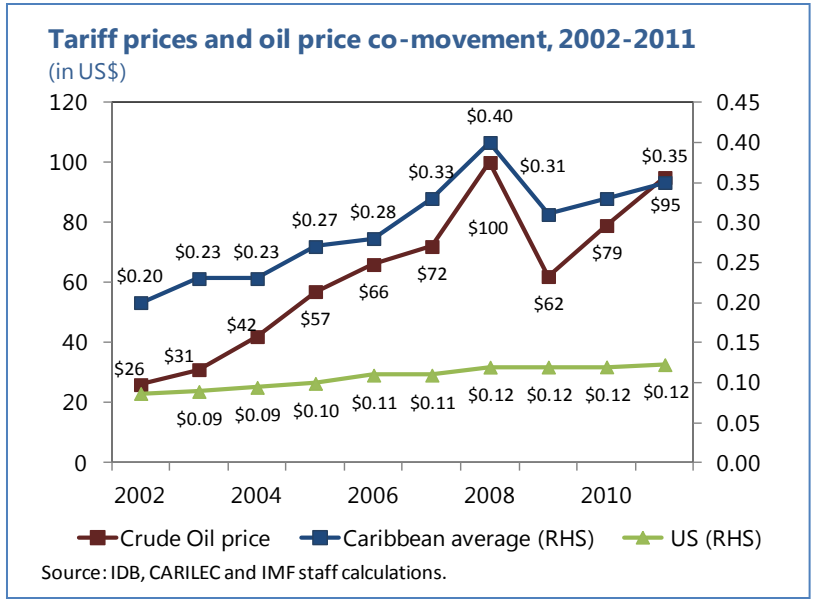
- Regional plans identify targets to diversify the generation mix and improve energy efficiency, yet the upfront investment cost associated with such plans can be quite substantial but feasible, with implications on fiscal and debt sustainability.
- We present IDB estimates of the magnitude of such investments and analyze the impact on debt sustainability under different investment scenarios in selected countries.
- Given the limited fiscal space in many of the Caribbean states, promoting private sector participation, including through Public-Private Partnerships, will prove critical to financing the sizable investment envelopes of these projects, although a strong institutional framework is required.
- Regulatory reforms remain among the low-hanging fruit to reduce energy costs, through facilitating the expansion of alternative energy sources and energy efficiency initiatives in the region.

II. Caribbean Energy Sector

Energy costs in the region are high despite the recent oil price decline

- ✓Over 2002-2012, average electricity tariffs in the region increased by almost 80 percent exceeding 0.34 US$/kWh for the bulk of the region in 2012, almost twice the LAC average (0.18 US$/kWh).
- ✓With the recent oil price decline, preliminary data indicate the electricity tariff currently hovers around 0.26 US$/kWh, still significantly higher than ROW.
- ✓Electricity tariffs and oil price movements are closely related, especially with oil price pass-through since 2005/6. In contrast, the US, with more diversified energy sources, has a lower and smoother electricity tariff path.



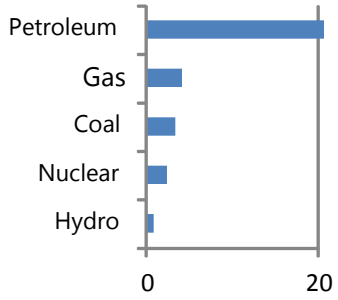


Overdependence on imported fossil fuels exposes the region to episodes of high and volatile oil prices

✓Petroleum is significantly more expensive than other sources of energy.
✓The region is highly dependent on this relatively expensive energy source, with 85 percent of primary energy consumed in the form of imported petroleum products.
✓In tourism-based economies, the most energy intensive users are hotels (commercial sector).

Electric Energy Production Costs in US, 2013

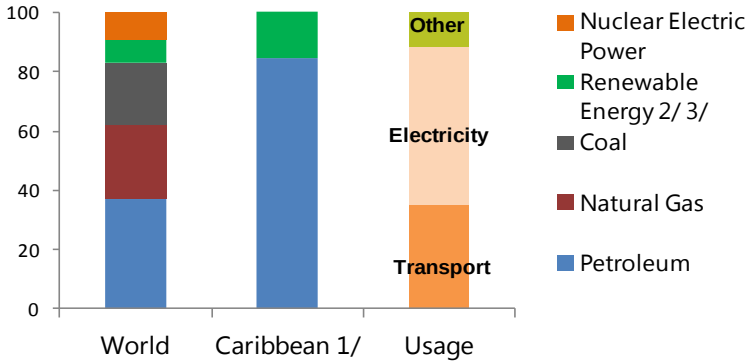
(In US cents/kWh)



Source: Nuclear Energy Institute

Primary Energy Consumption by Source and Use

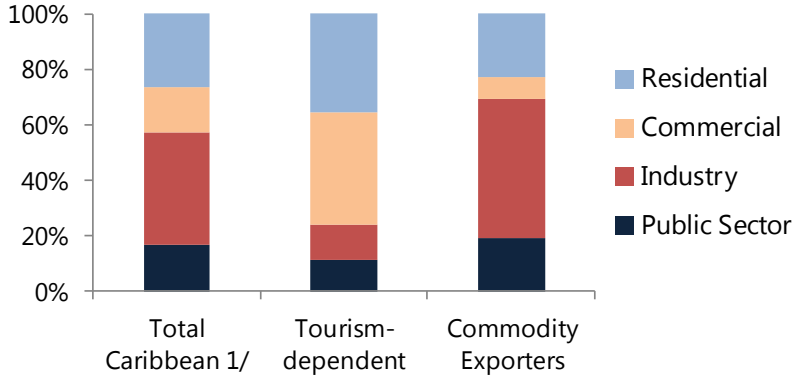
(In Percent of Total)



1/ Excludes T&T and Haiti
2/ Includes hydroelectric power, geothermal, solar/PV, wind, and biomass
3/ For the Caribbean, renewables include hydropower and biomass
Source: EIA; IDB: and IMF staff Caculations

Power Consumption in the Caribbean by Sector

(In Percent of Total)

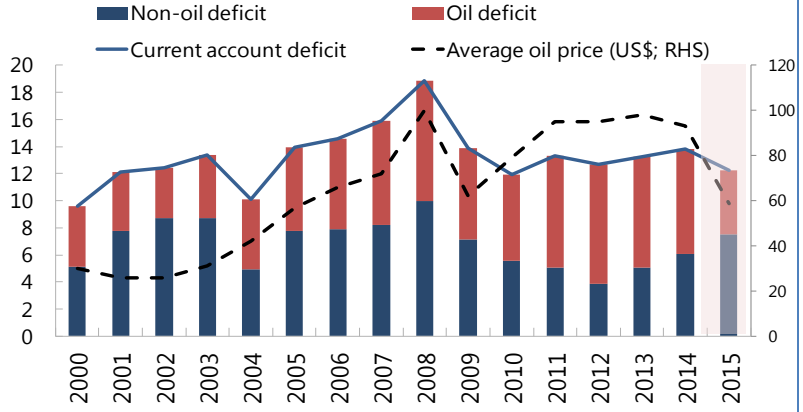


1/ excludes Trinidad and Tobago and Haiti
Source: IDB and IMF staff calculations

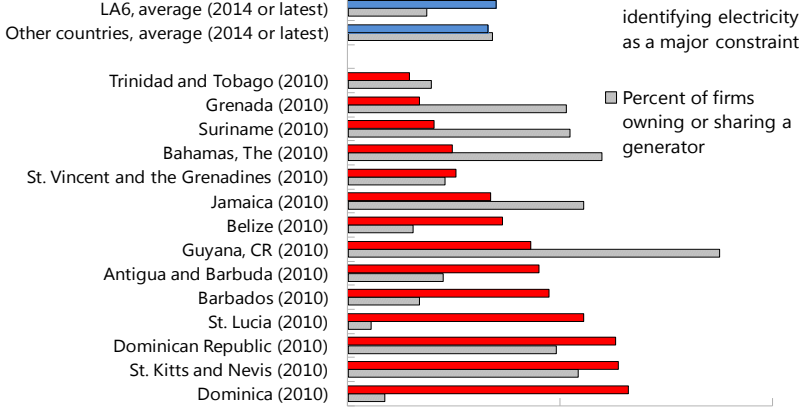
We examined macro impacts of oil price shocks

✓ Over 2005-2014, movements in oil prices increased external vulnerability: the oil trade deficit widened by an average of 3.7 percent of GDP annually for Caribbean economies compared to period prior to 2005. While in 2015, oil trade balance is projected to shrink by 3 percent of GDP with the oil price decline.

✓Fluctuating oil prices impacted the cost of doing business in the region: increase uncertainty of investment planning.



Sources: Country Authorities and IMF staff calculations.
1/ Excludes Trinidad and Tobago and Haiti.

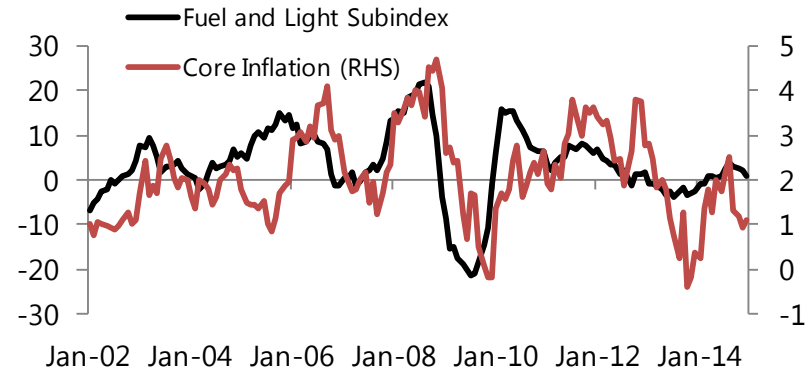


Sources: World Bank Enterprise Survey (2015), Fund staff calculations.

We examined macro impacts of oil price shocks

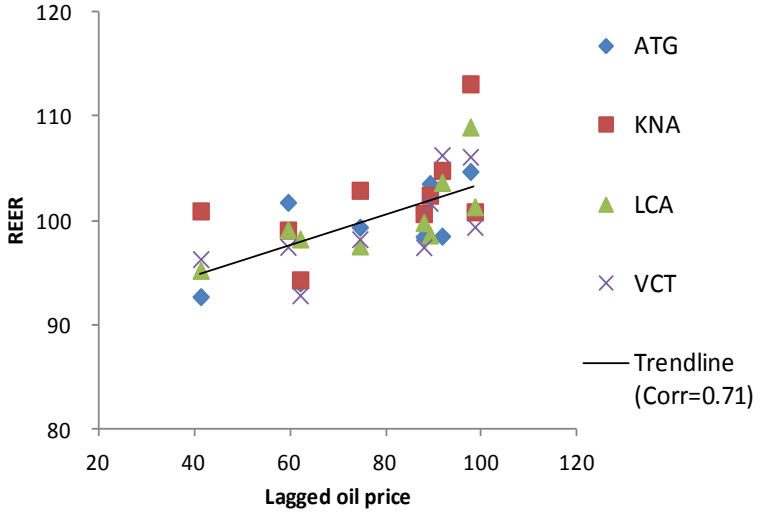
✓Oil price increases trigger inflationary episodes generating real exchange rate appreciation, with negative implications for competitiveness.

ECCU: Energy Price Volatility vs. Core Inflation 1/
(Y/Y change in percent)



1/core inflation excludes food and fuel; weights are based on St. Lucia consumption basket
Source: ECCB; IMF staff calculations

REER vs. One-year lagged Oil Price (2006-2014)



III. Macro-economic effects of oil prices and energy consumption efficiency

Quantitative Assessment: Strategy

In order to answer the question of how important is the impact of energy costs on growth and competitiveness, our approach was to examine the short-run and long-run.

- Short-run

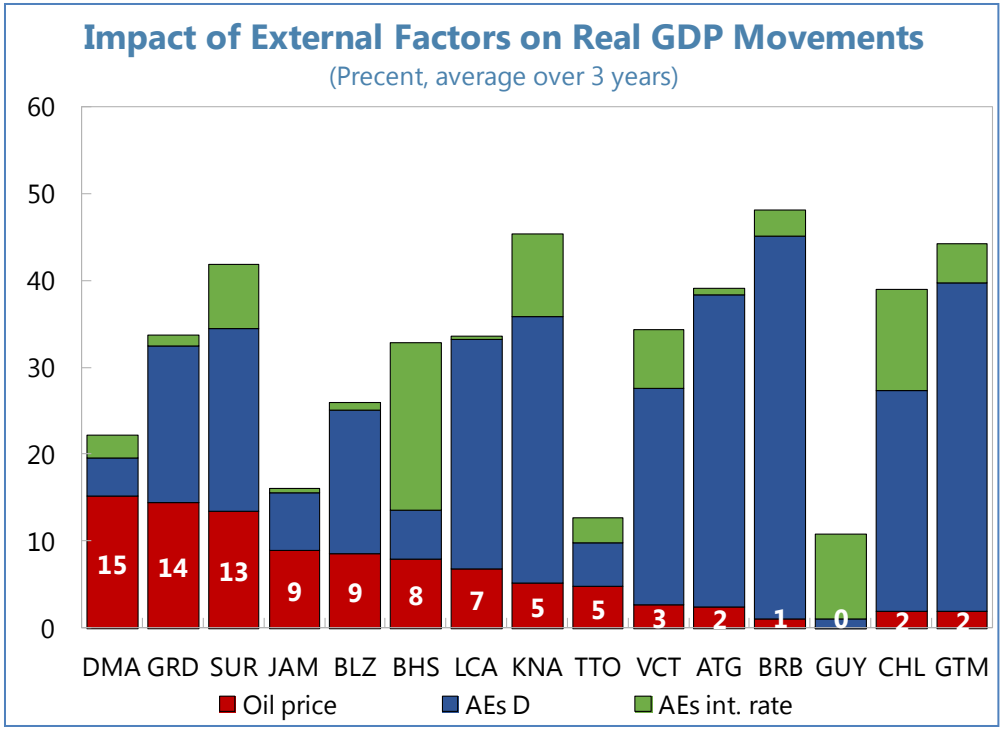
  Measuring the impact of higher oil prices on real GDP growth and REER of Caribbean economies in the short/medium-run.

- Long-run

  Since Caribbean countries are small open economies and are unable to influence oil prices. How can you contain energy cost and improve growth?
  ➔ Reducing the energy bill through increasing energy efficiency, on which you have some degree of influence. Therefore, we investigate the impact of energy efficiency on long-run GDP.

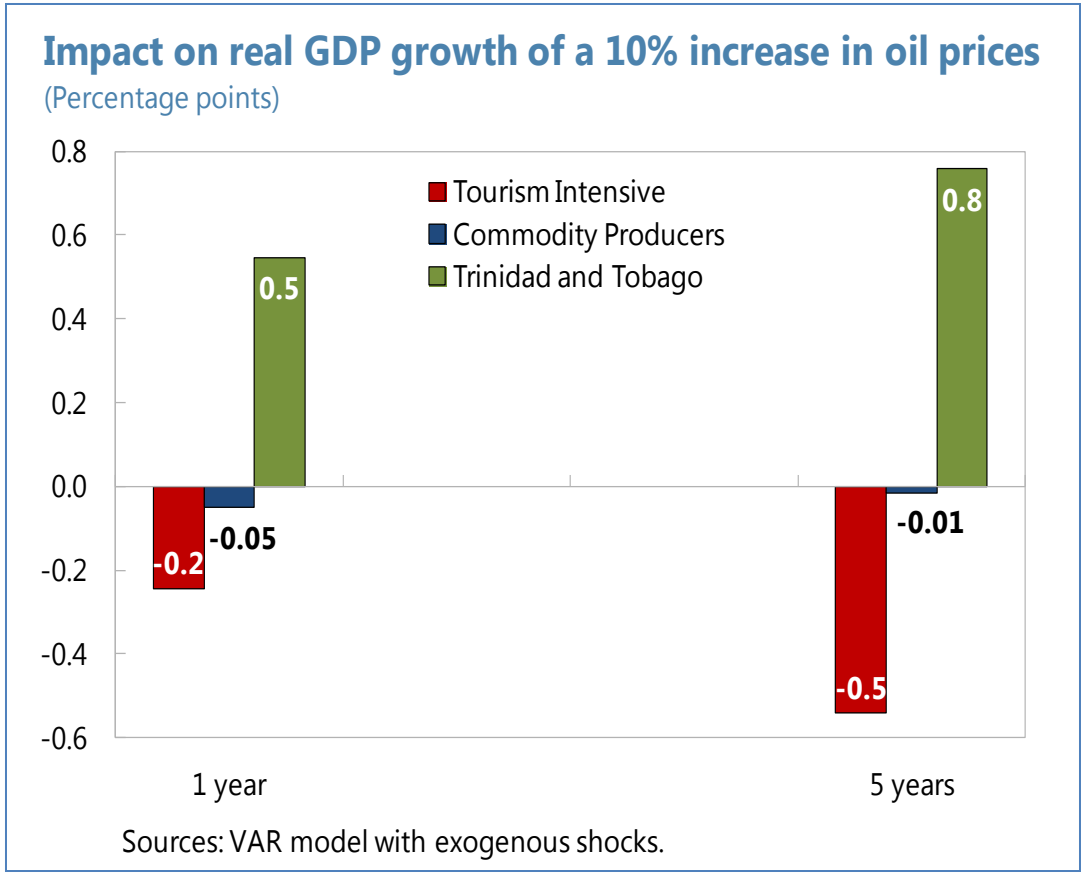
Quantitative Assessment: Short-run 1. Impact of External Factors

- ✓ Real oil price shocks explain on average 7 percent of real GDP growth variation, ranging from 15 percent in Dominica to less than 1 percent in Guyana
- ✓ Shocks from the external factors account on average for 30 percent of real GDP growth variation in the Caribbean
- ✓ The results are comparable to other Latin American countries such as Chile and Guatemala



Quantitative Assessment: Short-run 2. Oil Price Shock and GDP Growth

- ✓ An increase in oil prices (10%) has a negative impact on growth, particularly for tourism intensive economies; but a positive for TTO.

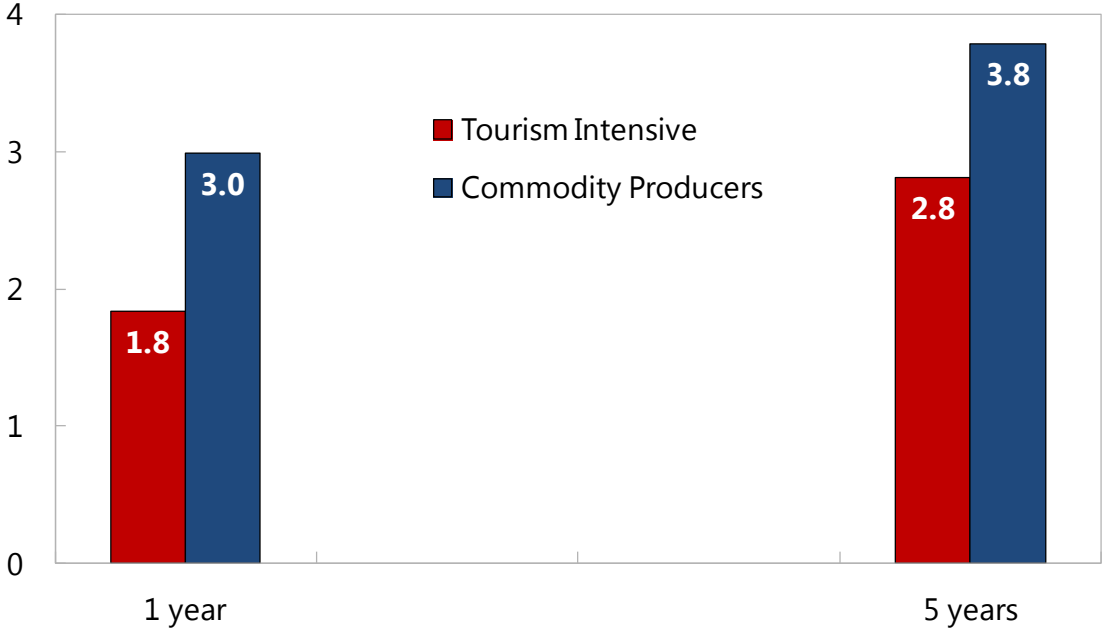


Quantitative Assessment: Short-run
3. Oil price shock and Real Exchange Rate

- ✓ Higher oil prices increase the rate of appreciation of REER for both tourism intensive economies and commodity producers

Impact of a 10% increase in oil prices on the rate of change of REER

(Percentage points)



Sources: VAR model with exogenous shocks.

Quantitative Assessment: Long-run

- ✓ Our results indicate energy consumption and efficiency, and fixed capital formation play a significant role in determining real GDP per capita over the long run
- ✓ In the long run, you will consume more energy to grow. But that means it is all the more important to contain the energy bill. To achieve that, you will need to improve energy efficiency.
- ✓ Importantly, we found that a 1 percent increase in energy efficiency leads to a 0.42 percent increase in long run GDP

Note: Higher energy efficiency means reducing energy consumption per unit of GDP.

Quantitative Assessment: Conclusions

- **Main conclusions:**

✓ While reducing energy costs is important to improve growth, it is not a panacea.

✓ The Caribbean needs to mitigate the impact of oil price changes on their economies, which countries cannot control.

- Thus, countries need to intensify their efforts to use energy more efficiently overall through:

  i) Reducing electric power costs by diversifying the power generation mix and;

  ii) Energy saving technologies on the consumption side

IV. Energy Sector Strategies

Regional Energy Plans

There is scope for energy reform to improve growth.

- Regional (CARICOM Energy Policy) and national energy plans embrace recommended energy strategies focusing on: regulatory reforms; diversifying the generation mix and improving energy efficiency.
- Building on the CARICOM Energy Policy (CEP), the Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS) was developed to provide CARICOM member states with a coherent strategy for transitioning to sustainable energy. The Roadmap sets specific regional energy targets for:
  - **Renewable power generation**: 20 percent renewable power capacity by 2017 (currently at about 15 percent), 28 percent by 2022 and 47 percent by 2027.
  - **Energy efficiency**: 33-percent reduction in energy intensity by 2027.
  - **CO2 emissions**: reductions of 18 percent by 2017, 32 percent by 2022, and 36 percent by 2027.
  - **Countries have national targets for renewable energy and energy efficiency that are aligned with regional targets**

Energy Sector Strategies

- Regulatory Reforms could contribute significantly. Regulatory reforms are needed to facilitate the expansion of alternative (cheaper) sources of energy, particularly renewable sources of energy in the region.
- Improving energy efficiency can generate significant gains in reducing energy costs.
- Diversify the generation mix through:
  - ✓ Exploring viable renewable energy technologies.
  - ✓ Diversifying through natural gas for countries when feasible.

Summary of Viable Renewable Energy Sources by Country

Country	Solar	Wind	Geothermal	Hydro	Biomass
Antigua and Barbuda	✓	✓			
Dominica	✓	✓	✓	✓	✓
Grenada		✓	✓	✓	✓
St. Kitts and Nevis	✓	✓	✓		✓
St. Lucia	✓	✓	✓		✓
St. Vincent and the Grens.	✓	✓	✓	✓	✓
Bahamas		✓			✓
Barbados	✓	✓			✓
Guyana				✓	✓
Haiti	✓			✓	✓
Jamaica	✓	✓	✓	✓	✓
Suriname				✓	✓

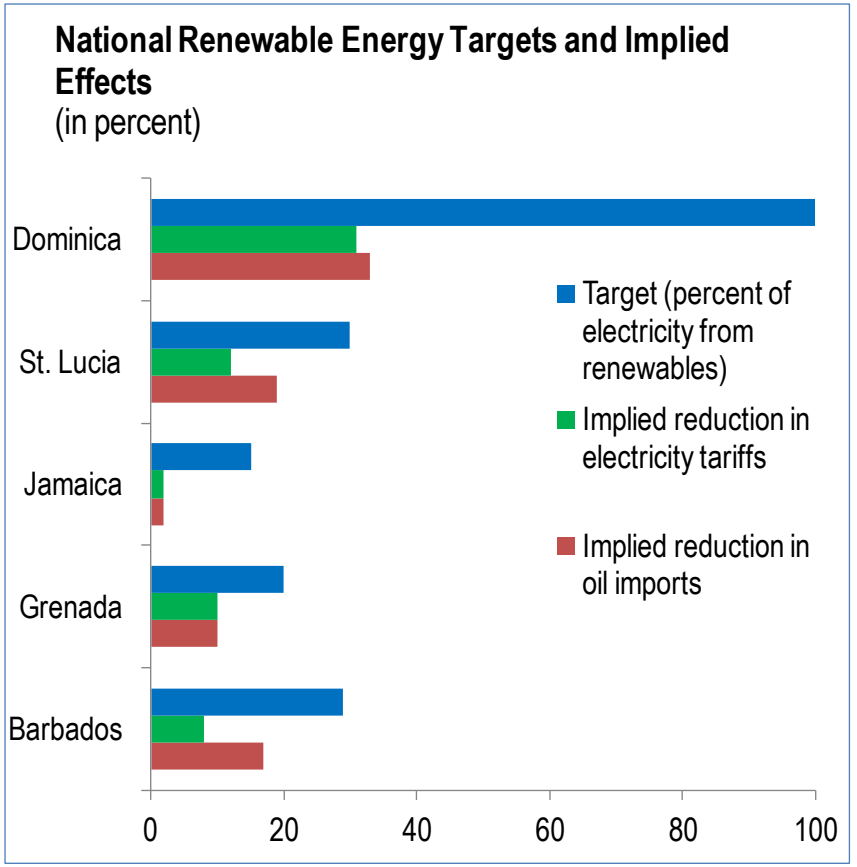
Source: CARICOM Caribbean Sustainable Energy Roadmap

We examined the appropriateness of the strategies and associated targets; our results indicate the impacts of achieving the targets are significant

Targets

Country	Renewable Energy Supply	Electricity from Renewables	Transport
Antigua and Barbuda		5% by 2015; 10% by 2020; 15% by 2030	Improve transport efficiency 40% in 15 years
The Bahamas		15% by 2020; 30% by 2030	Achieve fuel economy of 30– 35 mpg for 70% of vehicles in 5–10 years
Barbados	10% by 2012; 20% by 2026	29% increase by 2029	
Belize	Reduce fossil fuel dependence 50% by 2020		
Dominica		25% by 2010; 100% through the addition of geothermal (no date given)	
Grenada	20% by 2020	10% by 2013 (Grenada); 20% by 2017 (Grenada); 40% by 2011 (Carriacou and Petite Martinique);100% by 2030 (no date given)	
Guyana		90% through hydro development Install 15,000 solar home systems (no date given)	
Jamaica	30% by 2030	15% by 2020	
St. Lucia	20% by 2020	5% by 2013; 15% by 2015 30% by 2020	
St. Kitts and Nevis		20% by 2015	Reduce fossil fuel consumption 15% by 2015
St. Vincent and the Grenadines		30% by 2015 60% by 2020	Reduce fossil fuel consumption 10% by 2015 and 15% by 2020
Trinidad and Tobago		5% of peak demand (or 60 MW) by 2020	Convert 20% of all 500,000 vehicles to CNG by 2015; Reduce the sector's CO2 emissions by 10–15% (no date given)

Examples of Economic Impacts



Note: Implied reduction in oil imports is calculated based on the composition of generation mix and current import value. With the base load needed for generation, the actual reduction in oil imports could be smaller. The electricity tariffs are estimated by the cost of renewable generation mix.

V. Energy Sector Investments and Public Debt Sustainability

Supplying more energy at reduced costs will require significant investments in the energy sector

✓Diversification of energy mix requires investments in technology, power plant conversion, and upgrading together with investment in renewables.

✓Investment needs is estimated between 3.5% and 12% of GDP for Caribbean countries.

The Caribbean: Energy Investments Needs (in millions of USD)

	Private Investment[1]	Public Investment[2]	Total Investment	Total Investment (%GDP)[3]
The Bahamas	441	70	511	6.0
Barbados	324	115	439	10.1
Belize	59	-	59	3.5
Jamaica	720	140	860	6.3
Suriname	288	90	378	7.8
ECCU[4]	0	0	379	8.6
Antigua & Barbuda	-	-	-	
Dominica	-	-	52	9.9
Grenada	-	-	87.5	9.6
St. Kitts and Nevis	-	-	86.5	10.2
St. Lucia	-	-	66	4.7
St. Vincent & Gr.	-	-	87	11.9
Region Total	2062	1255	2626	8.2

Source: IDB.

1/ Includes estimated costs of converting existing plants to natural gas, building and upgrading power plants, regasification facilities, and wind and waste-to-energy renewables investments.

2/ Includes some renewable investments which also could be done by the private sector.

3/ 2014 data.

4/ Includes estimates only for 10MW Geothermal energy.

Energy Investments and Debt Sustainability: model

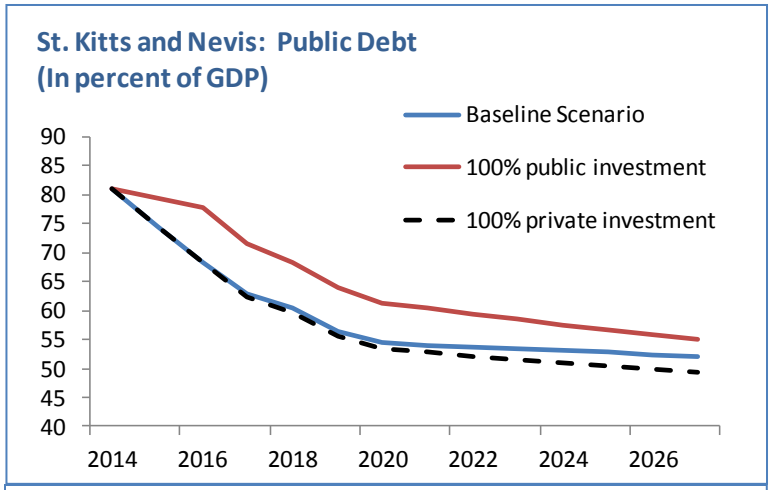
We gauged the impact of large investments in energy on debt sustainability taking into account the investment effects on short- and long-term growth.

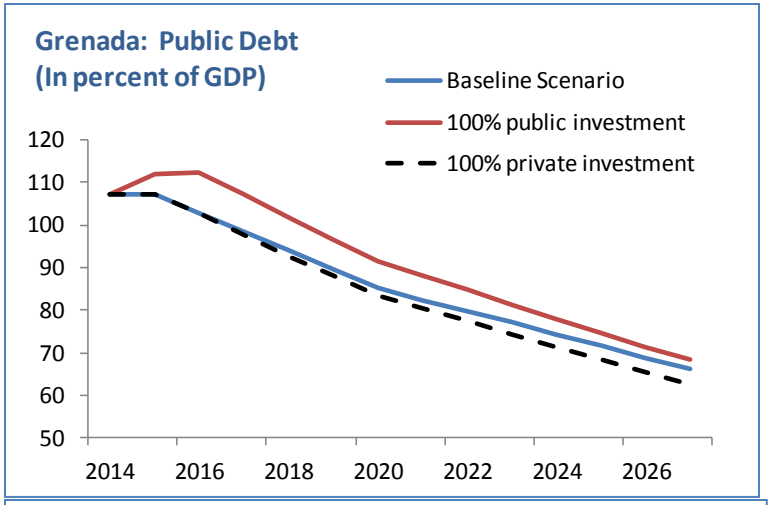
- Two financing scenarios for investments in energy:
  1) Government does 100% of the investment,
  2) 100% Private investment
- For the short term impact of the actual investment on growth (over 3 years), we assume elasticity of output to public investment of 0.15 as in Gupta, Kangar, Papageorgiou and Wane (2011).
- We estimate the impact of lower energy cost on GDP growth in the long run as equivalent to an improvement in energy efficiency (lower energy consumption for the same output) as follows:
  - We assume that electric power generation efficiency improves by 20% (equivalent to 10% improvement in overall energy efficiency in the economy).
  - GDP will increase by 4.2 percent at the end of the 10 years compared to the level without 20% improvement in energy efficiency.

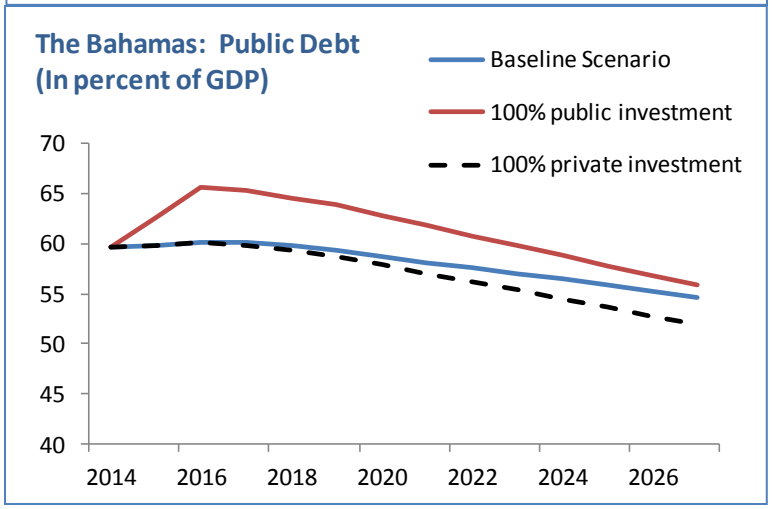
Energy Investments and Debt Sustainability: results

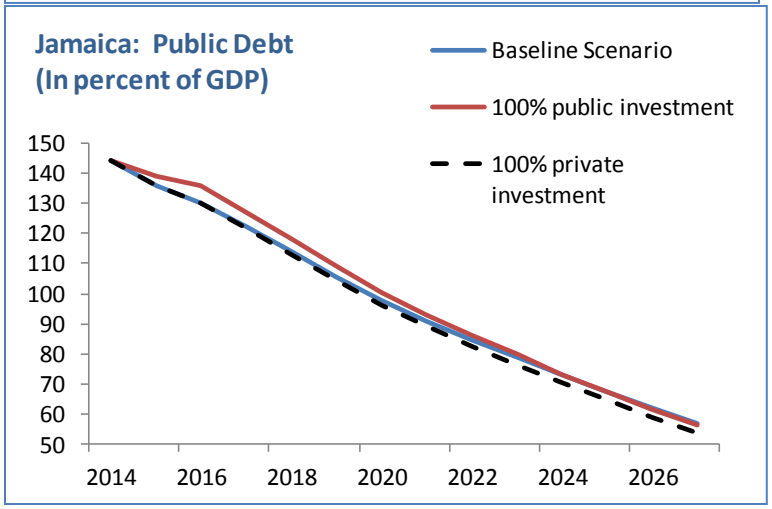
Taking into account the investment effects on growth, the debt dynamics does not materially alter the public debt trajectory of countries with sustainable debt dynamics: public debt-to-GDP ratio rises by about 2 pp compared to the baseline by 2027, and is about the same by 2027 if the government finances 50% of total investment and private sector undertakes the rest.

Assuming 20% improvement in power generation and transmission







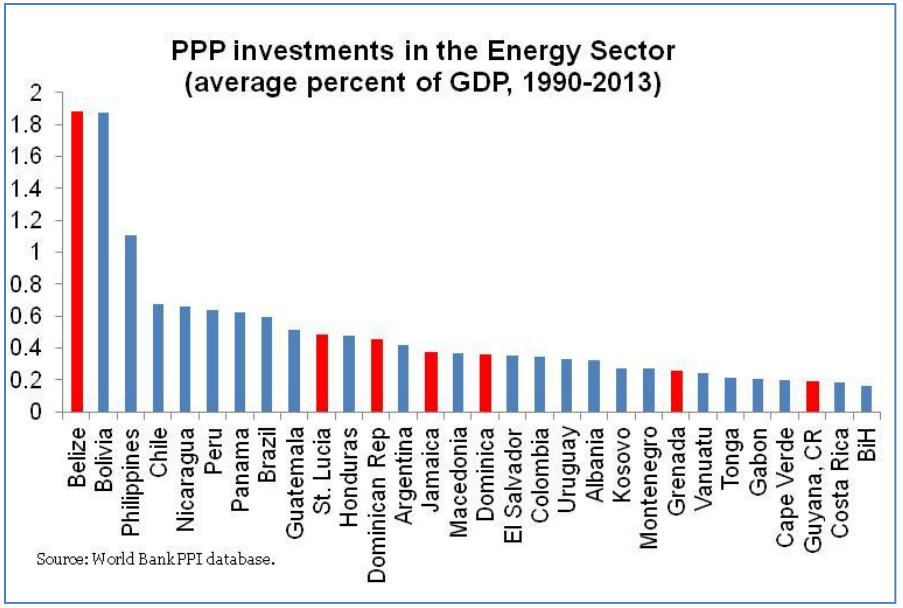


Private Sector participation provides a solution to sizable energy investment needs

- Public investments in energy sector are hindered by the high public debt load and unfavorable debt dynamics in some countries.

- Energy sector PPPs can be further developed in the Caribbean

- However,
  - PPPs can generate significant risks to the government; and
  - PPPs require a strong institutional and operational framework.



Thank you!

Additional Slides

Quantitative Assessment: Short-run

- Measuring the impact of higher oil prices on macro-performance of Caribbean economies in the short/medium-run:
  - ✓ We use country-specific vector autoregressive (VAR) model with block exogeneity restrictions.
  - ✓ We replicate spillovers literature: Cashin, P., and Sosa, S., 2013, Macroeconomic fluctuations in the Eastern Caribbean: The role of climatic and external shocks, The Journal of International Trade & Economic Development: An International and Comparative Review, 22:5, 729-748, and Osterholm, P., and Zettelmeyer, J., 2008, The effect of external conditions on growth in Latin America, IMF Staff Papers, Vol. 55, No. 4, pp. 595-623.
- **The model:**

✓ We use country-specific vector autoregressive (VAR) model with block exogeneity restrictions:

- ✓ an external block including foreign economic variables – the real oil price growth rate, advanced economies real GDP growth rates, and the advanced economies real interest rate;
- ✓ a domestic economy block - including real GDP growth rates and the real effective exchange rate (REER) growth rates.
- ✓ The specification of the model incorporates the small open economy assumption that foreign variables are exogenous to the domestic economy.
- ✓ The sample comprises the following economies: Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.
- ✓ For the purpose of the analysis, two groups of countries are formed: Group 1 includes tourism-dependent economies and comprise the ECCU , Bahamas and Barbados; Group 2 includes commodity producers and comprise the rest of our sample. Given that Trinidad and Tobago is the only net exporter of oil, we present separately the results for the country.
- ✓ The model is estimated using annual data from 1976 through 2013.

Quantitative Assessment: Long-run

- **Motivation**: The short run quantitative assessment shows that oil price shock has a significant impact on output and external competitiveness that requires an energy policy to mitigate these undesirable effects. Small open economies the Caribbean cannot control exogenous external shocks such as international oil prices. They can only reduce the quantity of imported fuel, by promoting more efficient use of energy and increasing domestic production of energy. Looking into the long-run relationship between growth and energy can provide recommendations regarding the appropriate energy policies.

- **The model:** Study the importance of energy consumption and efficiency on growth

- ✓ We use dynamic heterogeneous panel cointegration:

The model is based on Stern and Kander (2011) and Gaël and Kahraman (2014) and introduce energy as an input in the growth function. The long run relationship is:

$$y_t = \beta'_1 c_t + \beta'_2 e_{t-1} + \beta'_3 k_t + + \alpha_t + \varepsilon_i$$

where ***y*** is the logarithm of GDP per capita, ***c*** the logarithm of energy consumption per capita, ***e*** the logarithm for energy efficiency, and ***k*** the logarithm of gross capital formation per capita.

1/ Stern, David and Astrid Kander (2012) The Role of Energy in the Industrial Revolution and Modern Economic Growth, The Energy Journal, 2012, vol. Volume 33, issue Number 3.

2/Gaël, G. and Z. Kahraman (2014) "How Dependent Is Growth From Primary Energy? Output Energy Elasticity in 50 Countries," manuscript.

Note: The long-run model is estimated using annual data from 1980 through 2011.

Quantitative Assessment: Long-run Vector Error Correction Model (VECM)

- **The results:**
  - ✓ Our results indicate that a 1 percent increase in energy consumption leads to a 0.38 percent increase in long run GDP; and 1 percent increase in energy efficiency leads to a 0.38 percent increase in long run GDP. Similarly, a 1 percent increase in gross capital formation leads to a 0.25 percent increase in long run GDP.
  - ✓ Convergence (ECM) is achieved in the following countries: Belize, Grenada, Guyana. Weak convergence indicates too much heterogeneity across countries.
  - ✓ The results are comparable to related studies on OECD and Asian economies.

	Long-term elasticities
Energy Consumption Per Capita (c)	0.38 ***
Energy Efficiency (e)	0.42 ***
Gross Capital Formation Per Capita (k)	0.25 **

Notes: Energy consumption per capita is total energy consumption divided by population;
Energy efficiency is real GDP divided by total energy consumption
The long-run model is estimated using annual data from 1980 through 2011.