

Is hydropower still a good option for the Caribbean Region?

16th Annual Energy Caribbean Conference
Port of Spain, 2016 October 12

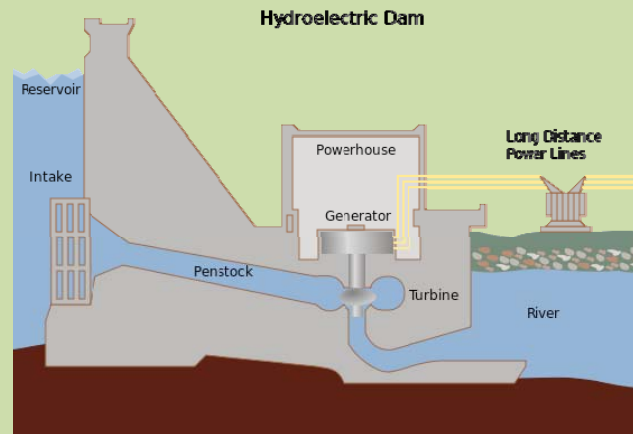
Donald Baldeosingh, President ENMAN Group

Some considerations

- Regional Hydropower resources
- Hydropower in the world of energy
- Renewable energy and carbon emissions in the Caribbean
- Hydropower in an integrated energy market
- Barriers and challenges
- Opportunities



Hydropower Plant design



Cross-section of a conventional hydroelectric dam (Source, Wikipedia.com)



The Energy Trilemma

Energy Security

- Long term stable supply
- Best possible price

- Energy prices
- Infrastructure cost

- Energy conservation
- Energy efficiency
- Clean and low carbon energy sources

Economic Competitiveness

Environmental Sustainability

Economic advantage

- Manufacturing and Hotel costs
- Tourism friendly
- Access to funding
- Sustainable jobs
- Foreign Direct Investment

Environmental

- Positive action on climate change
- COP21 Targets
- RE Targets
- SIDS issues

NATIONAL UNIVERSITY OF SINGAPORE
<http://www.eng.nus.edu.sg/EResnews/062014/sf3.html>

UN Sustainable Development Goals



Sustainability

Sustainability is the ability to continue a defined behavior indefinitely.

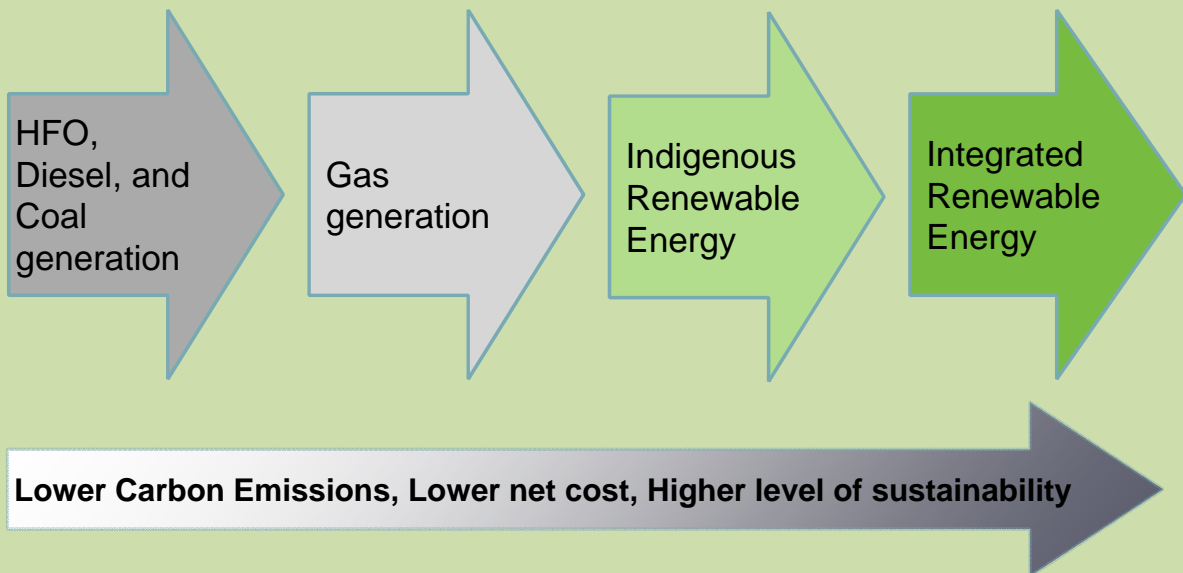
Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

X

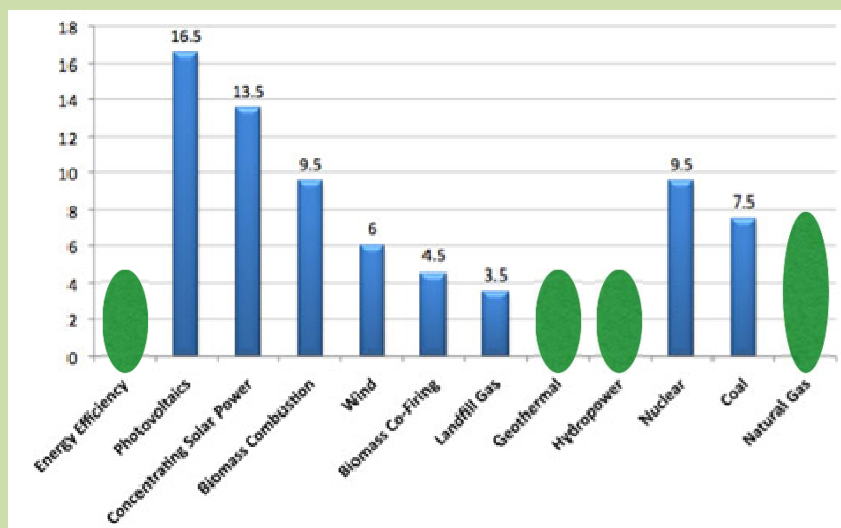
Consider planning to meet the needs of the future generations by the actions we take today



Regional Energy Progression



Levelised cost of power



LEVELIZED COST OF ELECTRICITY FOR VARIOUS POWER AND ENERGY EFFICIENCY OPTIONS, ¢/KWH
— National Hydropower Association

REGIONAL INTEGRATED POWER SYSTEM



Caribbean Undersea and Overland connection



Delivering cleanest and best priced power to main demand centres in the region
Many Territories become net exporters of energy

Hydropower in the world

World installed hydropower capacity at the end of 2015:
1,211 GW (including 145 GW pumped storage)

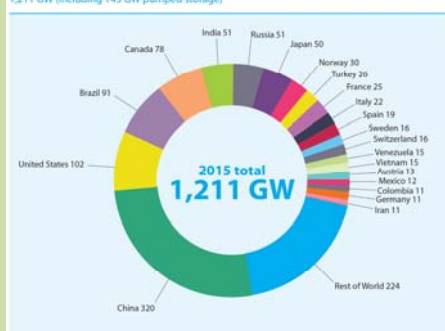


Figure 2: Global total of installed hydropower capacity (GW) by country at the end of 2015, including pumped storage

Hydropower drives regional interconnections Large-scale hydro often produces more power than is required to meet current national demand.

Therefore, regional interconnections are essential to make projects financially viable.

Many cross-border projects reached milestones in 2015, including: stations commissioned along the Turkey–Georgia border that utilise the recently completed Black Sea transmission line; the Dagachhu station in Bhutan, which will export power to India; further development of Laotian hydro resources for export to Thailand; a transmission line between Malaysia and Indonesia linking Sarawak hydropower with West Kalimantan; and plans for a USD 1.6 billion Northern Pass USA–Canada interconnection to meet growing demand for affordable clean energy in the USA.

International Hydropower Association

Caribbean hydropower picture - in brief

Rank	Country	Installed hydropower capacity (MW)*	Theoretical potential
1	Dominican Republic	543	~1000
2	Suriname	189	7987
3	Jamaica	23	80
4	St. Vincent and the Grenadines	7	5 to 10
5	Dominica	6	17
6	Guyana	1	7000

(International Hydropower Association, 2016)

*Includes pumped storage

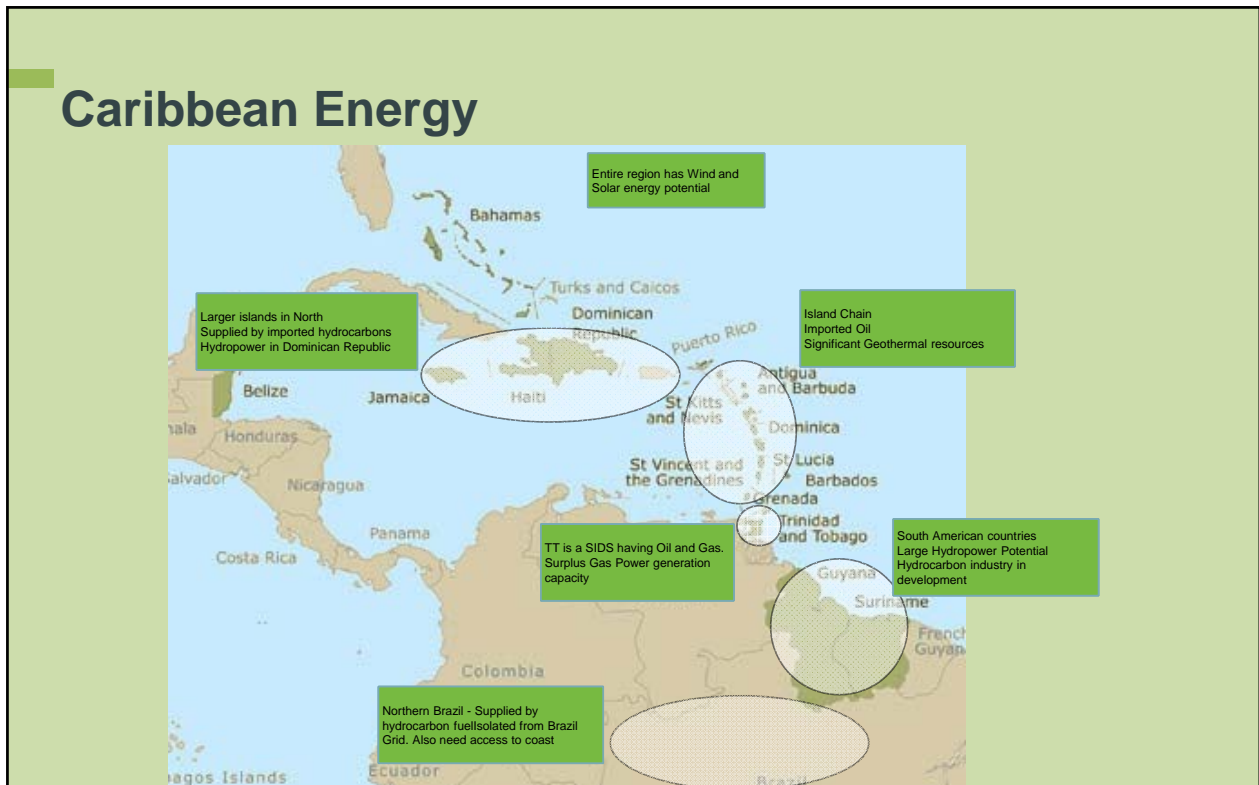


Suriname and Guyana Hydropower

- **Suriname** has 7987 MW of Theoretical hydropower and 2419 MW of Technical (i.e. expected feasible) capacity according to Johan Geeraert (2010)
 - Currently has 189 MW of available hydropower capacity
 - The Kabalebo site can produce 850MW in two phases
- **Guyana** has hydropower potential of 7000MW according to a 1976 UNDP report. None is currently developed
 - ENMAN has extensively studied the Turtruba site on the Mazaruni River in Guyana and determined that 800MW capacity is viable from the site
- Large scale hydropower is an attractive solution for the region. The main issue has been to have an immediate market for these capital intensive projects



Caribbean Energy

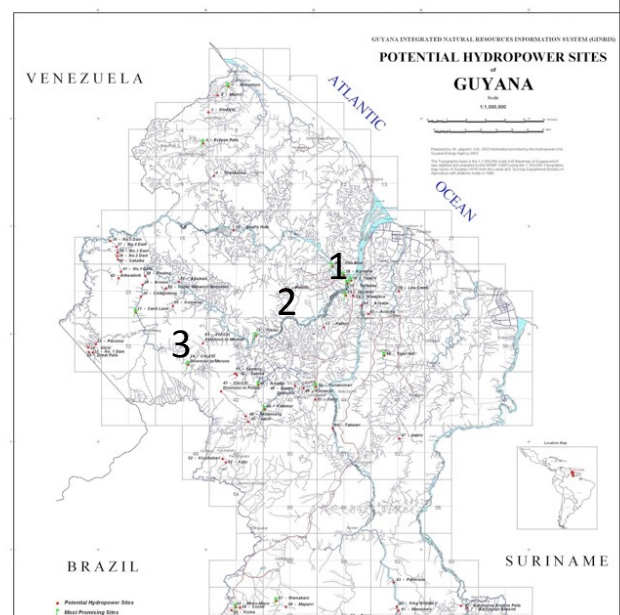


Guyana Hydropower Project



Mazaruni Basin Hydropower Plant Locations

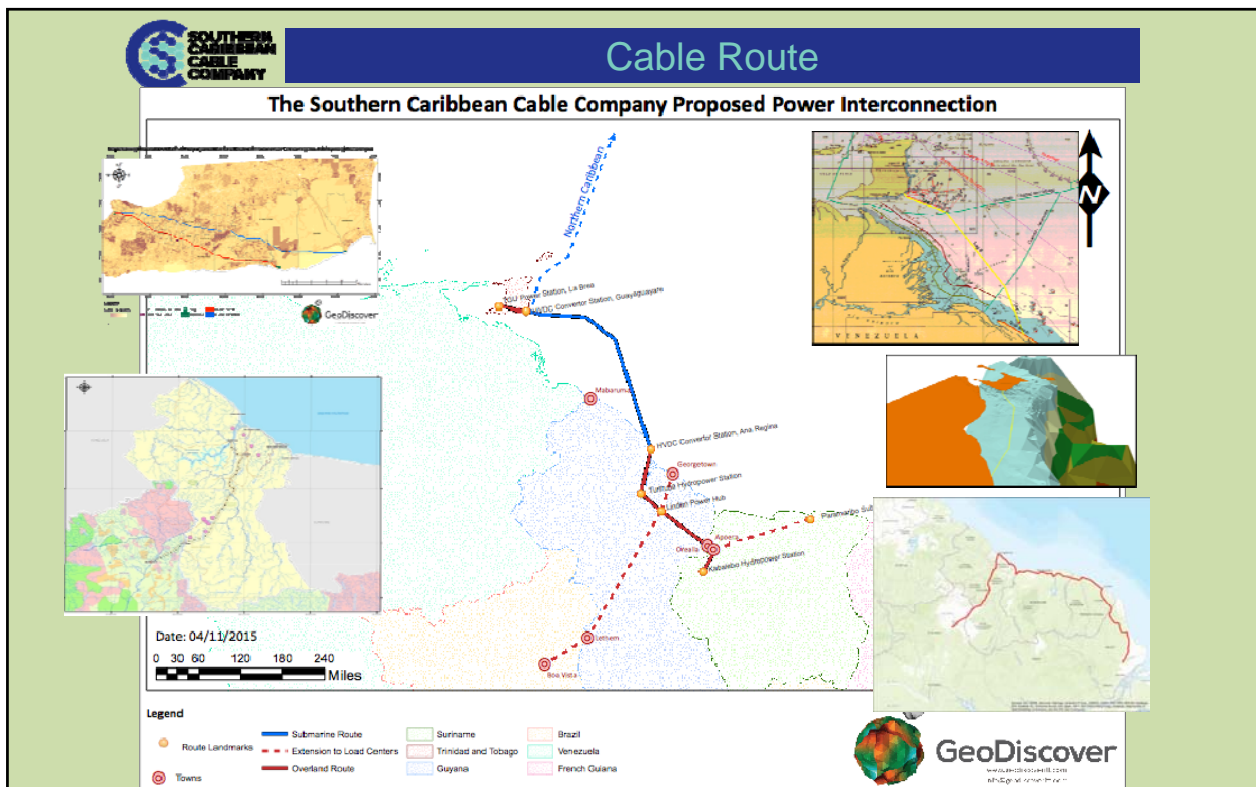
- The 800MW site is at the Marshall Falls near the Turtruba Rapids the Mazaruni River just upstream of Bartica.
- When this is built, the Tiboku site, further upstream is opened for approximately 300MW.
- This finally opens the Upper Mazaruni where 2000+MW is achievable.
- Therefore the potential of the complete development is 3000MW.
- The Turtruba site is navigable by river from the coast which will assist in the transportation to the site
- There is a large quarry in very close proximity for supply of aggregate material
- The town of Bartica is also close by and consultations have taken place with officials regarding the opportunities for residents and businessmen
- Less than 1200 persons either live or work in



Hydropower and The Southern Caribbean Cable Project

- The establishment of large hydropower plants in Suriname and Guyana will significantly improve energy security and the cost of power in the region
- It is close to impossible to finance such a venture in the absence of a power interconnection
- Power will be available for the national grid, the new industries such as the smelter and the balance will be exported on the power cable
- Gas generated power will remain connected to the system for peak demand and improved reliability. Hence TT will get best value for the gas generated power

Kabalebo Hydropower project in Suriname ~ 850MW in two phases
 Turturuba Hydropower project in Guyana ~ 800MW
 CAPEX for either project ~ US\$2Bn
 Construction period ~ 5 - 8 years



Arco Norte



ARCO NORTE
ELECTRICAL INTERCONNECTION
STUDY
Inter-American
Development Bank
Sylvia Larrea, Silvio Binato,
Dario Provenzano, and Carlos Jeifetz



Gas saved from injection of hydropower in Trinidad & Tobago (Source TTCIC)

Trillion Cubic Feet (TCF) of Gas Saved

Power, MW	Daily Gas,MMCFD	PPA, Years			
		25	50	75	100
500	80	0.7	1.5	2.2	2.9
1000	160	1.5	2.9	4.4	5.8

Million TT\$ saved

Power, MW	Daily Gas,MMCFD	Value of Gas, US\$/MMBTU			
		1	2	3	4
500	80	190	380	570	760
1000	160	380	760	1140	1520

Gas Reserves to be freed up from power generation ~ 3 TCF
 Cost of adding 3TCF of gas reserves ~ US\$3 Bn
 Reduction in annual subsidy on power cost ~ US\$155M

Barriers and challenges

- Market size and geographical spread
- Environmental and social impacts
- Financing - ensuring economically viable projects
- Current lower oil price and Petro Caribe
- Inertia of Governments... and Regional Agencies!
- Difficulty in negotiating multilateral agreements
- Uncertainty associated with a major change in thinking and operation
- Hydrocarbon dominance

Opportunities

- Start with the bigger markets
- Work with other current initiatives
- Bilateral initiative
- Focus on high upside, low downside
- Private sector led in partnership with Governments,
- Not depending on the regional agencies
- And Financially viable



Thank you!

Q &
A

ENMAN Group

“Doing good while doing well.”

- Southern Caribbean Cable
- Guyana Hydropower Project
- Carbon Zero Initiative of
Trinidad & Tobago (CZITT)
- Engineered Wetlands solutions

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