Guyana Hydropower Project

Project Presentation

Donald Baldeosingh
ENMAN Services Ltd

2011 April 12

ENMAN Group

- ENMAN Services Ltd
  - Engineering based Solutions
  - Design & Field Activities - Electrical/Instrument/Mechanical/Energy Management
  - Consultancy, Training, Technical support
  - Project Development - Guyana Hydropower & related projects
- GAMMA Components & Systems Ltd
  - Product based Solutions
  - Petrochemicals/Power Generation/Heavy Industries
- ENMAN Technology Applications Ltd
  - Information & Communication Technology business development
  - Interactive White Boards/21st Century Training
- Caribbean Information Television Ltd
  - Digital Signage
  - Production and deployment of health related video content at medical centres
- MAINMAN Services Ltd
  - Specialised Maintenance services onshore/offshore
- First Forum International Ltd
  - International Training and Conferences

Guyana Hydropower Project

- ENMAN Services Ltd have been studying regional energy problems in the global context for several years
- Considered also the recent record oil prices and the need for local action on Global Climate Change
- Reviewed the available resources for renewable energy
- Determined that Guyana hydropower presents the best option, and
- Turtruba site on the Mazaruni is by far the best location considering power potential, accessibility, manageable impacts, power price and proximity to target markets
- ENMAN entered into an agreement with the Government of Guyana for this development
- Developed the concept for a **800MW** hydropower plant as Phase 1, and **300-500MW** of combined Wind/Hydro as Phase 2
- Clean, reliable, affordable, independent of oil price
- World Bank plus environmental standards

Developers

- **ENMAN Services Ltd of Trinidad & Tobago**

  Technical arm of ENMAN Group, Caribbean based group in Engineering, Project Management, Marketing, ICT systems, Digital Signage, Training

  - **Donald Baldeosingh** MSc Engineering, Former Chairman Petroleum Company of Trinidad & Tobago, Former Member Industry Advisory Board ASME
  - Eur Ing **Aldwyn Lequay** HBM BSc FIEE FIMechE FASME FAPETT, Former Chairman National Training Board, Board of Engineering, Past Deputy Chairman Trinidad & Tobago Electricity Commission, Port Authority
  - **Darryl Mohan** MBA, Group Business Development Manager

- **Hardy Stevenson & Associates, Toronto Canada**

  Consultants in Energy, Infrastructure, Environmental & Social Impacts, Public Consultation

  - **David Hardy** RPP MES Former Coordinator - President & Chairman's Office, Ontario Hydro
  - **Ian London** MBA Former President, Ontario Hydro International
  - **Yuri Huminilowycz** Former VP, Ontario Hydro Networks
  - **Alastair Wilson** Former Director of Hydropower Resources, Ontario Hydro

- **Legal Advisors Venable, Washington DC, USA**

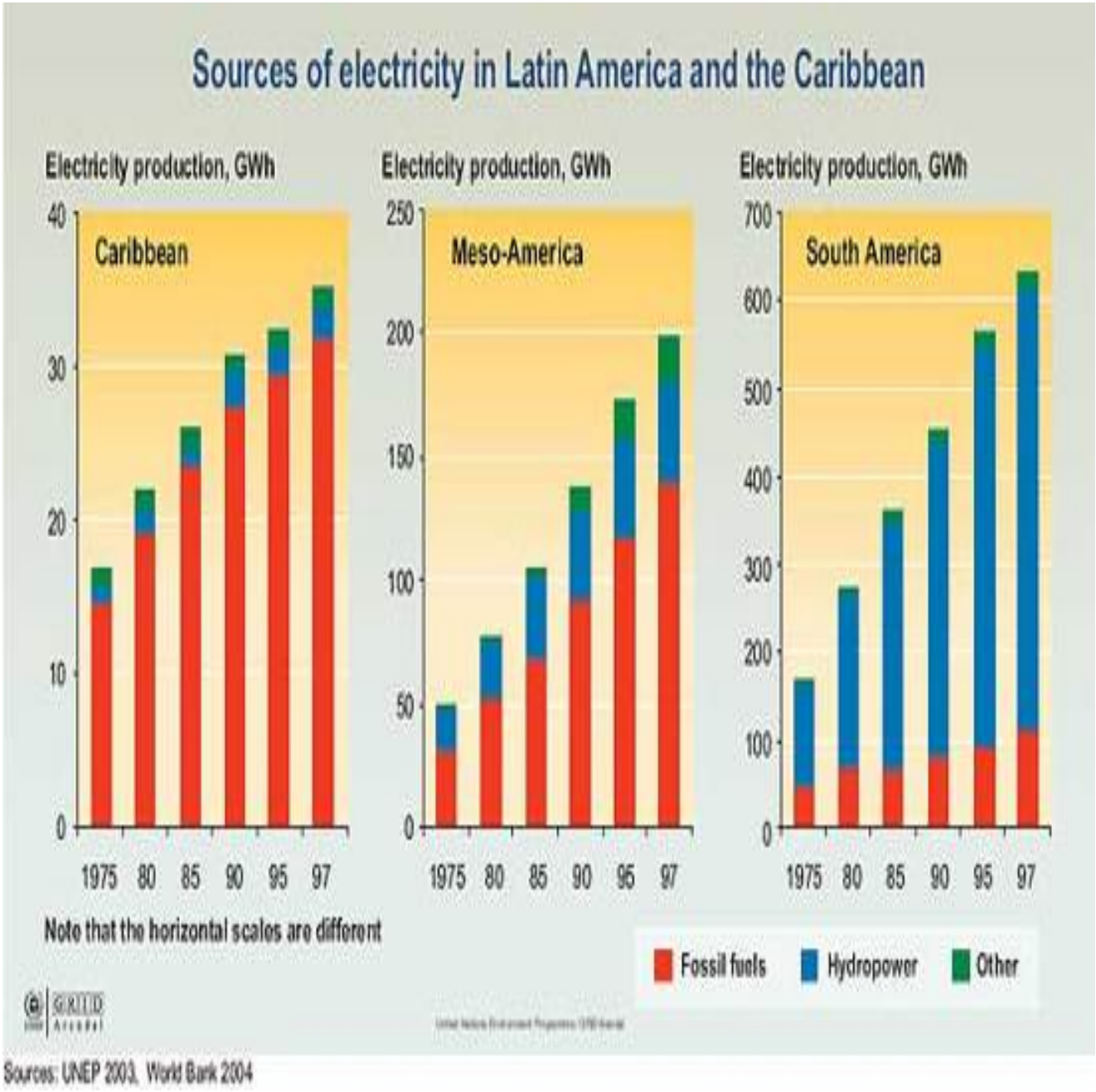
Project Executive Summary

- The Guyana Hydropower Project involves the design, finance, construction & operation of a large Hydroelectric Power Plant in Guyana, and associated Power Transmission with integral fibre optic communication
- The partners have completed a Pre Feasibility and other studies which prove that 800MW is achievable, possibly extending to 3000MW in phases
- The power can be sold within Guyana, to Brazil to the South, and/or Trinidad & Tobago via a submarine cable system
- The first leg of this development can be between Trinidad and Guyana
- Power can be directed from Trinidad to new industrial projects in Guyana, creating significant opportunities for TT investors and providers of services
- Products can be brought to TT for downstream processing
- Phase 1 will cost approximately US$250M and the final project value can exceed US$10B

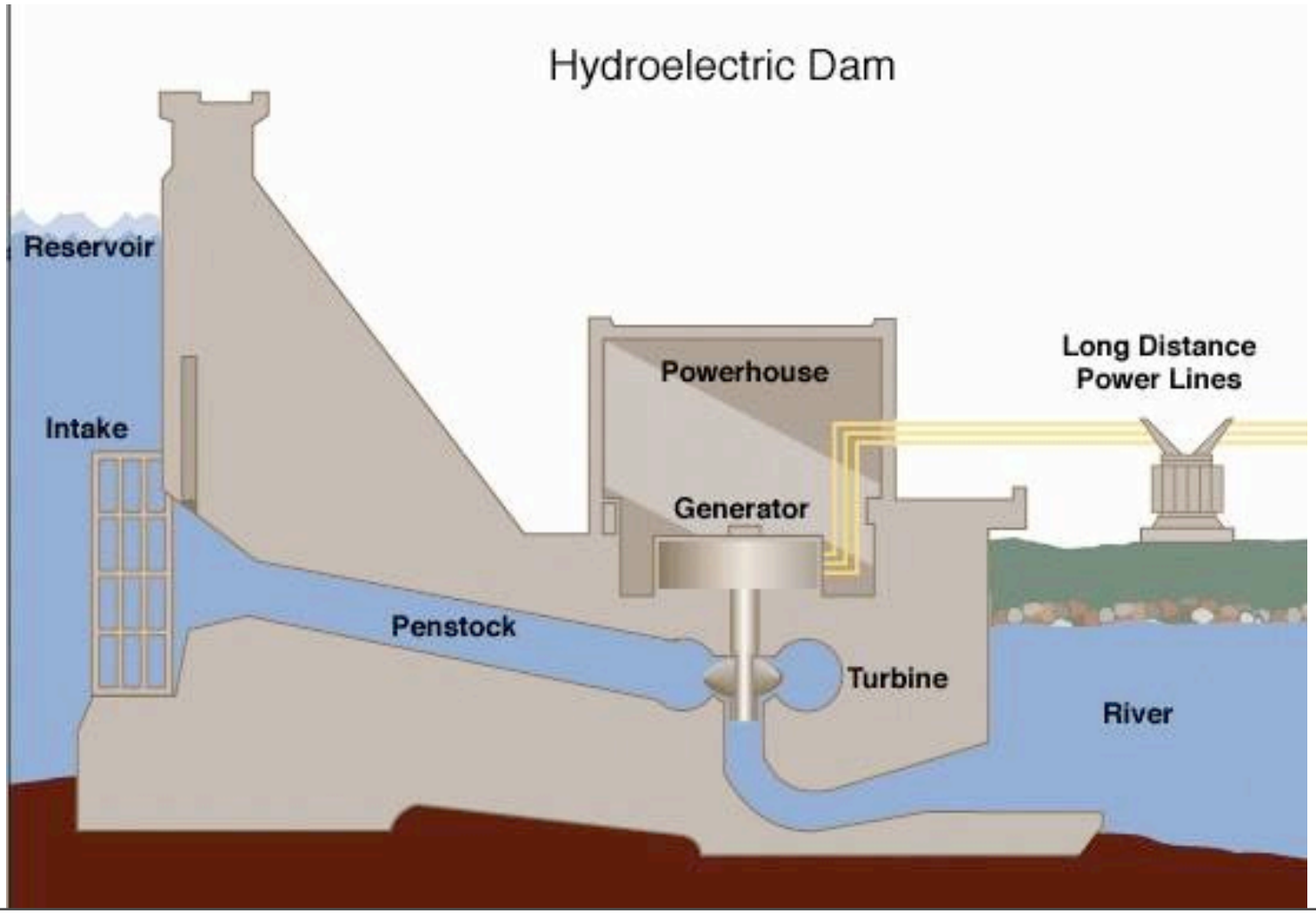
Trinidad & Tobago has an excellent opportunity to participate in the development of the "new" energy of the region, by taking an equity stake. This country can also secure some of the power to meet local demands while optimising gas reserves and realising the best value for gas. This view has been strongly supported by the Chamber of Commerce in meetings with the Government

Associated Projects

- Forestry and Mining
  - In area to be flooded and adjacent areas to be made accessible
- Fisheries and Eco Tourism in the lake to be developed
- Fibre Optic communications in association with the power lines
  - Americas II Fibre Optic Cable terminates in Guyana and can be extended to Boa Vista and Manaus in Brazil
- Institute for Sustainable Renewable Energy Development
  - Great need for capacity, skills development.
  - Partners intend to promote sustainability, future expansions
- Carbon Credits
  - From displacement of diesel and other hydrocarbon fuel
- New industries in Guyana to take advantage of affordable predictable power price


Sources of electricity in Latin America and the Caribbean
Electricity production, GWh
Caribbean
40
30
20
10
0
1975 80 85 90 95 97
Electricity production, GWh
Meso-America
250
200
150
100
50
0
1975 80 85 90 95 97
Electricity production, GWh
South America
700
600
500
400
300
200
100
0
1975 80 85 90 95 97
Note that the horizontal scales are different
Fossil fuels
Hydropower
Other
Sources: UNEP 2003, World Bank 2004

Hydropower Technology

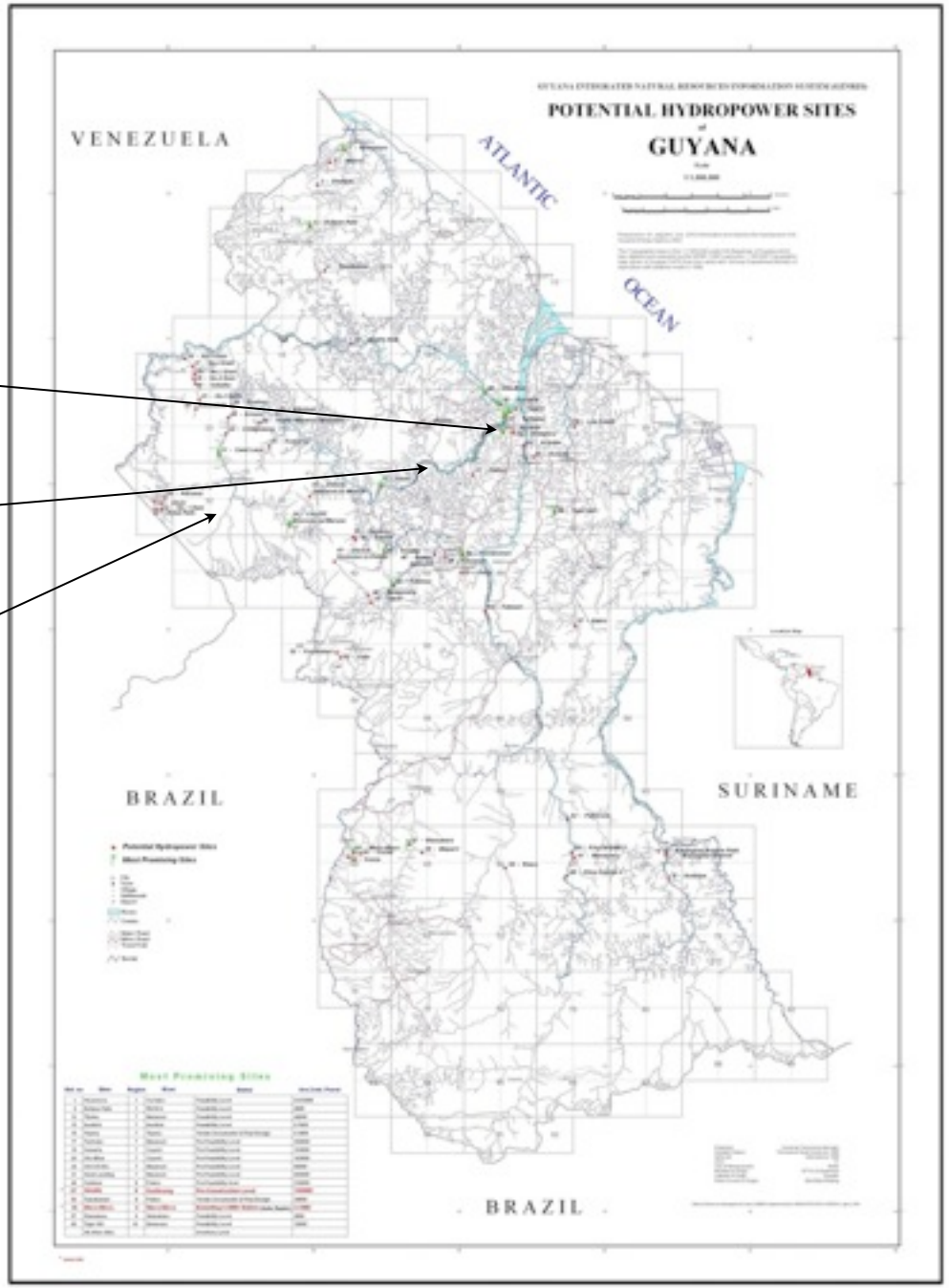


HVDC Power Transmission

Location

The 800MW site is on the Mazaruni River just upstream of Bartica.
When this is built, another site further upstream is possible yielding a further 300MW.
This finally opens the Upper Mazaruni where 2000+MW is achievable.

Therefore the potential of the expanded development is 3000MW.



Guyana Power Situation

- GPL generates/purchases power
- GPL handles Transmission & Distribution
- Transmission system not significant
- Many self generators
  - *100 MW demand from Grid*
  - *300MW of self generation*
- Other hydro project proposed for several years by private company to supply Grid ~ 100 MW
- 10% of GHP power to be reserved for Guyana

Pre Feasibility Study

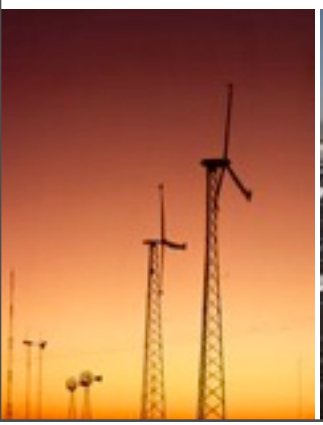
- Conducted by Hardy Stevenson & Associates and ENMAN, MOBEC Engineering of Montreal and Mr Samuel Ramsahoye, former Guyana Chief Hydrologist, now resident in Canada
- Built on the 1976 UN funded study by Monenco (now SNC-Lavalin)
- The PFS set out to address several questions
  - Is the Project feasible in terms of being able to provide reliable low cost power?
  - Can it provide immediate and long term benefits to Guyana?
  - Are there construction obstacles which would serve as significant impediments?
  - Can the scheme be optimised in terms of power price and environmental impact?
  - Are there any insurmountable Environmental and Social Impacts?
- The first report published in 2005 concluded that the project is feasible
- "*Because of the good foundation conditions, large volume of flow, excellent reservoir characteristics, good transportation facilities, and proximity to load centers, the site provides a sound source of power*"
- It is the best site from among the possible contenders that have been examined in previous studies.

Environmental and Social Impacts

- It is inevitable that a hydropower project will disrupt people and natural habitat
- Disruption and change will occur at the dam site and over the considerably larger hydraulic storage area upstream
- From our analysis, no significant socioeconomic and environmental effects have emerged that cannot be avoided, mitigated, managed or compensated
- The project has adopted World Bank plus environmental standards

Vision for (Renewable) Energy Future

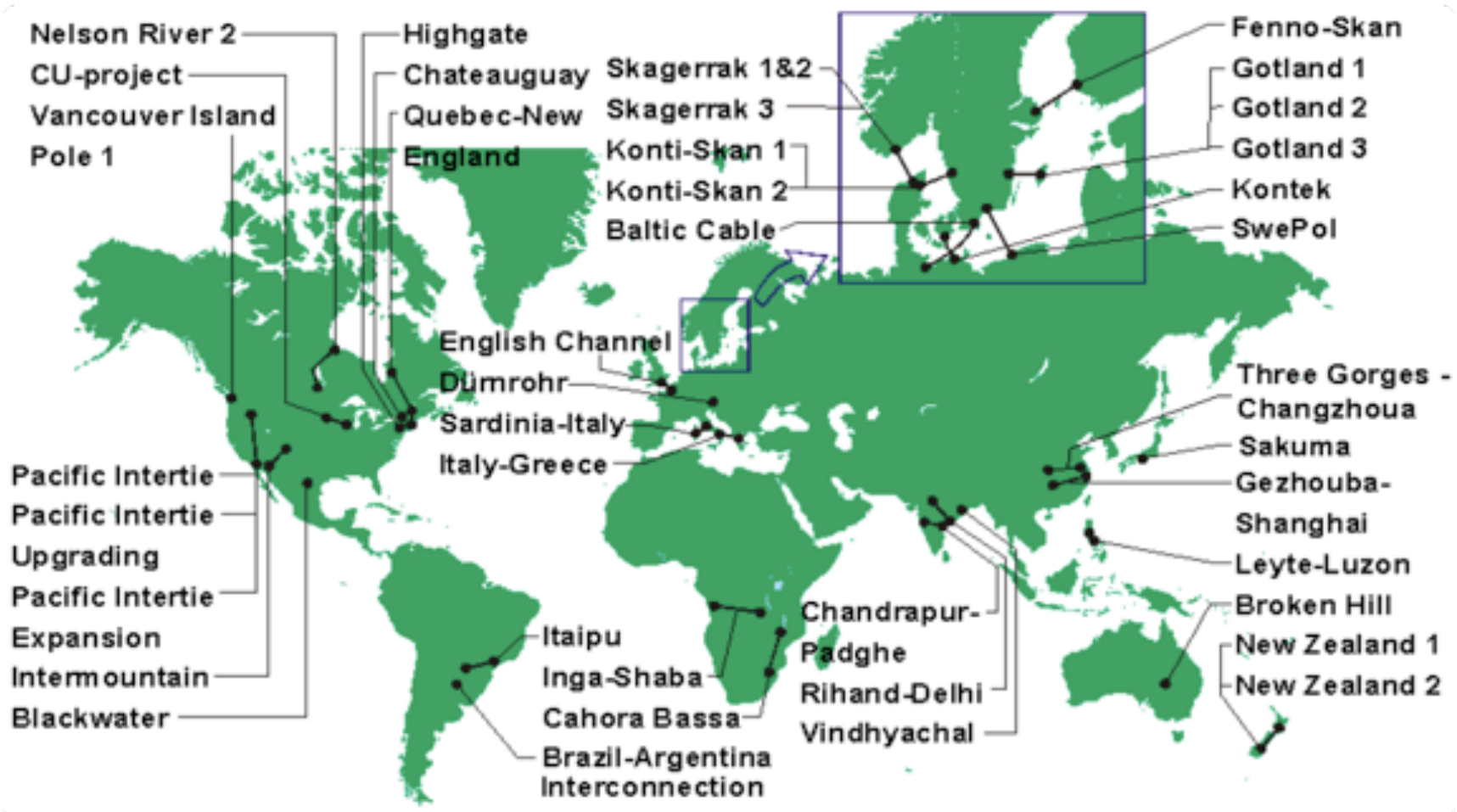
- All territories have developed their major renewable energy sources
- Lowest carbon emissions
- World class technology, world scale plants
- Hydrocarbons utilised for backup/reserve/peak demand
  - And for transportation - in association with hybrids/ethanol from plants
- Requires regional approach, optimisation
- And most importantly *INTEGRATION* of energy systems



A Regional Approach

Guyana's Hydroelectric Power will be the basis for a Caribbean integrated power system supplying *reliable, low cost, renewable and sustainable* energy North to Trinidad and beyond in the Caribbean, and South to Boa Vista and beyond in Brazil.

HVDC Installations around the world



Connection to Trinidad and Brazil

Guyana to Trinidad

- 150 miles at closest points
- Approx. water depth 300 ft

Compare with

- NorNed (Norway-Holland) 360 miles, 1600 ft, 1000 MW, 400kV
- SAIPEI (Sardinia-Italy) 260 miles, 5200 ft, 1000 MW, +/-500kV
- BritNed (Britain-Holland)160 miles, 1000 MW
- Basslink (Tasmania-Australia)180 miles, 600 MW

Many islands systems are connected

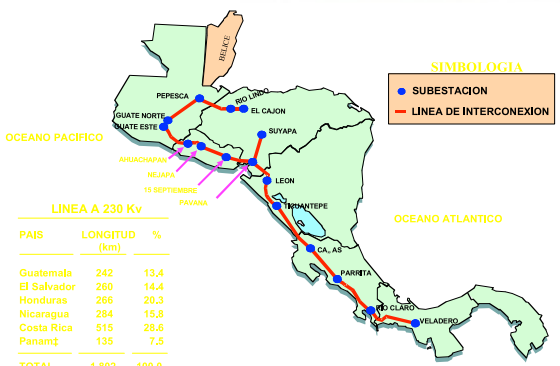
- Hawaii, Philippines

Guyana to Brazil

- Less than 370 miles along new road

Consider SIEPAC Project - overland through several countries in Central America

Worldwide there are over 55 HVDC systems with a capacity exceeding 45,000MW



Need for interconnection

- Inter-Caribbean energy mix becomes available to all connected utilities
- Easier shutdowns of current systems for maintenance and scheduled outages
- Diversifies supply sources. Security of supply
- Utilities can choose whether to use petroleum vs. hydropower vs. renewables at any given time depending on what is running and putting power on the grid
- Policy decisions can be made about carbon targets if large supplies of hydropower are available as base load
- The resulting interconnection will be an Integrated Power System whereby some islands will be producers and others consumers
- World scale Geothermal, Wind and Ocean current plants will be constructed in the islands, removing their dependence on high cost, imported hydrocarbon fuel and reducing their carbon footprints and qualifying for Carbon Credits
- Other territories are considering the submarine interconnection
- Allows sharing of capital costs of new renewable and non-renewable energy projects across many jurisdictions
- Creates economies of scale for purchasing
- Allows adoption of technologies suited to large market and best generation technologies
- Provides for shared risks and benefits
- Lowers unit costs. Provides stability in electricity pricing
- Allows best use of petroleum resources

Remarks from Ambassador Lolita Applewhaite, Secretary General (Ag.) Caricom at 35th CARICOM COTED (Energy) Meeting, Guyana 24 March 2011

"...There is no doubt that the **cost and supply of energy are most urgent items** on the global economic agenda and therefore on the agenda of CARICOM. Movements in oil prices are exacerbating the hike in food prices, through increased fertiliser, irrigation and transportation costs and even as we meet today, the impact of the earthquake-damaged nuclear power plants in Japan and the reported leaks of radioactive gases may be causing a **re-thinking of world energy policy**...

...It appears that **renewable energy will have to play an even more important role** than originally contemplated as we go forward. In fact, all CARICOM countries have already recognized the need for developing their renewable energy resources towards diversifying their energy matrix for improved energy security and for ensuring the production of cleaner energy for improved climate compatibility...

...Madame Chairman, Honourable Ministers, Delegates, Ladies and Gentlemen, I challenge us to see how we can **leverage the energy sector advantages** both fossil and renewable to advance our development, through such approaches as **cross border integration of energy systems**, encouraging participation in downstream energy sector industries and implementation of regional strategies to support capacity development in the sector..."

Note: Emphasis was added.

Christiana Figueres, Executive Secretary of the UN Framework Convention on Climate Change, recently noted before a gathering at the Organization of American States:

"If opportunities for renewable energies are not taken advantage of and supported, the developing countries in the Americas will intensify their fossil fuel based generation capacity as they expand their infrastructure.

This will lock-in infrastructure with high levels of carbon emissions and waste [the region's] natural endowment of renewable energy. This is detrimental to the sustainable development of each of our countries and, for obvious reasons, to the world."

Caribbean Power Interconnection is happening

http://www.caribbean360.com/index.php/

White House supports Nevis energy proposal

CHARLESTOWN, Nevis, Thursday April 7, 2011 – The White House has given its support to the idea of a submarine electrical interconnection to supply low cost renewable "green" energy from Nevis, West Indies to Puerto Rico.

West Indies Power (WIP) proposes to supply geothermal energy to Puerto Rico, by 2015, via a submarine cable similar to what is already in use in Europe (Norway to Holland).

The US Government's backing of the idea came in the 'Report by the President's Task Force on Puerto Rico's Status', which offers concrete proposals to spur the Puerto Rico economy as well as specific transportation, energy and federal programme proposals.

It recommends that "to advance discussions in the Caribbean region on the potential for subsea electrical interconnection under the Energy and Climate Partnership of the Americas, the Department of State, through a grant to the Organization of American States (OAS), should fund a pre-feasibility study to examine an interconnection between Puerto Rico and St. Kitts and Nevis".

"This work results from a request from the government of St. Kitts and Nevis for the Department of State's assistance as it tries to develop Nevis' geothermal resources (estimated potential of up to 300 megawatts (MW)). St. Kitts and Nevis' power demand is approximately 40 MW, making Puerto Rico an important prospective market," it added.

WIP's Chief Executive Officer Kerry McDonald said the company was happy to see that the US Government supports the company's idea of a 'Caribbean Interconnect Project' which proposes the creation of a submarine electrical grid to supply electrical power from its geothermal power plants in Nevis, Dominica and Saba to the islands of the Caribbean including Puerto Rico.

Lula sees potential in hydro plant

PRESIDENT Lula Da Silva has declared his country's commitment to the construction of the much-talked about 800 megawatts hydropower plant in Guyana. Da

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Editorial

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Plugging into renewable energy

GUYANA'S planned US$2 billion renewable energy Turtruba Hydropower Project, which has already won the support of Brazil's President Lula da Silva has the potential to spur the development of a significant industrial base in Guyana as well as assist in strengthening Brazil's industrial growth.

The main article in last week's issue of *Newsday*'s Business Day noted that the Governments of both Guyana and Brazil had cleared the way for the project to proceed.

Interestingly, this project was conceptualised by Enman Services Limited, a Pt Lisas based engineering and development firm, headed by former Petrotrin Chairman, Donald Baldeosingh.

"It is the biggest engineering project ever undertaken in this region," Baldeosingh pointed out.

The project, an 800 megawatt hydropower development planned for Guyana's Mazaruni River has the capacity to stimulate infrastructural development in Guyana.

In an aptly entitled article, "The next major regional development on the regional landscape," Srinath notes: "By far the most important source of sustainable energy in the world is hydropower, which has the advantage of high reliability. This has been the situation from the very beginning of electricity generation.

"It is noteworthy that in examining the world's development of renewable, hydro was identified early as the cheapest from of electric power. Small wonder then that hydro is the preferred source of power for aluminum smelting, given the high reliability required by this process.

"The use of hydropower is not a new concept and currently accounts for 20 per cent of the world's electricity supply, developed countries such as the United States and Europe, only recently turning to other alternative sources of energy, having already harnessed their readily available hydropower resources."

These would include, as the TTMA has pointed out, the creation of a renewable energy policy and legislative framework which would identify specific renewable options to be targeted.

It is clear that Government has to act and quickly on the several renewable options long before the stage of depletion of our fossil fuels is reached. The TTMA has put forward a series of arguments which deserve serious study and time is not in

Trinidad & Tobago

- Long term reliable supply of power independent of hydrocarbon prices
- Opportunity to reduce carbon emissions from Gas based power generation
- Carbon Credits, reduction of Carbon Footprint
- Free up Gas Reserves to achieve best value for Gas
- Subsidised gas price for electricity expires 2019. Need decisions today to avoid much higher cost of power in 2019
- Gas sold at same price both for feedstock and power to petrochemical industries. Steam drives (from gas) may be converted to electrical supply
- Port of Spain power station (approx. 300MW) could be retired in 2012.
  - Can be extended to coincide with availability of Guyana Hydropower
- DC Power, inverted to AC provides frequency stabilisation
- Can supply gas based electricity to system for peak demand
- Leadership role for “new” energy in region
- **Power from TGU plant can be supplied to a new industrial park in Guyana which later can be supplied from Guyana hydropower**

Trinidad & Tobago businesses

- Project has a policy of maximisation of local/regional capabilities
- Engineering services
- Construction - Civil, Electrical, Mechanical
- Financing opportunities
- Training services
- Support services - Accounting/Finance, Legal+++
- Ancillary project development
  - Eco Tourism development
  - Fisheries
  - Forestry

Standalone or First Phase

- Build cable from La Brea to Guyana
- Sell power, say 200-300MW, to Guyana
- Utilise TT services and encourage TT businesses to invest
  - Low power price
  - Forestry products, Gold, Bauxite, Fisheries, Agroprocessing
- NEC should support
  - Leader in energy developments
  - Promotion of TT “Local Content”
  - Linkage to Manufacturing Sectors
  - CF. PLIPDECO, Caribbean Gas Pipeline breakthrough projects

Time and Money

- Construction of Power Cable to Guyana 2-3 years, $200-300MM
- Funding for Feasibility Study $3MM

- Pre-construction activities for Hydropower expected to take 12-18 months
- And construction 4-6 years, Construction costs: $2.5B

  Funding needed to get to Financial Close of Hydropower portion: $20MM

- Portion of financing to be offered to local/regional banks
- Expected multilateral financial institutions - interest shown by IDB, CDB and others

Thank you

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