



# Planning for renewable energy:

## A 100% renewable energy vision for Barbados

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A presentation for the:  
23<sup>rd</sup> September 2016



**BARBADOS TOWN  
PLANNING SOCIETY**

### *Presentation overview*

- Recap of Olav Hohmeyer's 100% vision
- A look at the technology options
  - Solar PV
  - Wind energy
  - Pump storage Hydro
- What about the transport sector?

# A 100% renewable Barbados AND lower energy bills

Progress to date...

## Origin of this scenario



**Professor Olav Hohmeyer**

Teaches on UWI's MSc programme

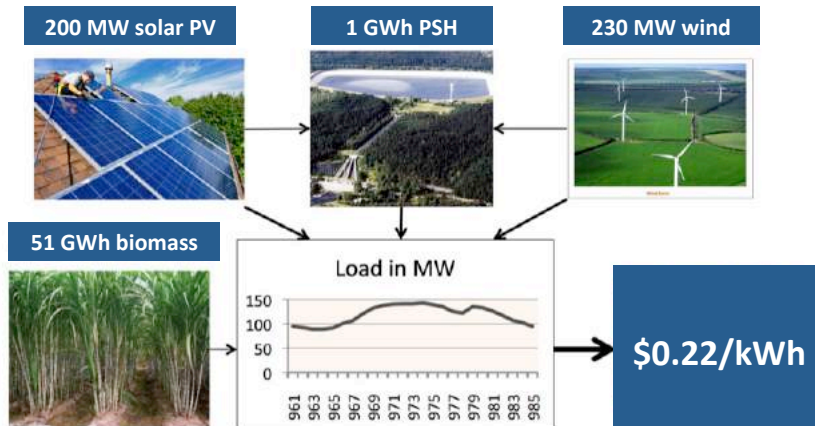
- Energy economics
- Shaping energy systems

- 40 years experience in RE sector
- Lead author IPCC report on renewable energy
- Key player in Germany's renewables success



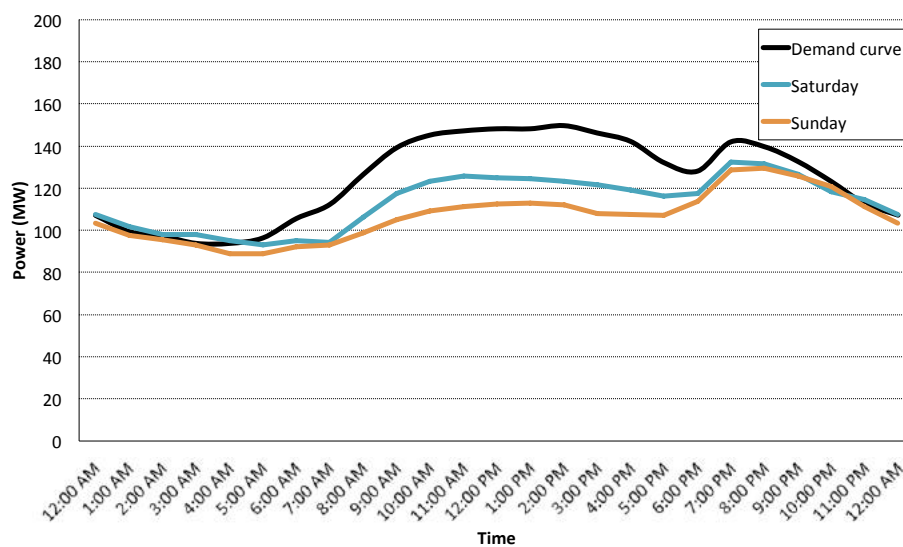
Available to download from [www.brea.bb](http://www.brea.bb)

## A 100% renewable scenario for Barbados



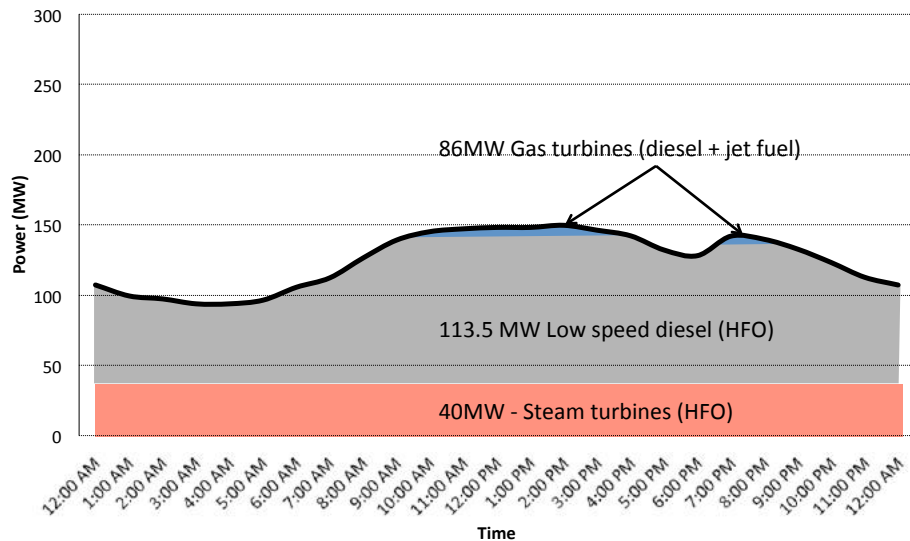
Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## Demand curve for Barbados



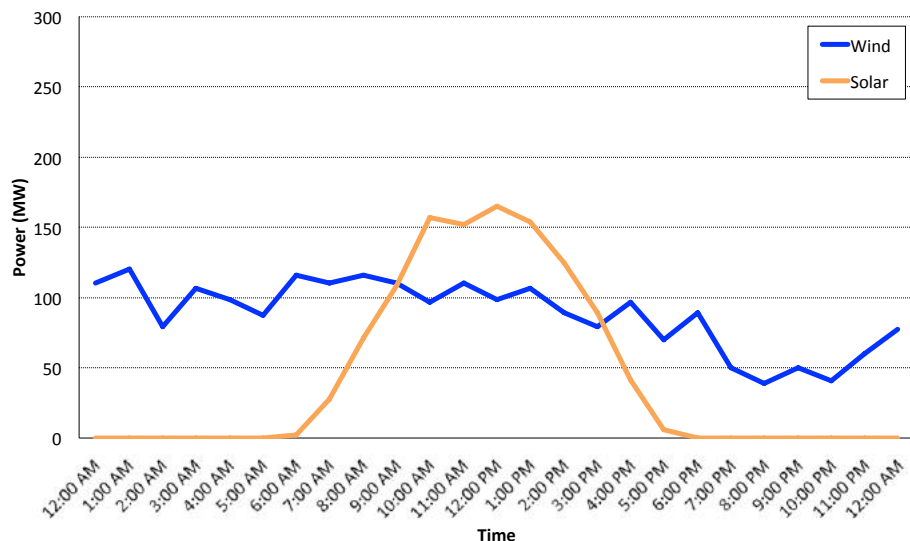
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## Demand curve for Barbados

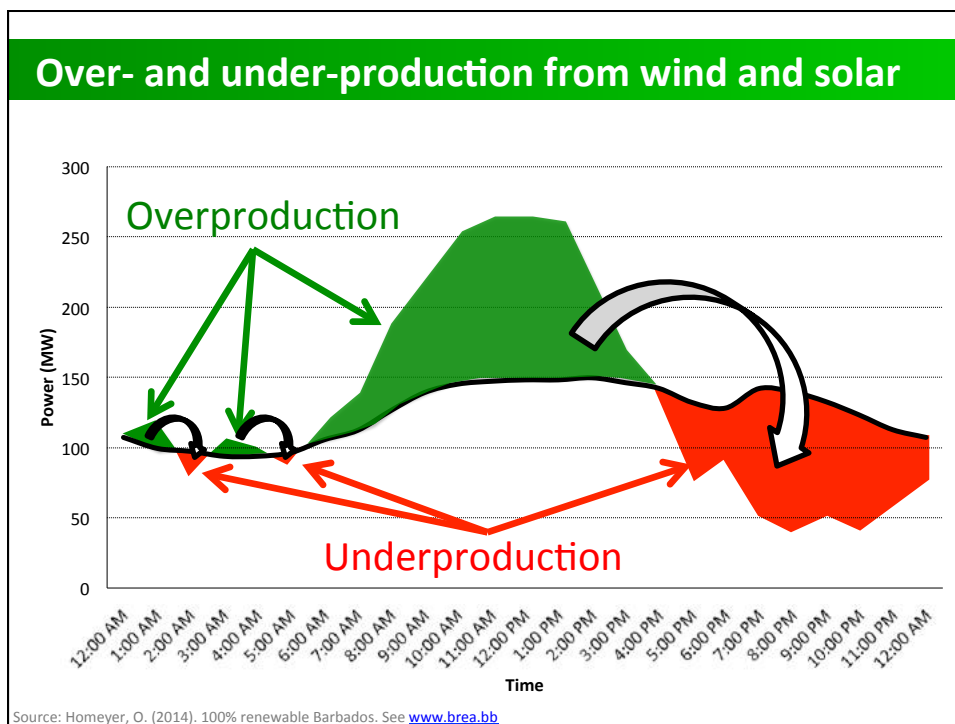
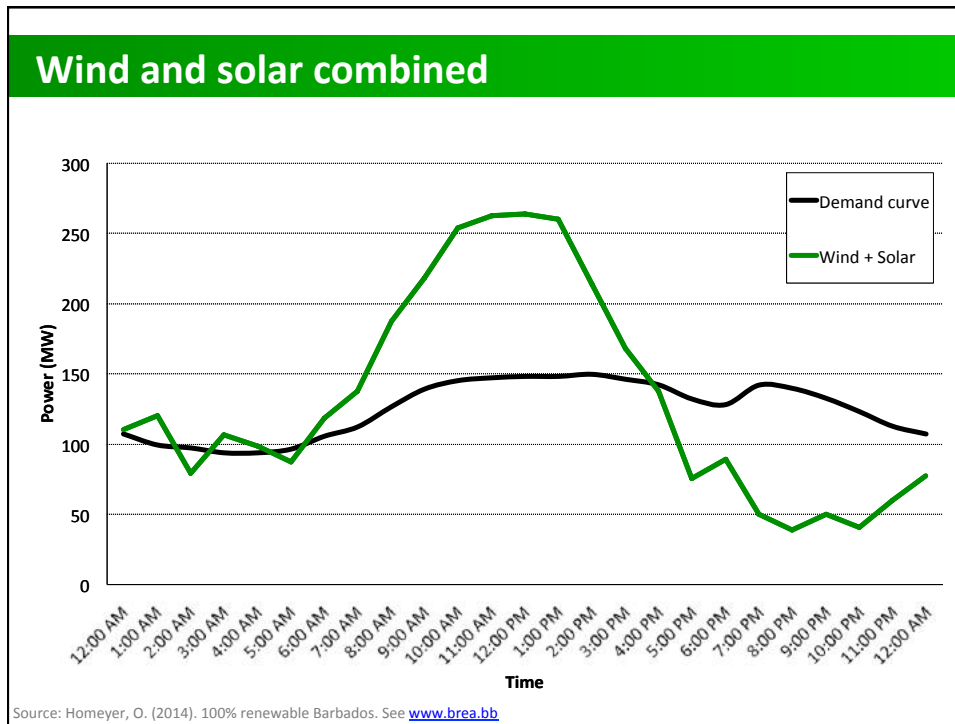


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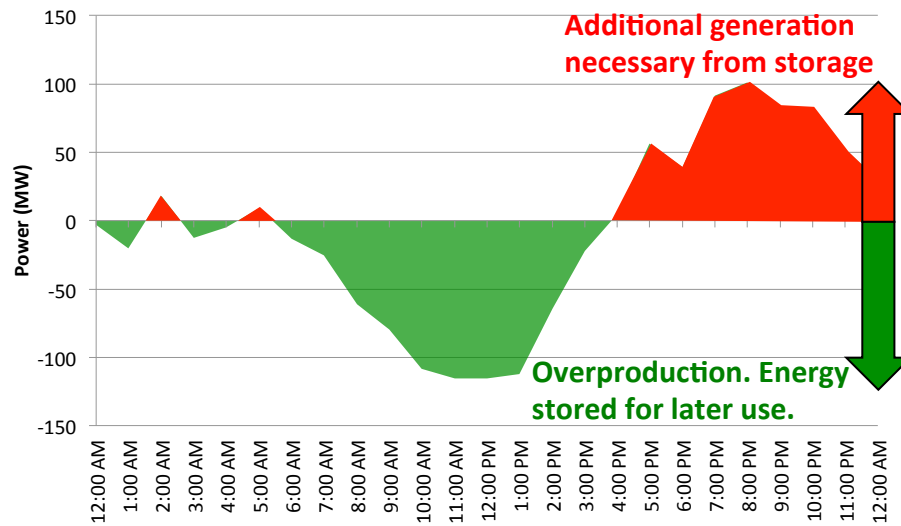
## Generation from wind and solar



Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)



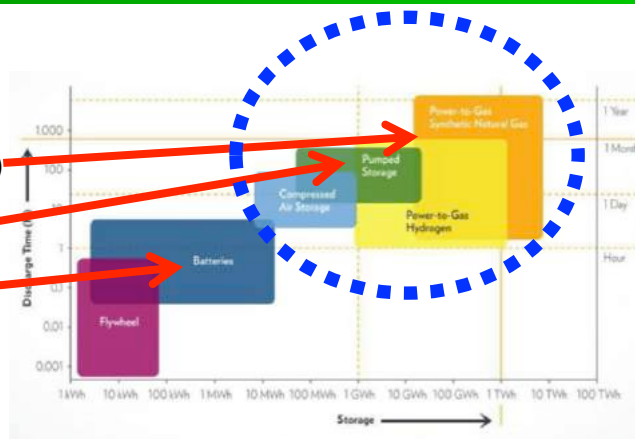
## Residual load curve



Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## Storage options

- Power to gas (to power)
- Pump storage hydro
- Battery storage

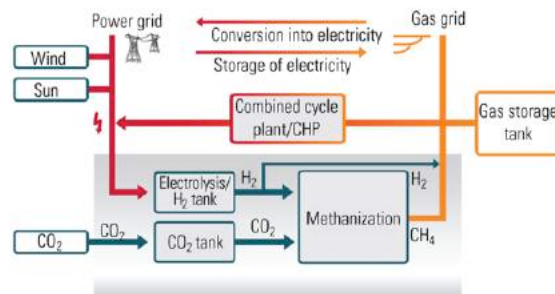


Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## Storage options: Power to gas (to power)

### Power to gas (to power)

- Appropriate size GWh
- Very low efficiency
- High costs
- Not a mature technology



Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## Storage options: Batteries

### Batteries

- Easy to install
- High efficiency
- Electricity loss over time
- Relatively expensive  
(US\$500-600/kWh storage)
- Too small for Barbados  
(MWh range when we need GWh range)

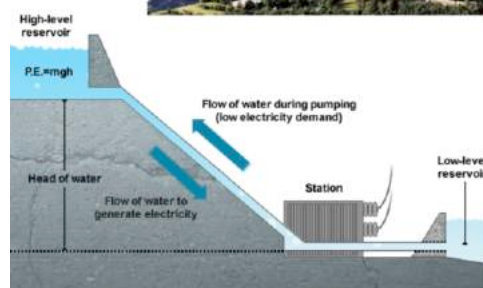


Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## Storage options: Pumped storage hydro

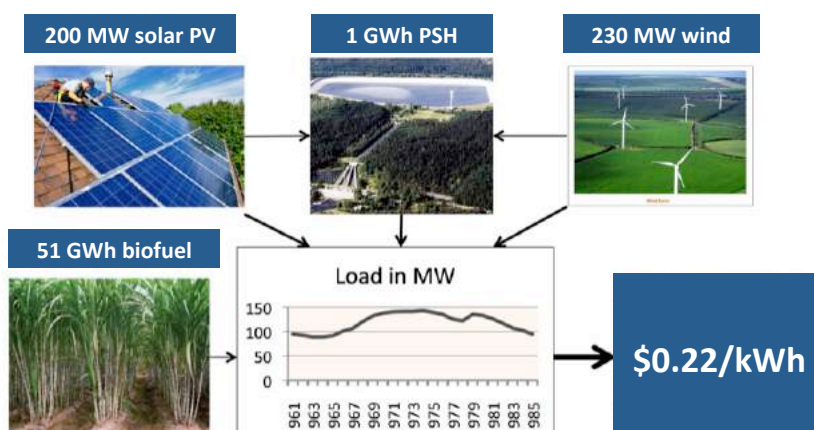
### Pumped storage hydro

- Appropriate size GWh
- Low cost per MWh storage (<US\$100/kWh storage)
- Major construction needed
- Needs special locations with large altitude differences
- Possible for Barbados



Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## When the storage is depleted?



- Biomass options (biodiesel or biogas)
- Attraction of keeping diesel generators operational

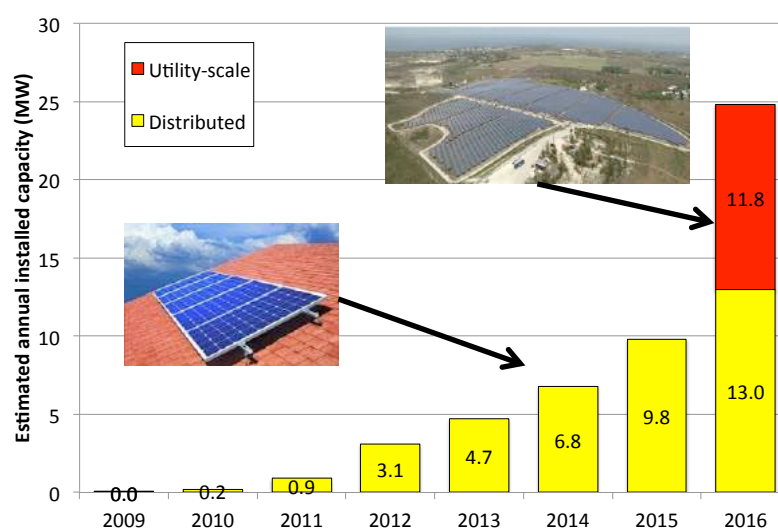
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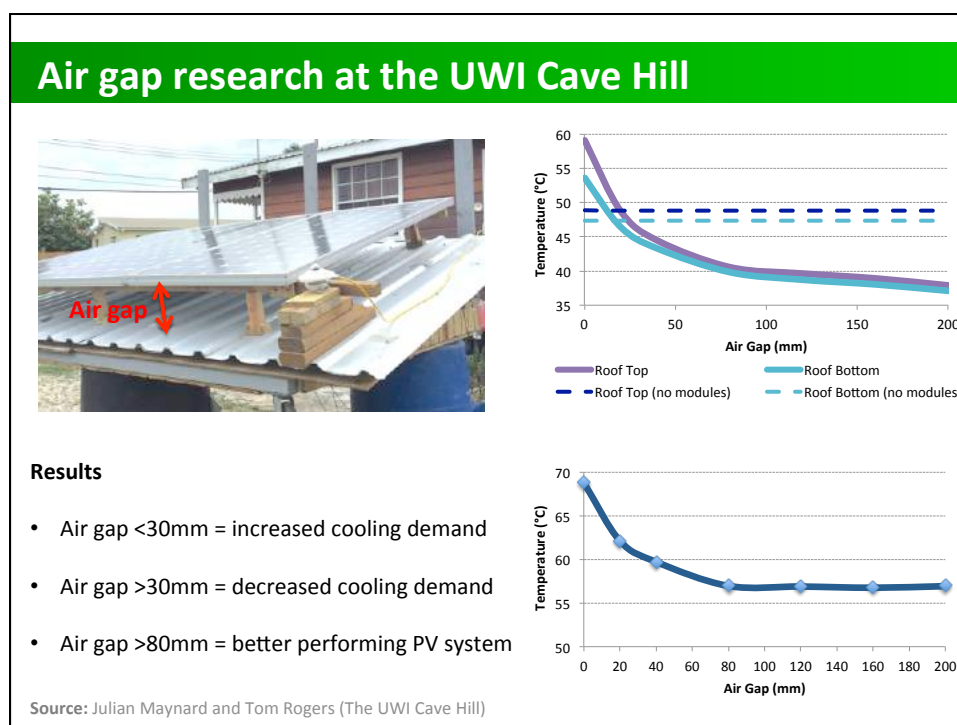
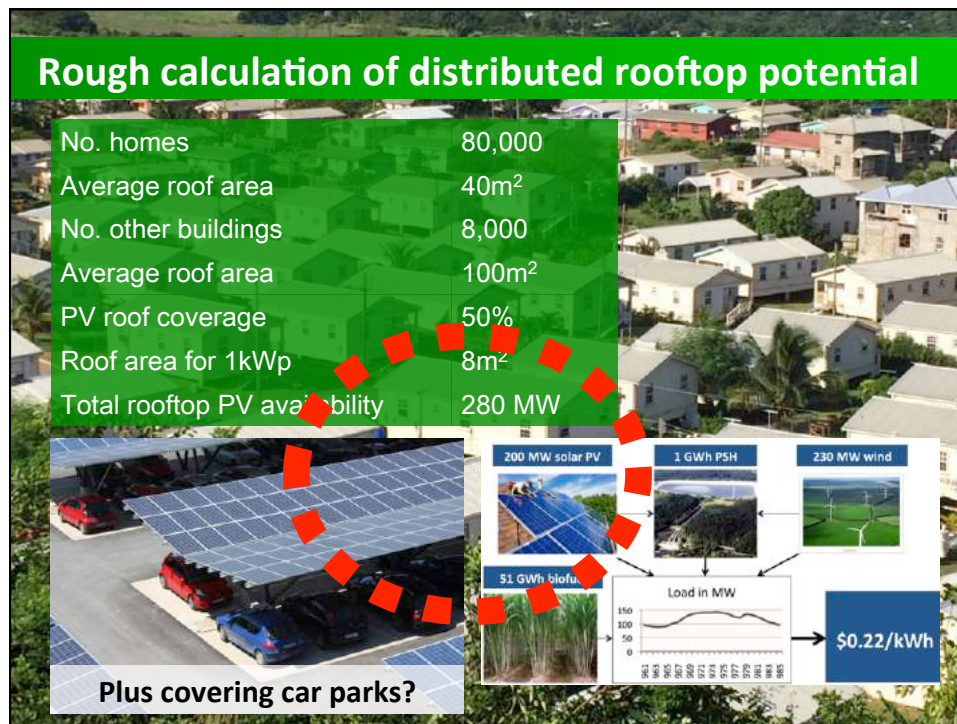


## A look at the different technologies

### Solar PV

#### Estimated cumulative installed solar PV capacity



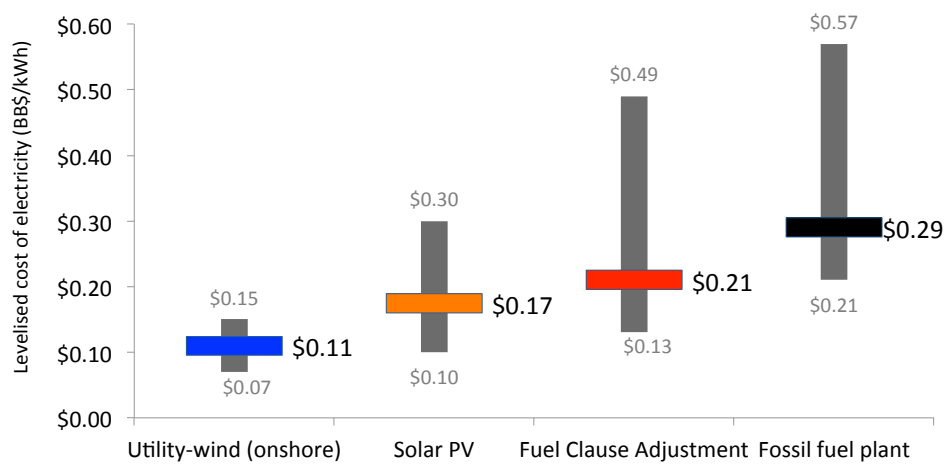


## A look at the different technologies

### Wind

### Why wind?

Levelised cost of energy for different generation options in Barbados



## Past experience in Barbados



### Past experience

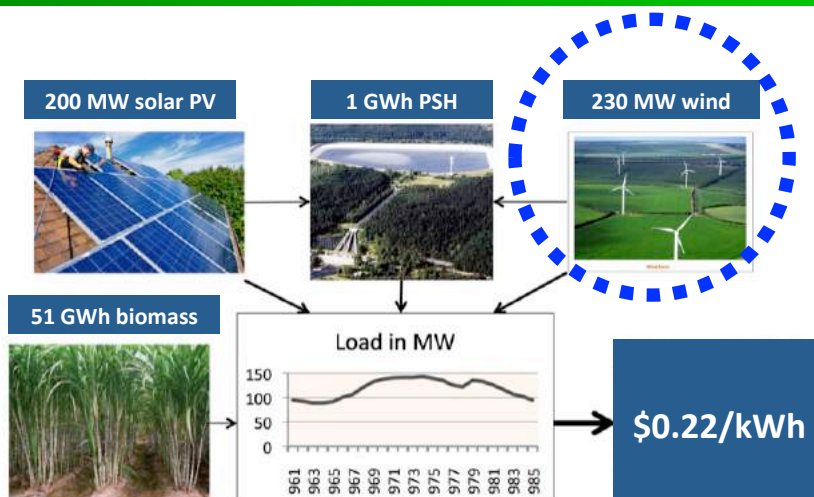
- One wind turbine
- Installed in St Lucy
- Concrete tower
- Stainless steel blades
- Operated for 5 years
- Safety concerns



### Modern turbines

- Greater power output
- Quieter
- Longer lifespan
- Wigton wind farm provides vital Caribbean experience
- Able to survive category 4-5 hurricane

## How much wind do we need?



Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## A desktop study of wind potential for Barbados

### WindPRO 3.0



#### Inputs

- Weather data
- Terrain data
- Surface roughness data
- Wind turbine selection and location

#### Outputs

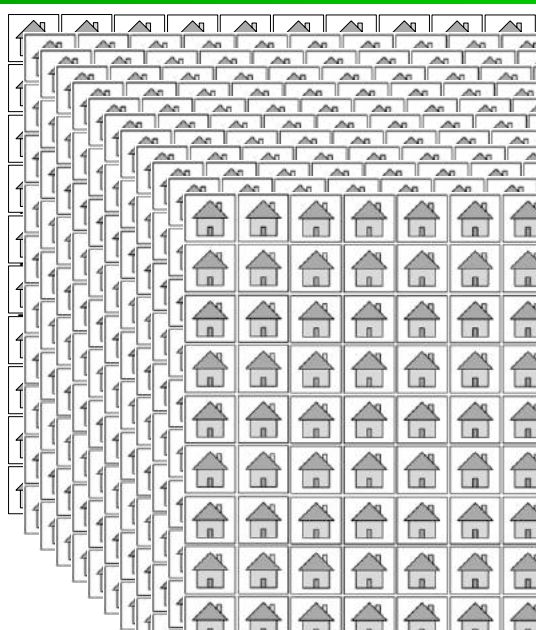
- Energy yield prediction
- Financial modeling
- Electrical integration modeling
- Noise maps
- Shadow flicker maps
- Photomontages

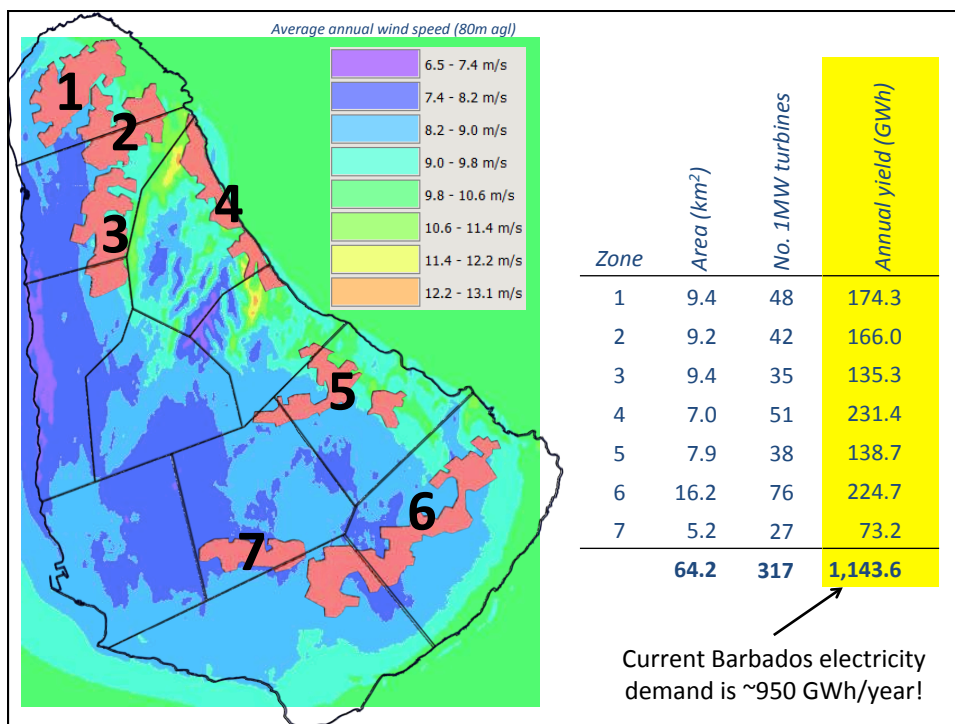
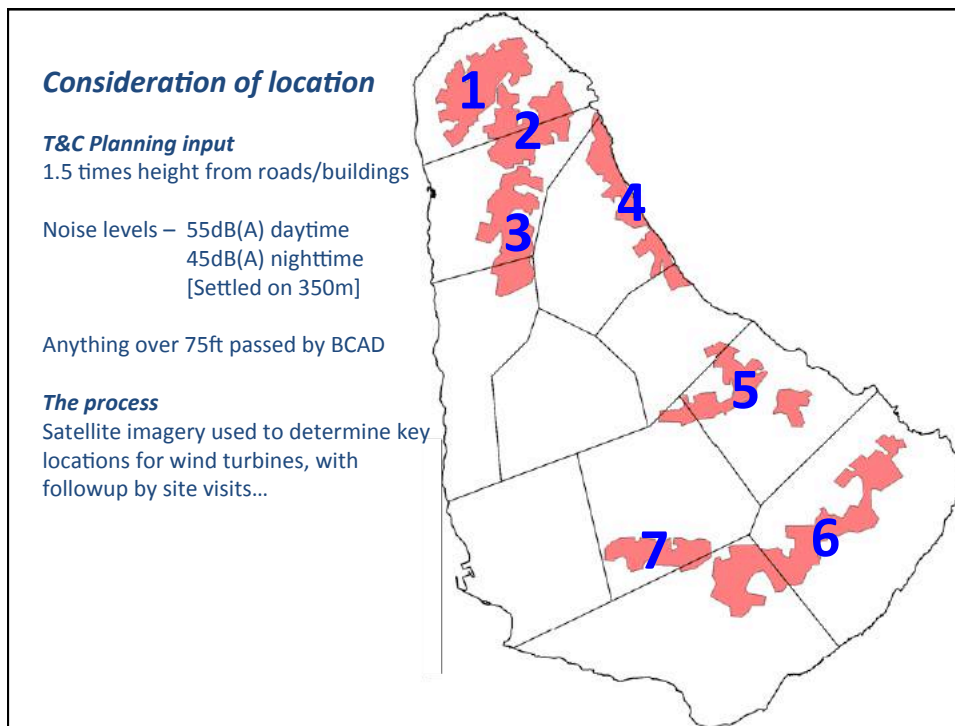
Link: <http://www.emd.dk/windpro/>

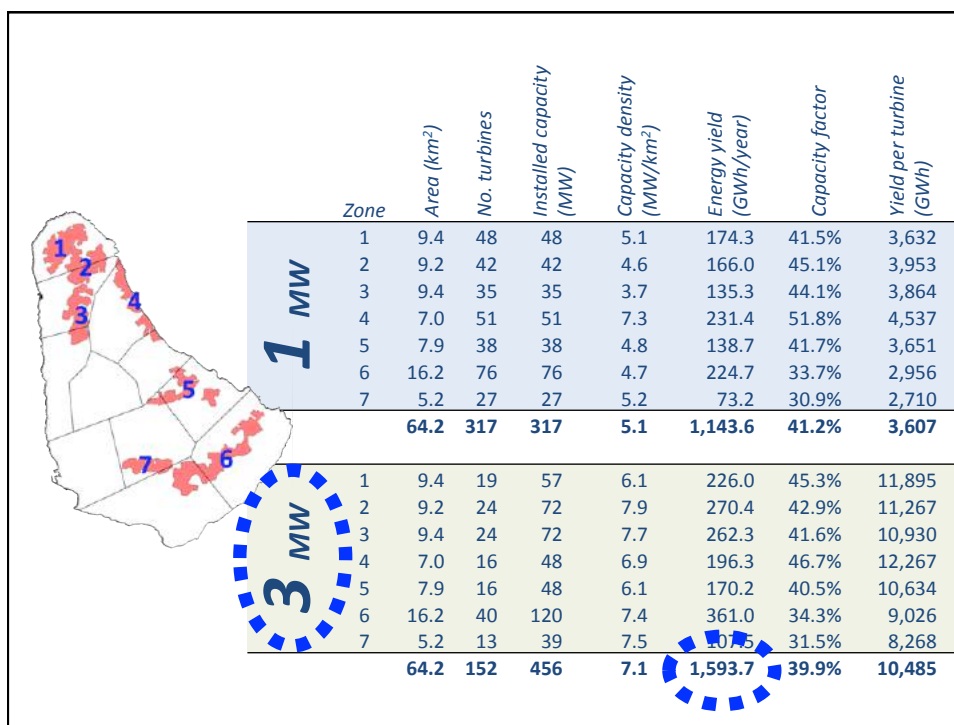
## Wind turbine selection



A 1MW wind turbine can power  
~1,200 homes in Barbados





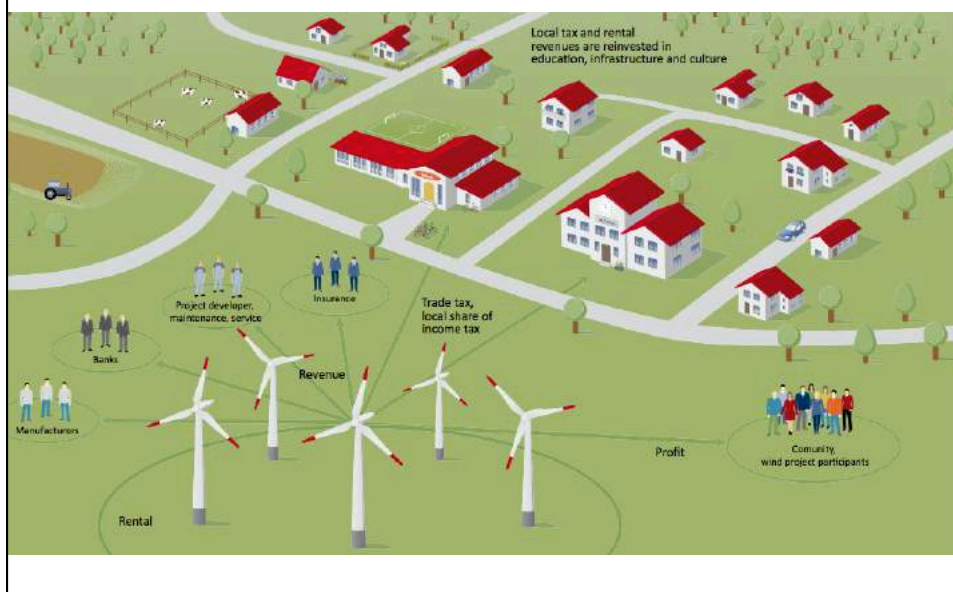


### Next steps for turning technical potential into reality

1. More detailed wind resource assessment
2. Wind power electrical integration study
3. Incorporation of wind into the next PDP
4. Radar system at GAIA
5. Public involvement in the ownership and benefits of wind



## Involve the local community...



## Community wind

### 7 good reasons for local ownership

1. Results in more installed wind capacity
2. Creates local dialogue and acceptance
3. Helps raise public awareness about wind
4. Solves problems and conflicts
5. Local turbines are democratic
6. Local production makes sustainable development understandable
7. Gives people opportunity to act for sustainable development

Source: <http://www.middelgrunden.dk/middelgrunden/?q=en>



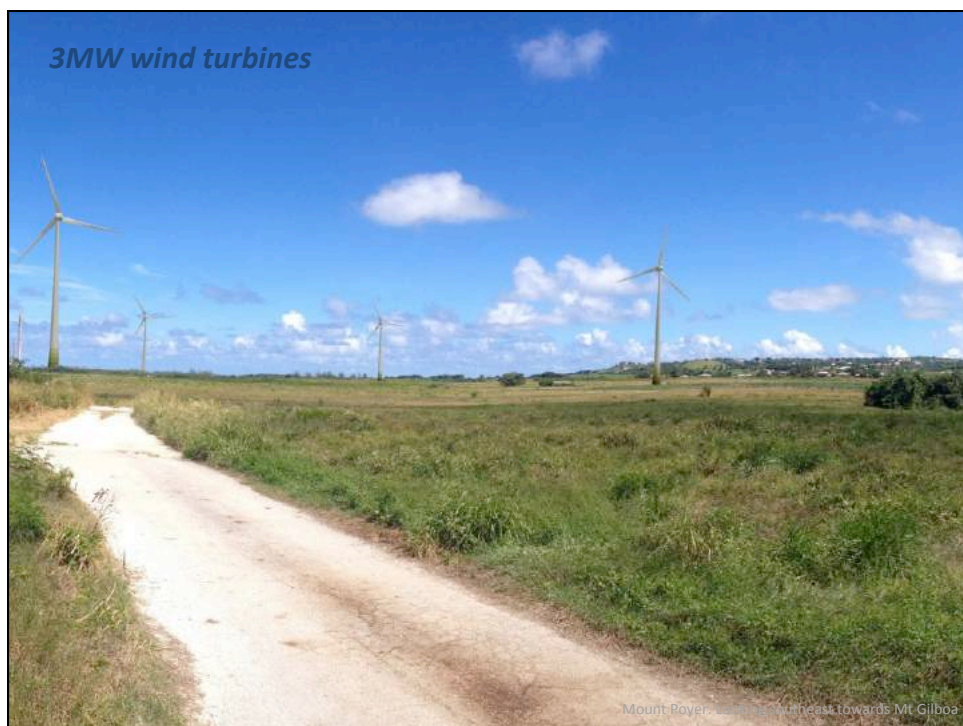
## Make them a tourist attraction!

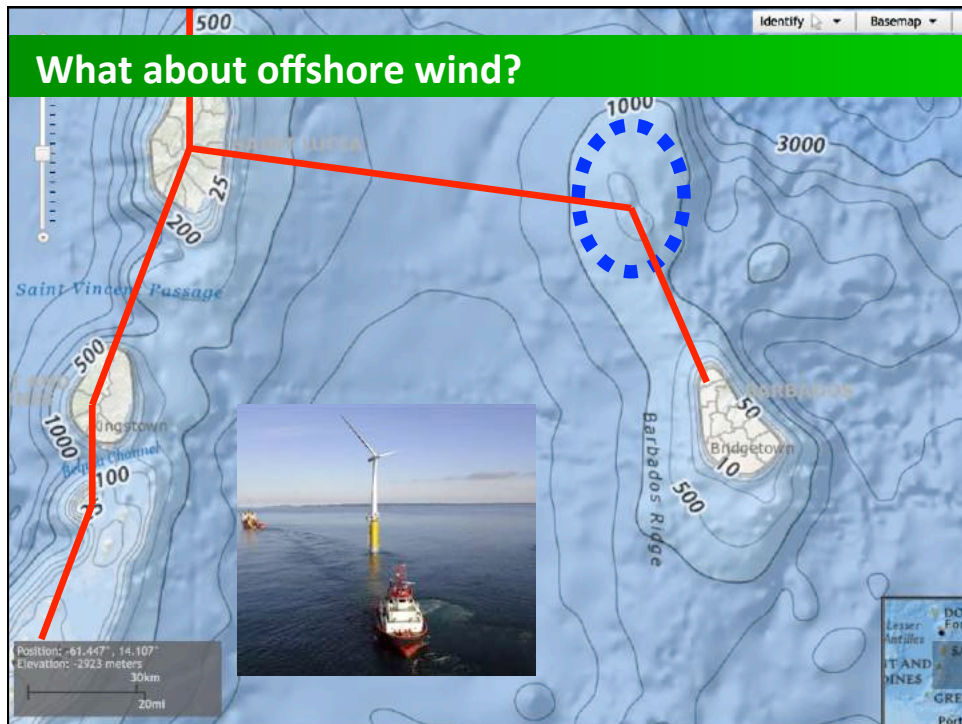


Wind turbines  
with special  
viewing platforms

*1MW wind turbines*









## A look at the different technologies

### Pumped-hydro storage

#### Sea as the lower lake?



- Examples include this scheme in Japan
- Corrosive seawater means more expensive turbines and equipment
- Environmental risk if seawater in upper lake were to leak

## News in Barbados

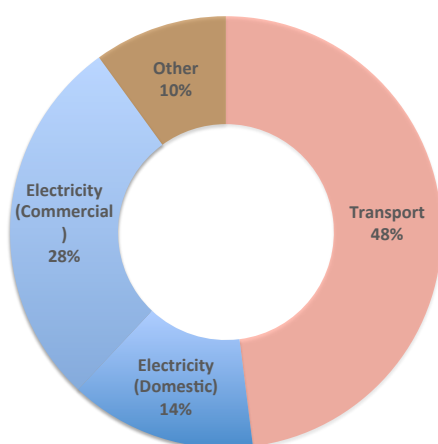
- Williams Ind. Emera Caribbean + Stantec investigating suitable sites.
- 1GWh equals two 1,200,000 m<sup>3</sup> lakes
- Roughly 250m by 250m, and 20m deep

## One possible site...



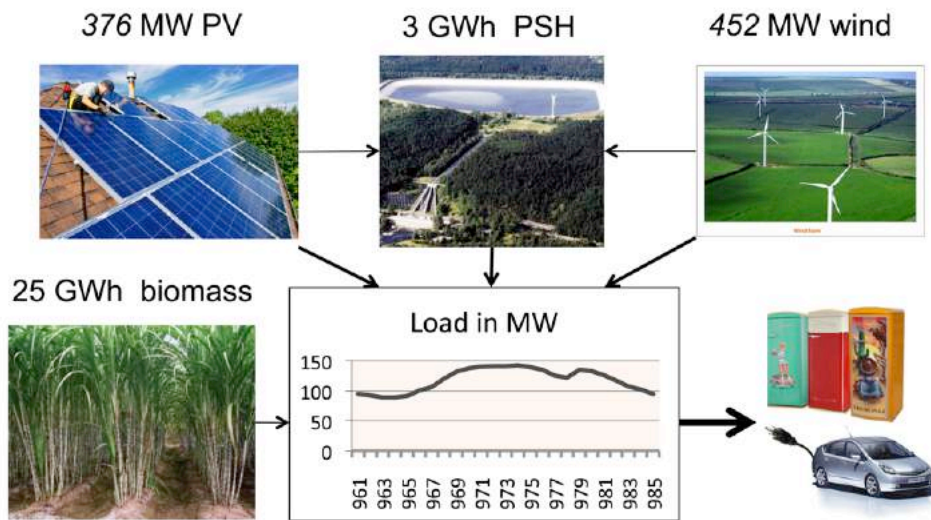
## What about the transport sector?

### What about the transport sector?



- Transport sector accounts for 48% of primary energy consumption on Barbados.
- Electric vehicles offer a way to decarbonise this transport sector
- Also provide lower running costs
- ()
- Could help with grid management using vehicle-to-grid services. Potentially, eventually, negating the need for backup generation from LSD plants

## What about the transport sector?



Source: Homeyer, O. (2014). 100% renewable Barbados. See [www.brea.bb](http://www.brea.bb)

## Conclusions

## Conclusions

- Shift to renewable will increase Barbados's energy security
- Any investment should come from domestic investors
- Onshore wind the cheapest source for foreseeable future
- Barbados has a good onshore wind power potential
- Citizen/community wind ownership should be explored



The Barbados Renewable Energy Association (BREA)  
In Association with  
The Central Bank Of Barbados

International Conference and Exposition  
**SUSTAINABLE ENERGY INDEPENDENCE IN THE CARIBBEAN:  
MAKING IT HAPPEN**

November 10 – 11, 2016  
Lloyd Erskine Sandiford Centre  
Bridgetown | Barbados

### OBJECTIVES

- Explore the realities of energy markets across the Caribbean region.
- Synchronize energy policies with a focus on energy efficiency and renewable energy.
- Empower civil society and businesses to inform the structure of the sustainable energy market through a replicable model for associations.
- Explore the cross sectoral benefits of sustainable, affordable energy.
- Formation of a Caribbean Sustainable Energy Association.

### PROGRAMME

Business Presentations  
Individual Presentations  
Ministerial Discussion Panel  
Thought-provoking "Lightning Fire Round"  
Breakout Sessions






## FEATURED SPEAKERS

<b>The Hon. Didier Dodgely</b> Minister of Renewable Energy, Government of the Seychelles	<b>Dr. Mark Glick</b> Hawaii State Energy Office, Government of Hawaii	<b>Prof. Henrick Lund</b> Professor, Development Planning, Aalborg University, Denmark
<b>Dr. Daniel Kammen</b> Professor of Energy, University of California, Berkeley	<b>Ms. Loretta Duffy-Mayers</b> Regional Programme Manager Caribbean Hotel Energy Efficiency and Renewable Energy Action Advanced Programme, Caribbean Hotel and Tourism Association	<b>Prof. Olav Hohmeyer</b> Professor Energy, University of Flensburg Germany



### Register at [www.brea.bb](http://www.brea.bb)

**Come join us  
in this Conference-**  
Help us to build sustainable  
energy independence in the Caribbean!!



**Thank you!**

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