

# Realistic Energy Mix for Jamaica Including RE and Balancing Climate (Climate Change Perspective)

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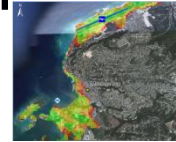
September 25, 2012

# Content

- What Science tells us
- CO<sub>2</sub> pathways
- Technology to achieve pathways
- Jamaica's energy mix to meet target
- New technologies – How and Where?
- Conclusions

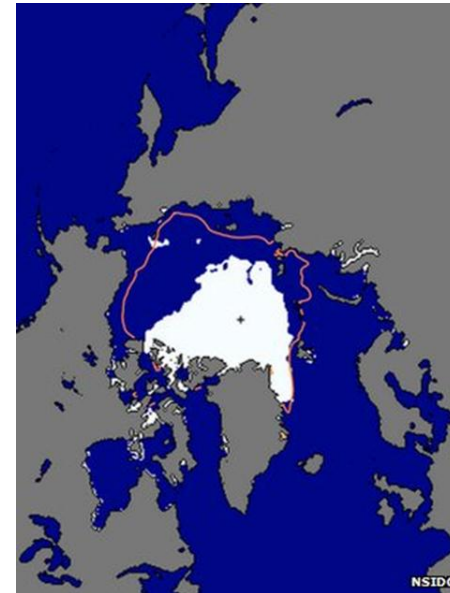
# What Science tells us

- Dangerous consequences of continued use of fossil fuel
  - More frequent extremes
  - More intense tropical and extra-tropical storms
  - Accelerated Sea Level Rise
  - Complete melting of polar ice caps
  - Venus syndrome 
- Safe limit of CO<sub>2</sub> - 350 ppm
  - Equivalent to 1.5<sup>0</sup>C rise in temp above Pre-industrial age
- 450 ppm or 2<sup>0</sup>C rise in temp – 50 % chance of avoiding dangerous consequences



## Recent BBC Headline news

- 19 September 2012 : **Record minimum for Arctic sea ice**
- 7 September 2012: **Arctic ice melting at 'amazing' speed, scientists find**
- Sept 9, 2012: **Arctic ice melt 'like adding 20 years of CO2 emissions'**
- 20 May 2012 : **Arctic melt releasing ancient methane**

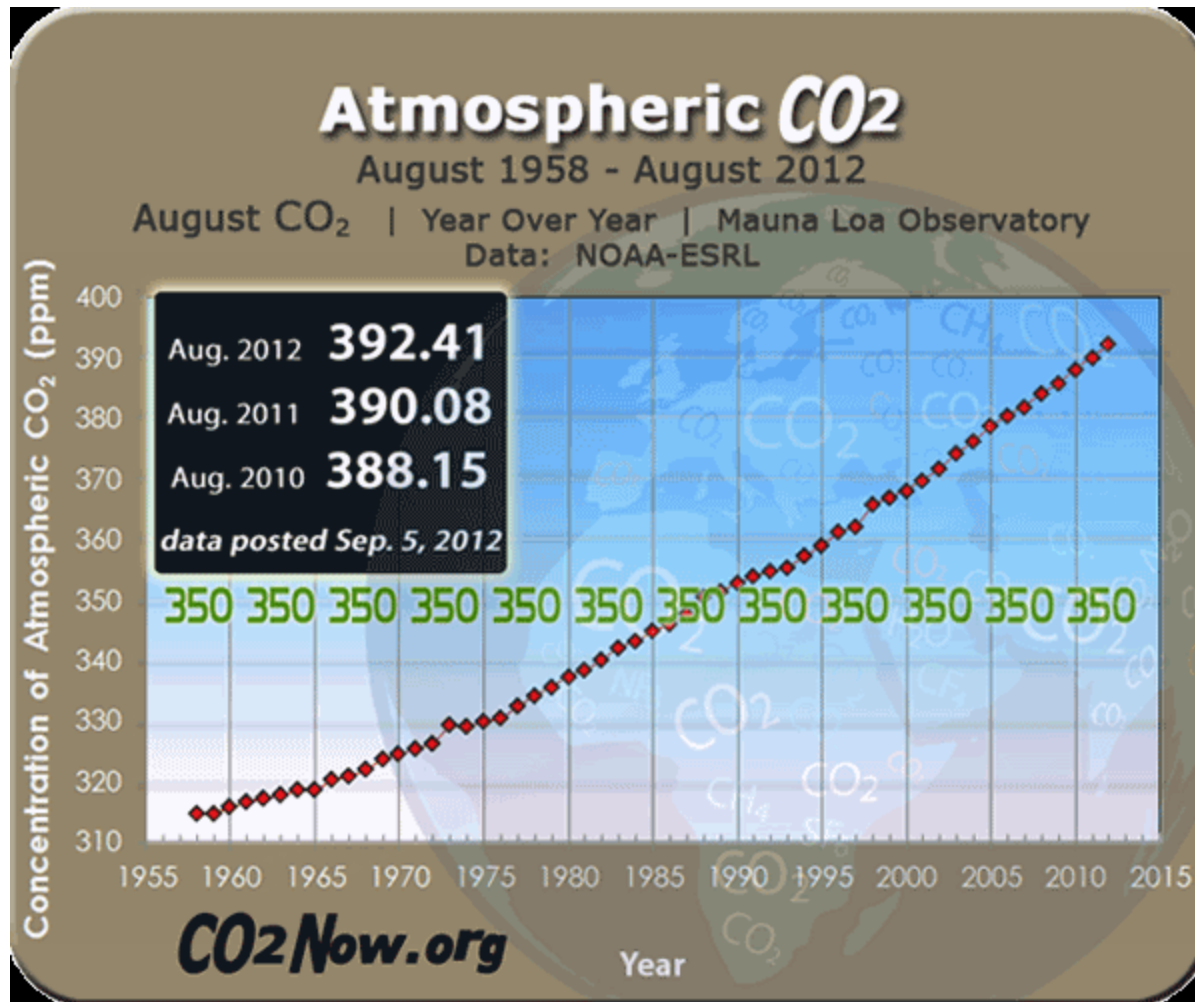


1979-2000  
average  
(Red)

August 29,  
2012  
(White)



# CO<sub>2</sub> pathways: 350 ppm out of reach?



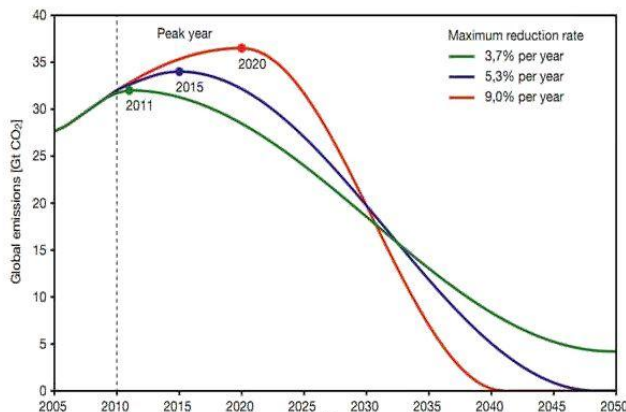
# CO<sub>2</sub> pathways to achieve 450 ppm or 2° C limit

Copenhagen accord (2009): To prevent dangerous anthropogenic interference with the climate system, (COP) recognizes "the scientific view that the increase in global temperature should be below 2 degrees Celsius"

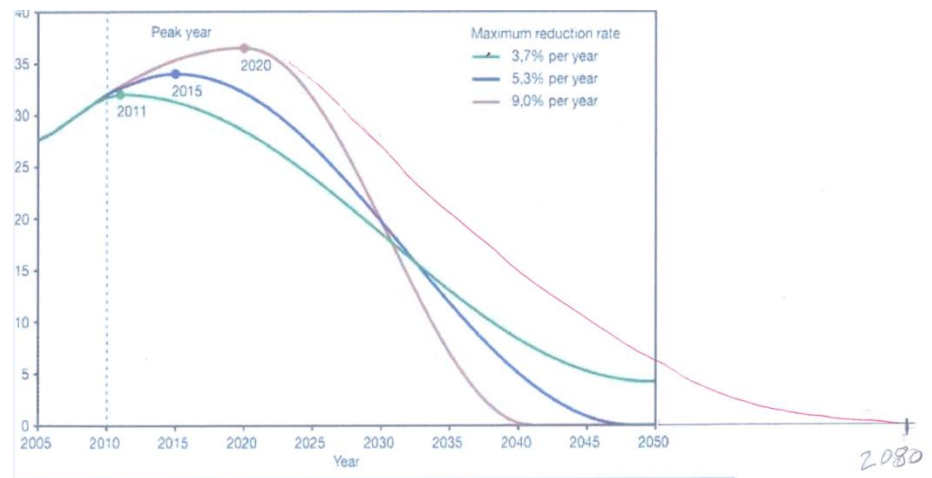
- Previous scenario

## The Mitigation Challenge:

Global Emissions Pathways Giving 67% Chance of Achieving Compliance with 2°C Guardrail



- Present scenario



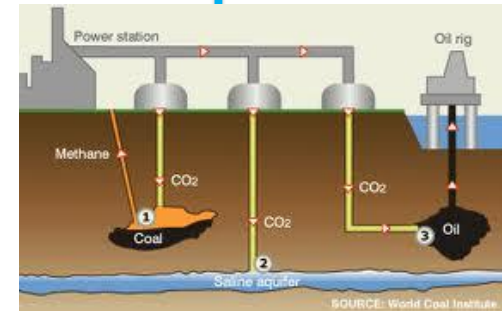
- Emission of CO<sub>2</sub> to peak in 2020 and there should be no emission after 2080
- Due to CO<sub>2</sub> lifetime of ~ 100 years in atmos.
- Will apply even to Jamaica and other SIDS

# Bharrat Jagdeo: '25 to 50 per cent by 2020'

- **Janet Silvera, Senior Gleaner Writer**
- 18 April 2012
- GEORGETOWN, Guyana:
- **THE CARIBBEAN must cut greenhouse gas emission by 25 to 50 per cent by 2020 to avoid catastrophic climate change, warns environmentalist Bharrat Jagdeo.**
- Jagdeo's comments come in the wake of a World [Bank](#) study, which determined sometime ago that 10 or 15 of the most vulnerable to climate conditions countries are in the Caribbean.
- Criticising many of the decision makers in the region, who he accused of sleep-walking on the issue of climate change, the former Guyanese president made an alarming revelation that even after an intergovernmental panel determined that for the Caribbean to have a sustainable trajectory it had to limit global temperature to two degrees Celsius above pre-industrial level by 2050, no such agreement had been signed.

# Technology for Mitigation: Developed Countries Options

- Nuclear
- Renewable Energy
- Carbon Capture and Storage (CCS)
  - Capture of CO<sub>2</sub> after combustion, transporting or shipping to storage site
    - Geological formations, e.g., Exhausted oil wells
    - (Not feasible in porous limestone areas, e.g., in Jamaica)
- Clean Coal
  - Removal of harmful by-products (sulphur dioxide, mercury, arsenic, radioactive uranium and thorium and others)
    - Key component of environmental safety
  - Removal of CO<sub>2</sub> by CCS
    - Key component of climate mitigation process





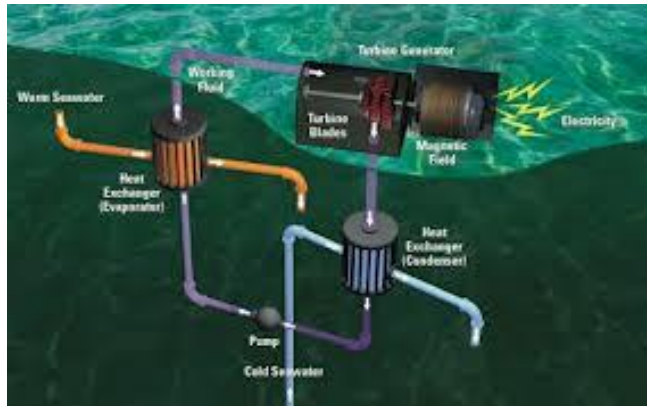
# Technology for Mitigation: Options for Jamaica

- Firm or Balanced Renewable Energy
  - Hydro (~ 80 MW)
  - Waste to Energy (~ 80 MW)
- Peak or Intermittent Renewable Energy
  - Wind (~ 200MW)
  - Solar PV ( Unlimited)
  - Solar thermal Water Heating and Cooling (Unlimited)
- Future Firm or Balanced Energy (R & D Needed):
  - Ocean Thermal Energy Conversion ,OTEC (Very large capacity)
  - Solar thermal with storage (Unlimited power but siting problem)
  - Small nuclear (~ 10 MW per plant)
  - Hydrogen Fuel Cells (Can produce large quantities of H)

NB. Wave is a future intermittent energy source and we have enough of that in wind and solar, so it may not be a good option of Jamaica



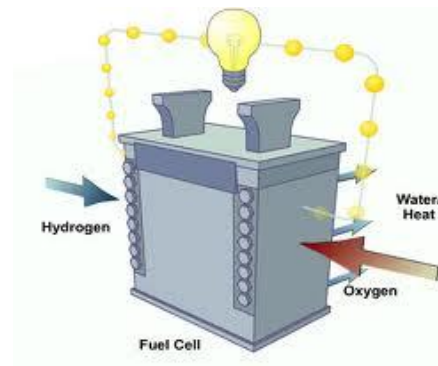
**Waste  
to  
Energy**



**Ocean Thermal Energy  
Conversion (OTEC)  
Technically, but not yet  
economically viable**



**Solar Tower**



**Hydrogen Fuel Cell**

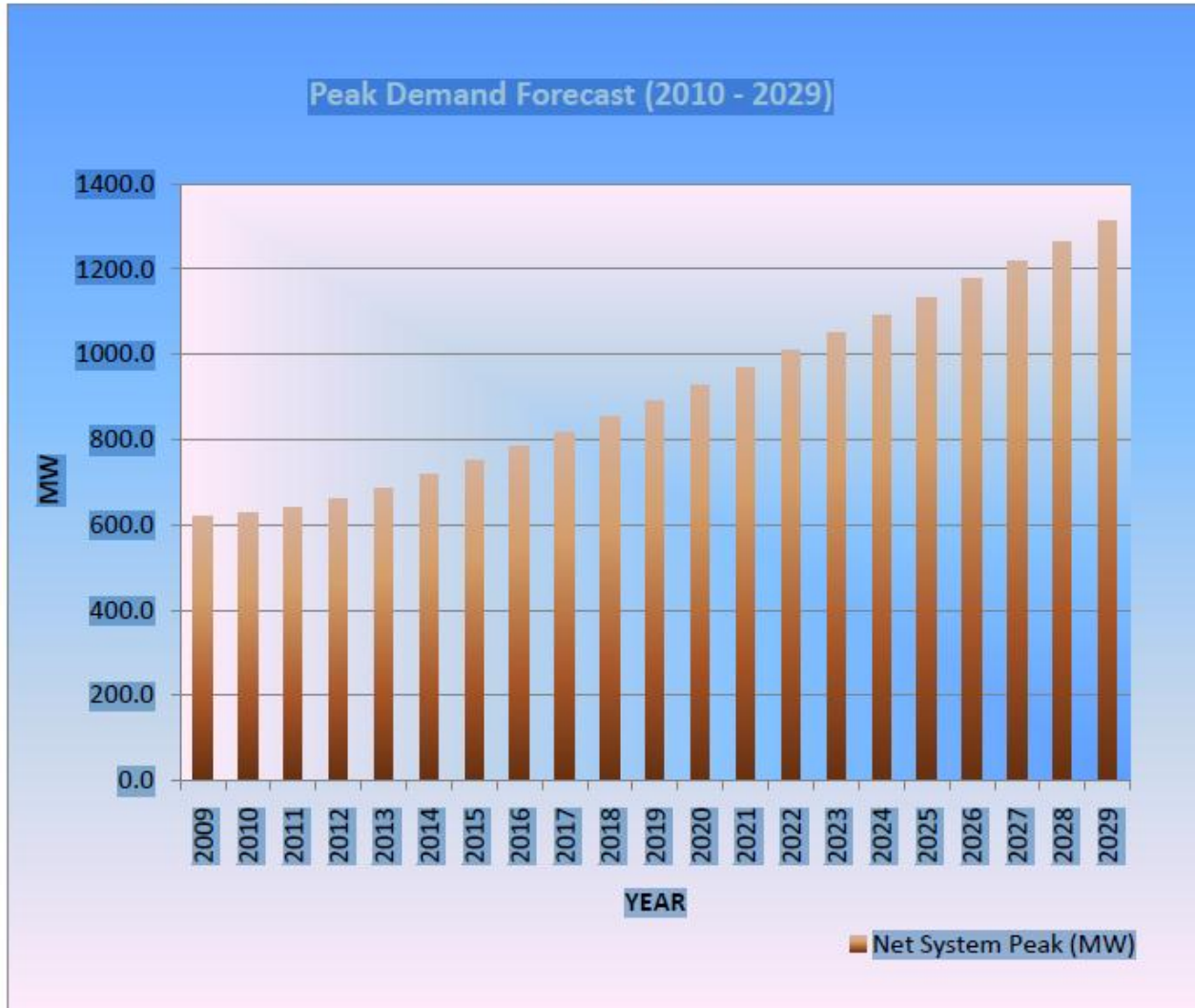
**On verge of  
being  
economically  
viable**

# Forecast of Peak Electricity Demand (2010 – 2029)

Source: OUR Generation Expansion Plan 2010

- 1300 MW by 2029

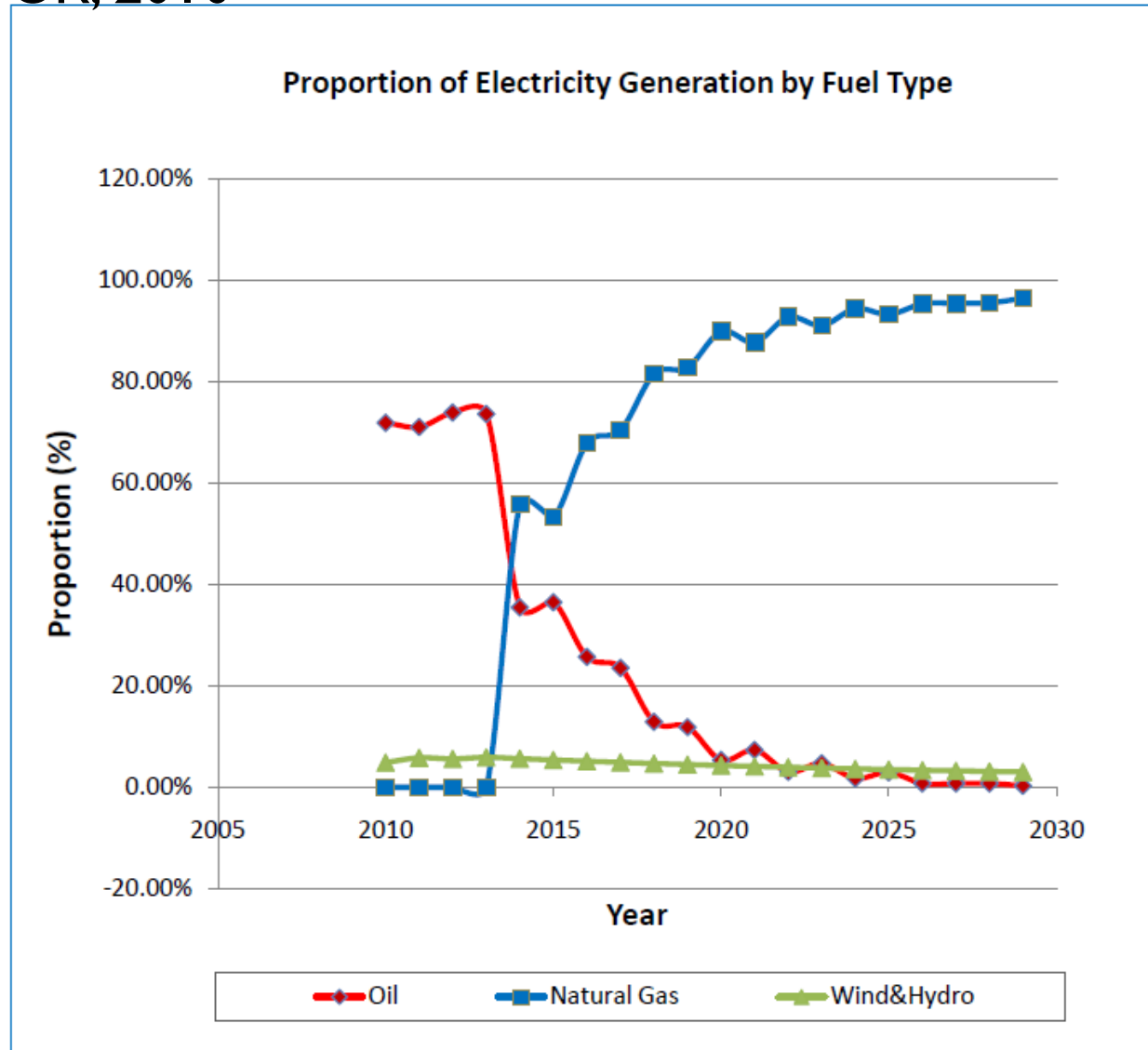
Figure 3.2-1: Base Forecast – Net Peak Demand (2010 – 2029)



# Natural Gas Strategy to achieve 1300 MW by 2029

Source: OUR, 2010

Figure 9.4.1-2: Proportion Electricity Generation Fuel Type (NG strategy)

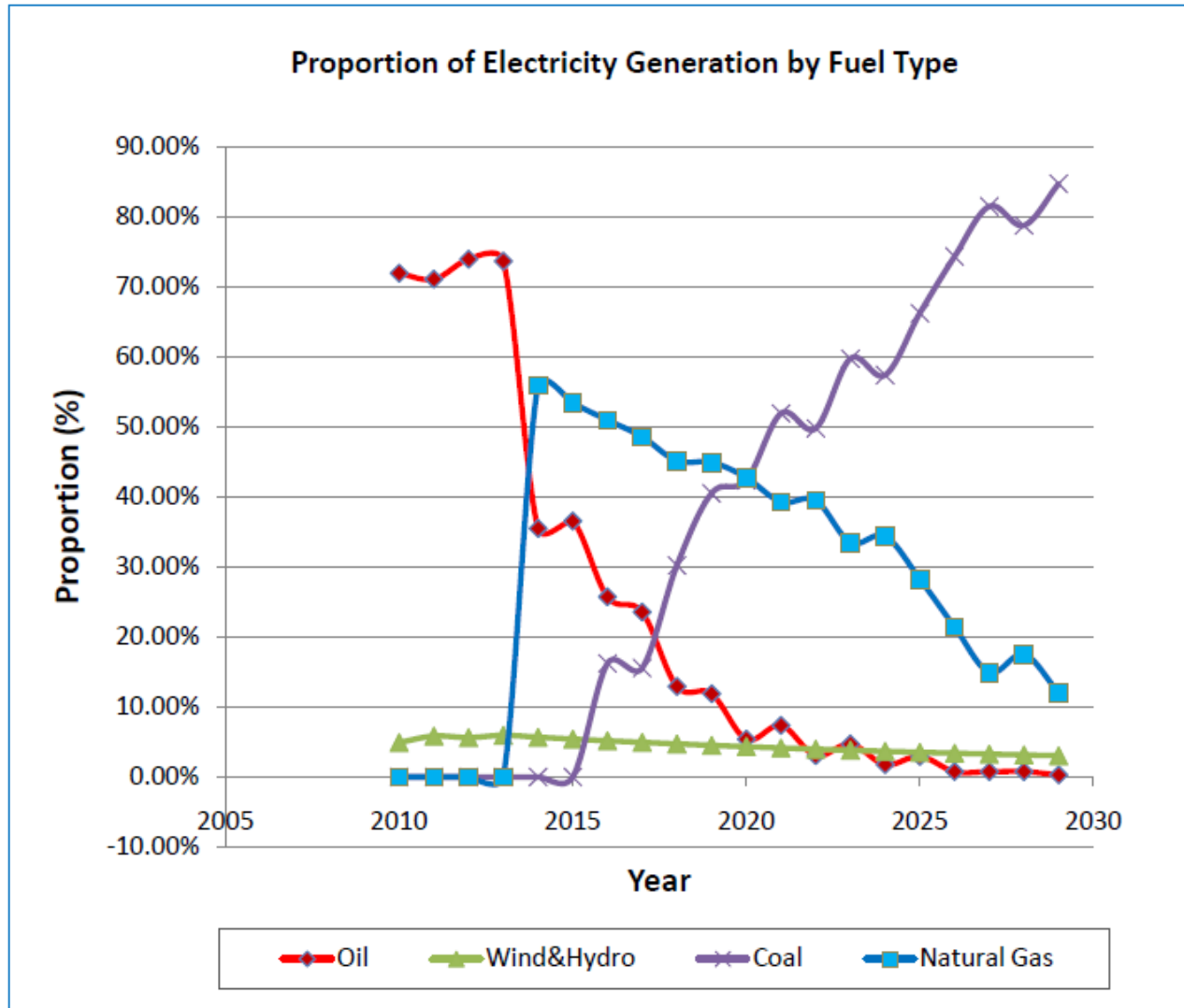


Jamaica's energy mix

# Natural Gas/Coal Strategy to achieve 1300 MW by 2029

Source: OUR, 2010

Jamaica's energy mix



# Oppose Coal Unless

- Harmful by-products are removed (Advanced coal)
- CO<sub>2</sub> is captured by CCS
- Additional cost for these need to be considered
- Natural gas much cheaper but no estimates for LNG

## W. Pinnock: Impact of Toxic Mercury from Coal-Fired Plants

- Some of these are present in the original coal in trace amounts, but because significant masses of coal are burnt in a typical plant the amount emitted is significant.
- Mercury – is a neurotoxin that accumulates in fish and has been found at unacceptable levels in fish sampled near coal-fired plants in the US.
- Elevated mercury levels lead to impairment of the development of unborn children, produces learning disabilities- impaired visual/motor coordination - in young children.
- In a 1997 Report to the US Congress the EPA reported at least 8% of women of child-bearing age having blood mercury levels above acceptable limits. A 2009 study of mercury in 291 streams nationwide showed mercury in all fish collected, with 1 in every 4 having mercury above levels allowed for average fish-eaters.
- About 50% of this mercury is thought to come from coal-fired plants.

# Energy Mix up to 2029

- Ja's energy policy of 30% renewable
- Total Capacity ~ 1300MW
- 30% Renewable ~ 390 MW
- Fossil Fuel ~ 910 MW



# Renewable Energy Mix up to 2029

- Firm Energy
  - Hydro ~ up to 60 MW from 24 MW
  - Waste to Energy ~ up to 40 MW from 0 MW
- Intermittent Energy
  - Wind ~ up to 150 MW from 40 MW
  - PV ~ up to 140 MW from 0 MW
- Total Renewable – 390 MW
- Assume grid has been upgraded to take 290 MW of intermittent energy

# Energy Mix from 2029 to 2080

- Maximum fossil fuel at any one time ~ 910 MW
  - Fossil fuel to peak in 2020
  - New fossil fuel plants may be added to replace old
- No new fossil fuel plant after ~ 2040/2050
  - To phase out fossil fuel by 2080
  - Plant life time of 30 – 40 years
- After ~ 2040/2050 all new plants will be non-fossil
- Intermittent energy limited 30% of total energy unless smart grid and load control established to take more intermittent energy

# Renewable Energy Mix from 2029 to 2080

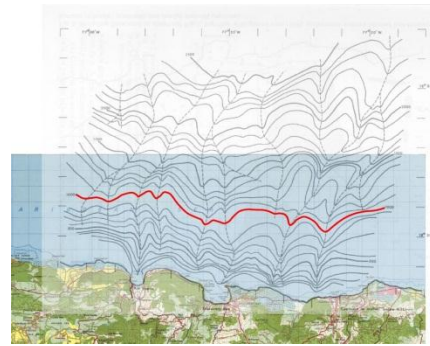
- Hydro ~ 80 MW (Base load) – PCJ Study
- Waste to energy ~ 80 MW (base load) – PCJ + Private
- OTEC ~ 4 x 100 MW plants to be incrementally established (Base load) – Ja's Bathymetric profile
- Solar Thermal with storage ~ 10 x 20 MW to be incrementally established (Base load) – Google search
- Wind ~ 200 MW (intermittent)
- PV ~ 200 MW (intermittent)
- Total Renewable ~ 1160 MW
- Hydrogen Fuel Cell, other RE and Nuclear to take up remaining base load

# How to ensure economic viability

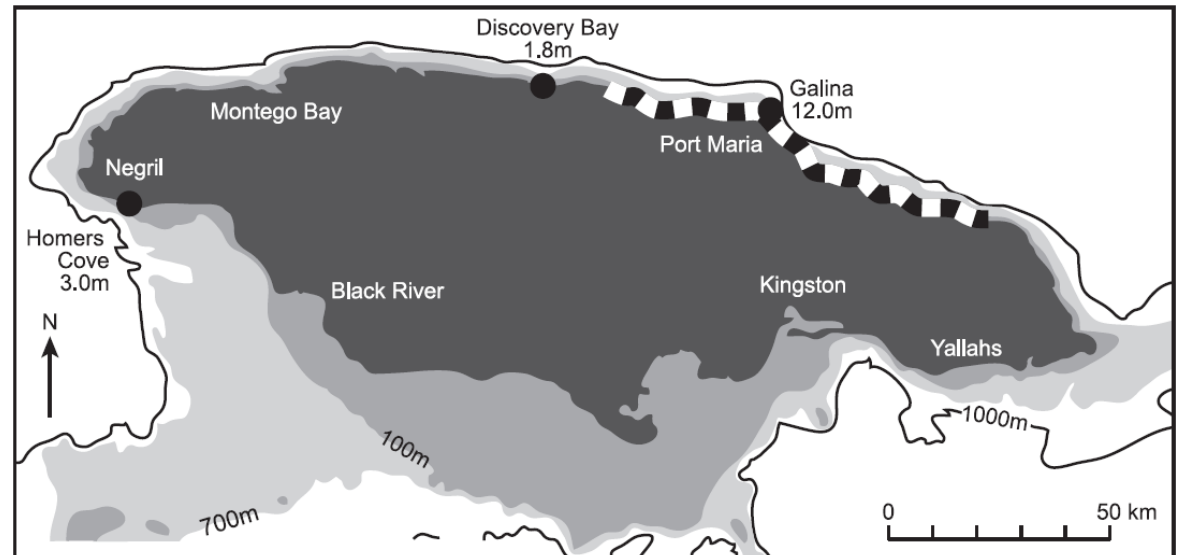
- Need to find significant funding for international R & D (Green Climate Fund, bilateral funds, etc.)
  - Improve design and manufacturing techniques
  - Design for Developing countries
- Economy of Scale
- Costs will fall just as it did for wind, solar PV

# OTEC sites

Uses temperature difference between surface and 1000 m depth



- Discovery Bay
- Yallahs Delta
- Galina Point
- Homers Cove

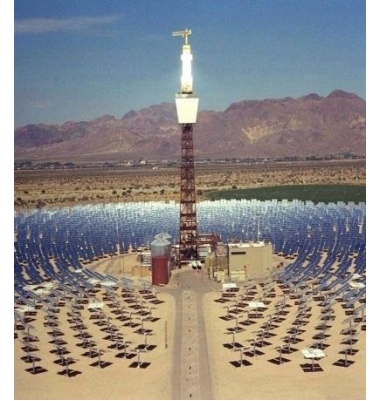


Rowe, Khan Robinson, 2009

Where?

# Sites for solar thermal with storage

- 20 MW
- ~ 200 acres
- Secluded because of brightness
- At least 10 such sites in Jamaica
  - e.g., Hellshire Hills



# Conclusions (to be elaborated on)

- Proper appreciations of dangerous consequences of climate change and need for mitigation
- Link Renewable energy to energy security and energy independence and saving in foreign exchange
  - Use what resources we have, be independent of imports
- IMPROVEMENT IN GRID
  - Smart grid
- Pilot Project in OTEC and solar thermal w. storage
  - Through Green Climate Fund?
- Have a clear understanding of energy situation and status of renewable energy by 2020 in order to make right choice
- RE has to be an important arm of MSTEM

# Not another Venus



Thank you for coming