



# Developments, Potential and Prospects of Renewable Energy in Ghana



by  
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# Presentation Outline



- Overview of Ghana
- Ghana's Energy Resources
- Renewable Energy Resource Potential
- Renewable Energy Policy Strategy
- Priority Areas of Renewable Energy Investments
- Some Renewable Energy Applications in Ghana
- Other Renewable Energy Technologies
- Renewable Energy Technologies for Off-grid communities



3

## Overview of Ghana



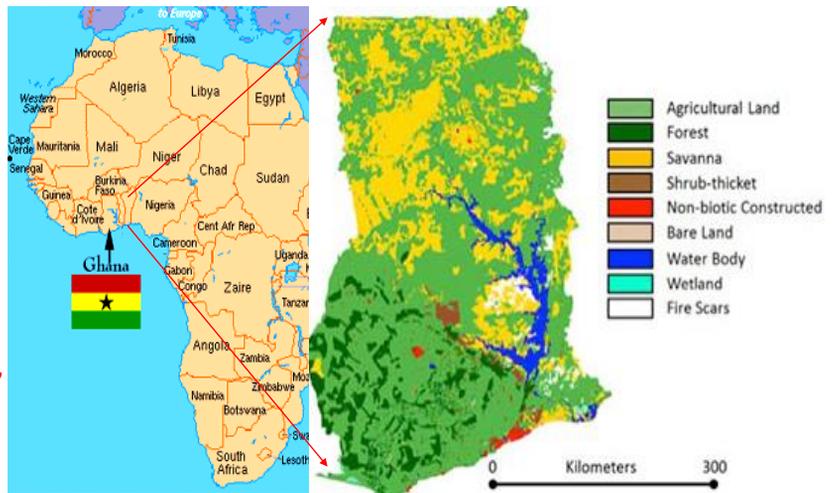
Land Area: **238,500 km<sup>2</sup>**

Population: **24,658,823** (2010 Census)

Electricity Access: **80%** (2015)

Average GDP Growth Rate: **7%** (2013)

Major Export: **Cocoa, Gold, Timber, Bauxite, Oil and Electricity**



4

# Ghana's Energy Resources



Biomass

Oil ( and Gas)



Hydro



Solar

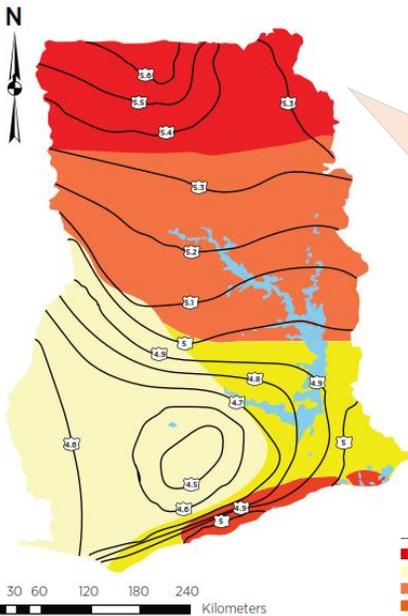


Wind



5

## Potential Solar Energy Resource in Ghana



High solar irradiation **4-6kWh/m<sup>2</sup>/day** with sunshine duration of about **1,800-3,000 hours/year** to support grid and off-grid electrification

Global solar irradiation increases towards the Northern sector of the country

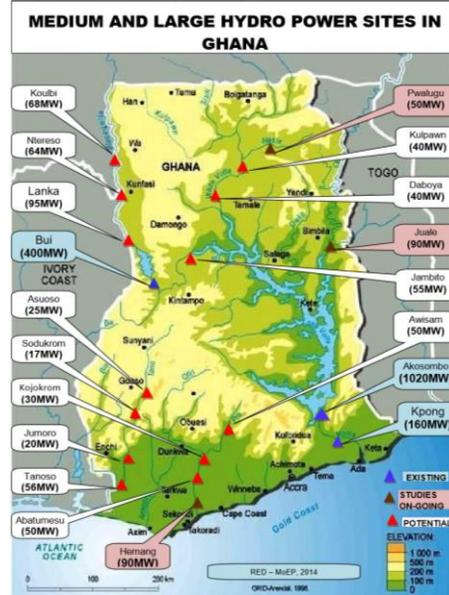
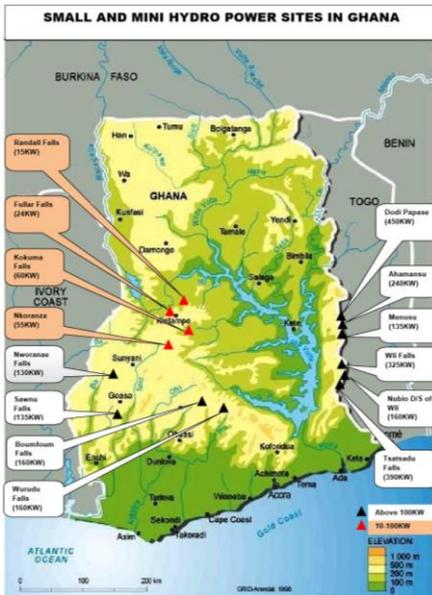
- Global (Total) Radiation (kWh/m<sup>2</sup>/day)
- Very Low Diffuse Radiation (32%)
- Very High Diffuse Radiation (48%-53%)
- Moderate Diffuse Radiation (41%-45%)
- Low Diffuse Radiation (36%-40%)
- High Diffuse Radiation (45%-47%)

Source : Ministry of Power

6



# Potential Hydro Sites



7

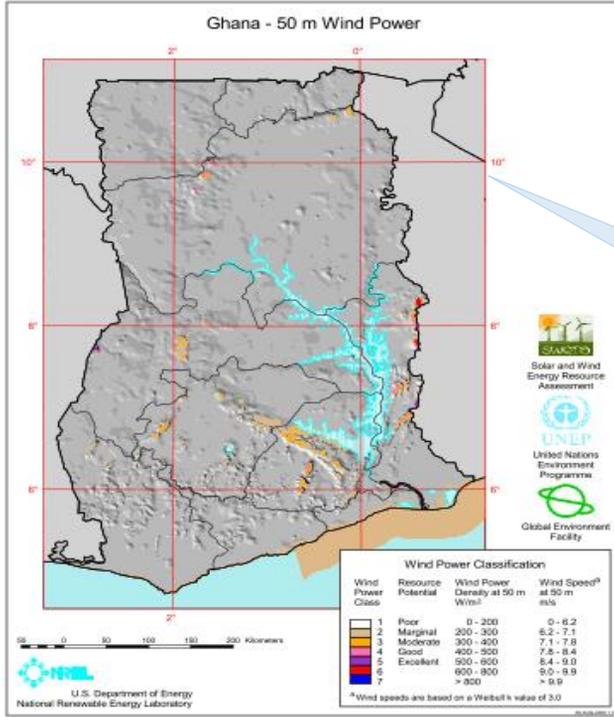
## Potential Hydro Sites – Cont'd



- Ghana has several potential hydro sites with individual capacities of 4 kW to 2,000 kW yet to be explored
- Hydro power schemes of up to 100 MW qualify for renewable electricity Feed-in-Tariff (FiT) under Ghana's Renewable Energy Law, Act 832.
- Ghana currently does not have a Renewable Hydro power plant per the Renewable Energy Law.



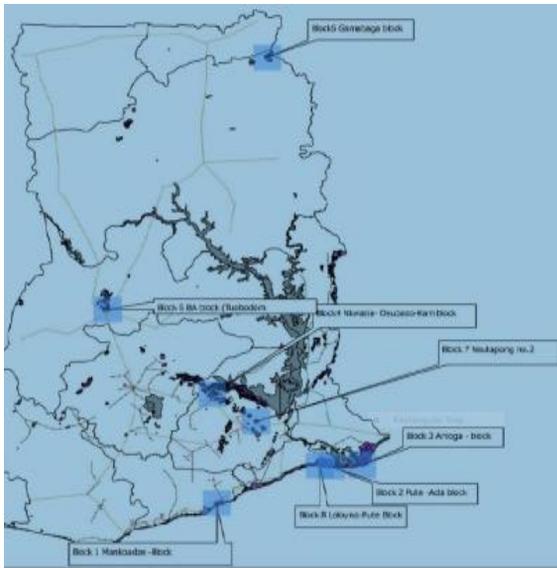
8



**Wind Power Resource Potential of Ghana - NREL**



# Wind Power Resource Potential – Cont'd



**Volta River Authority (VRA) of Ghana's identified potential wind power project sites;**

**Greater Accra – Lekpoguno, Akplanya**

**Volta region – Anloga, Angola West**

**Brong Ahafo – Amoma North and South**

**Northern region - Gambaga**

**Wind speeds in Ghana range from low to medium**

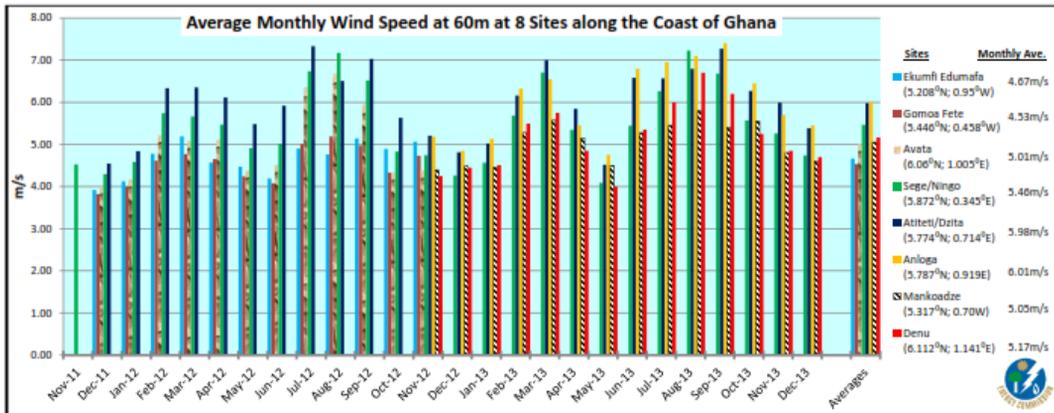


## Wind Power Resource Potential – Cont'd



The Energy Commission of Ghana also conducted resource assessment at eight (8) locations along the coast of Ghana to measure wind data at reference height of 60m above ground level

The monthly wind speed data for the various eight (8) sites are shown in the graph below.



11

## Wind Power Resource Potential – Cont'd

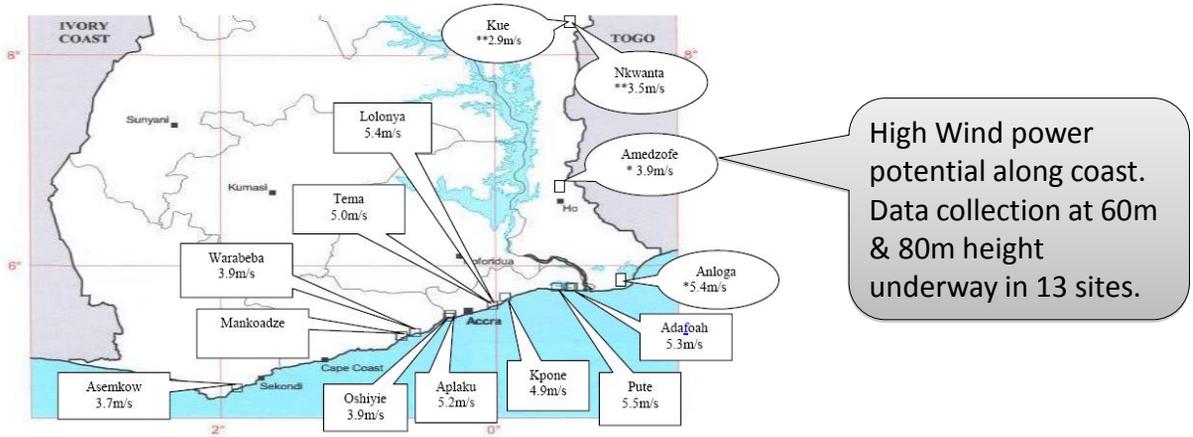


- Wind speeds at the identified sites range from 4 – 6 m/s at a mast height of 60m.
- Wind speeds increase with an increase in mast height, therefore there is the potential for higher wind speeds for power generation.
- Results show that wind power projects are economically viable in the Ghana.
- However, Ghana can not boast of any commercial wind power project in the country although several project developers have shown interest in development of the wind sector.



12

# Wind Power Resource Potential – Cont'd



The wind data can be acquired by investors who seek to develop wind power in Ghana.

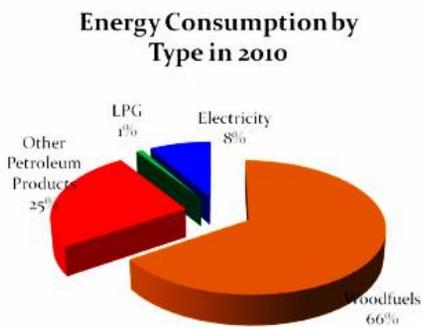


13

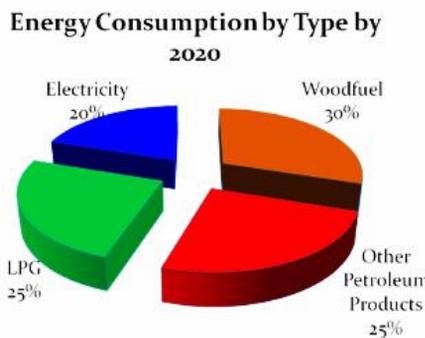
# Renewable Energy Policy Strategy



Achieve universal access to modern energy forms by 2020



Ghana is predominantly a woodfuel-based Energy economy



Universal access to electricity and high penetration of LPG to substitute for woodfuels

Reduce share of combustible renewables (woodfuel) in total energy mix to levels below 50%

Use of clean cooking fuel alternatives e.g. LPG and efficient woodfuel cookstoves



14

## Renewable Energy Policy Strategy – Cont'd



**Increase the contribution of RE (including hydro, solar, biomass and wind) by 10% for grid, mini grid and off-grid applications; by 2020.**

PLANT TYPE	QTY	TOTAL CAPACITY (MW)	%
THERMAL POWER PLANT**	11	2,061	56.25%
LARGE HYDRO POWER PLANTS**	3	1,580	43.12%
GRID CONNECTED SOLAR**		23	0.63%
OFF GRID SOLAR	41,820	0.8	
OTHER RENEWABLES (Biomass)	4	4.034	
<b>TOTAL INSTALLED CAPACITY**</b>		<b>3,664</b>	
<b>CONTRIBUTION OF MODERN RE TO GRID**</b>		<b>23</b>	<b>0.63%</b>



**EXCLUDES STANDBY DIESEL/PETROL GENERATORS AND INDIVIDUAL SOLAR HOME SYSTEMS**

15

## Renewable Energy (RE) Act 2011 (Act 832)



- Provides the fiscal incentives and regulatory framework to encourage private sector investment.
- Key Provisions includes:
  - **Feed-in-Tariff Scheme** under which electricity generated from renewable energy sources would be offered a guaranteed price.
  - **Purchase Obligation** under which power distribution utilities and bulk electricity consumers would be obliged to purchase a certain percentage of their energy required from electricity generated from renewable energy sources
  - **Net Metering (distributed generation)** under which RE generated on site may be delivered to the local utility to offset the cost of electricity provided by the utility.



16

## Key Provisions in the RE Act 832



- **Off-grid Electrification** – promote Mini-grid and stand-alone RE systems for remote off-grid locations
- **Woodfuels** – Promote efficient production and utilization of woodfuel use for cooking,
- **Renewable Energy Fund** to provide incentives for the promotion, development and utilization of renewable energy resources.
- **Establishment of Renewable Energy Authority** to own, implement and manage renewable energy assets on behalf of the State. (particularly for off grid electrification)



17

## Priority Areas for RE investments (Grid connected)



Programme	Preliminary Target Installed Capacity by 2020
Feasibility study and the development of medium hydro potential sites	3-6 potential sites (200-300MW)
Utility Scale Biomass & W2E (Waste to Energy) Power Plants	50-100MW
Utility Scale Wind Park	150-300MW
Distributed grid connected RE generation through Net-metering (solar, wind, biomass, hydro)	30-100MW
Utility Scale Solar Farms	150 MW



18

## New Regulations for Utility Scale Solar Power Plants (Oct. 2014)



- In order to maintain the integrity of the national grid,
  - A total nation-wide capacity for Solar PV Plants without grid stability/storage is limited to 150MWp.
  - Maximum of 20MWp per Solar plant without grid stability/storage shall be allowed to be connected to 161KV or 330KV at any solar PV generation site.
  - Maximum of 10MWp per plant without grid stability/storage shall be allowed to be connected to the Distribution System at any solar PV generation site.



19

## Priority Areas for Off-grid Renewables and Mini grid Energy investments

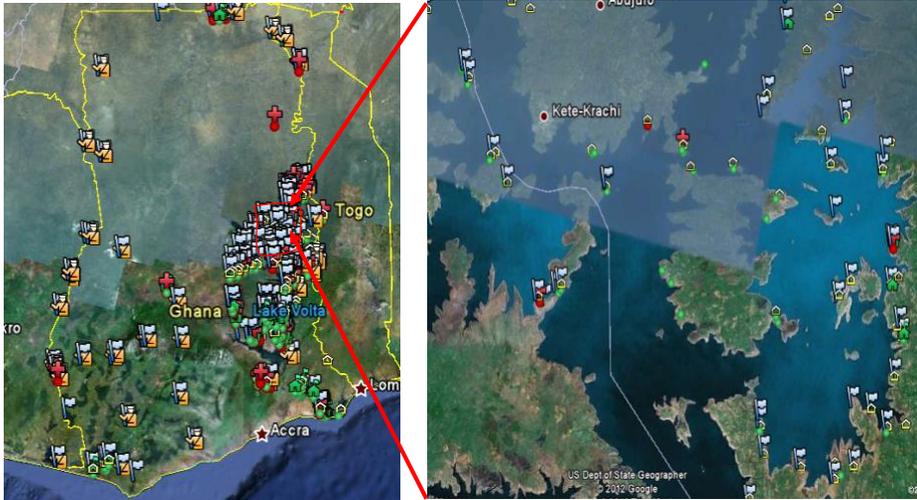


Programme	Target by 2020
Mini Grid Renewable Energy based electrification in isolated communities	20–50 communities (2MW)
Deploy Solar Home Systems (SHS) in isolated off-grid households	50,000 SHS (5MW)
Deploy Solar Lanterns (SL) with mobile phone charging facilities through local assembling and partial subsidy	2 million lanterns (20MW)
Solar electrification in off-grid public facilities (schools, clinics, security outposts)	6,000 Public facilities (1.5MW)
Solar Community Lighting Systems (Solar Street lights) for isolated communities	12,000 systems (1.5MW)
Pilot Wind & solar water pumps, Biogas, Solar crop dryers etc to support SMEs in Agric	200 systems



20

## Map of Installed Solar Home Systems in Ghana



21

## Renewable Energy Applications in Ghana



### Off-grid Solar Electrification

- Solar for off-grid application has potential to increase energy access for:
  - Limited lighting and battery charging
  - ICT (TV, radio, entertainment phone charging)
- Significant impact quality of life of rural people
- Mobile phone charging, music and other forms of entertainment are made possible with solar power.
- Solar has potential to support ICT education in remote rural schools



22



## Solar Street lights

- Community Solar (street) lights have reduced the risk of wild animal/reptiles (snakes) confrontation.
- Women take advantage of the Community solar light for economic activities.
- Solar streetlight and cameras at security outpost has enhance visibility of security officials.



Rural communities



Cities



## Enhanced Communication





## Improved Water Delivery

- Solar water pumps prevents drinking of contaminated water from rivers and streams.



- Clearly the economic benefits of Solar PV far out ways the financial cost involved.

25



*Solar-wind hybrid micro-grid at Peditorkope, an island community in Ghana*

The Southeastern island of Peditorkope is located in the Dangme East District of Ghana. The community with a population of about 1,500. The facility is an AC micro-grid hybrid system of 39 kW solar, 11 kW wind with a 30 kVA diesel back-up generator. The facility is to generate power for the community and to support economic activities on the island. A similar facility has also been built for some surrounding islands to generate power for domestic and commercial purpose.



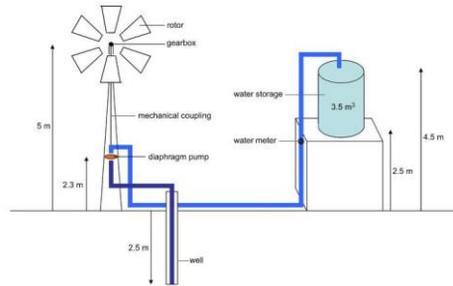
26



## Tiptop Farms, Anloga – Hybrid System



- Renewable Energy demonstration farm located in Anloga in the Keta District.
- Farm started with a 1.6m diameter wind pump irrigating 0.5 acres daily
- Currently the farm has a total of 20 acres under all year irrigation from solar, wind, biogas and electricity.



27



*Solar-biomass drier at the Ejura Market in the Ashanti region of Ghana*

This is a solar-biomass hybrid drier built by Pens Food Bank in collaboration with the Agricultural Engineering Department of the Kwame Nkrumah University of Science and Technology (KNUST) in Ghana. The drier can be used for drying 5mt of produce per batch (2 batches/day) over a period of 8 hours. It has a biomass furnace which uses 30 kilos of corn husk for drying harvests per batch during the major (raining) season. Biomass furnace pump and air circulation fans in the drier are powered by solar PVs.



28



*Solar water purification at Nabogu*

The Facility provides clean potable water to about 1000 inhabitants at Nabogu and surrounding villages. The facility runs on a 5kW solar panel powering 2 DC pumps and equipment for purification. An efficient purification technology called Advanced Multi-Stage Filtration and Reverse Osmosis is employed for water purification.



29

## Volta River Authority's Grid-connected Solar Plant at Navrongo



- 2.5MW
- Commissioned on 9th of May, 2013.

- 3,622 Polycrystalline modules
- 11.79 acres
- Constructed by China Wind Power



30



**SOLAR WATER HEATERS IN GHANA**



*Solar water heaters for steam generation for industrial use – HPW Fresh & Dry Limited, Ghana*



*Solar water heaters in some hotels in Ghana*



**Installed Solar Thermal Capacity in Ghana (m2 and kWth)**

As at the end of July, 2015, the total installed capacity of solar water heating systems was estimated to be 1018.48kWth (1454.97 m2) - ECREEE

**Improved Health Facilities – Solar Vaccine Refrigerators**



- Community Health Planning and Service (CHP) centres equipped with solar vaccine fridges.
- Solar lights for the CHPs makes it possible to see patients at night
- Child delivery and other emergency health cases could be attended to at night.



### 20MW Solar PV Plant at Onyandze in Western region of Ghana

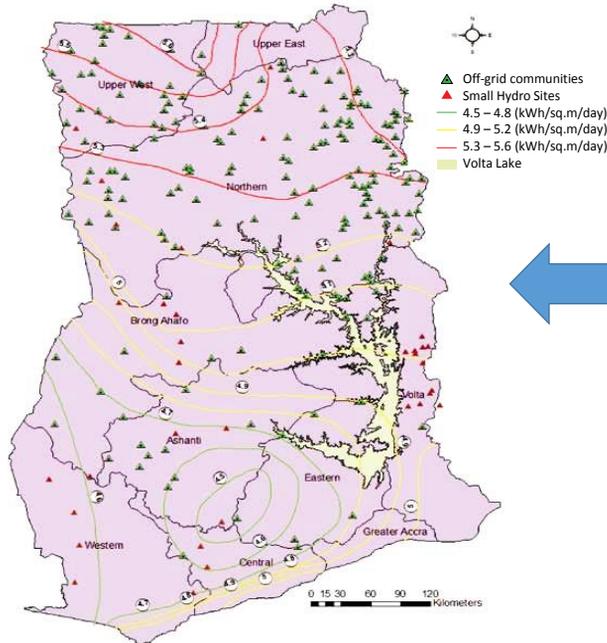
Built by BXC Ghana Company Ltd. ( a subsidiary of Beijing Fuxing Xiao-Cheng Electronic Technology Stock Com Ltd.)



### Other RE Technologies deployed in Ghana



## Map of Recommended Off-grid Communities in Ghana with Solar Radiation Levels



More opportunities  
for investment in  
solar energy  
applications



35

## Conclusion



Ghana is committed to the development and promotion of renewable energy.

The RE Law 2011 (Act 832) presents unique opportunities for the private sector to harness the benefits of renewable energy in Ghana.

Ghana has the right enabling environment for attracting private sector investment in sustainable energy solutions.



- Political stability and good governance;
- Strong and independent institutions;
- The rule of law;

- Free and independent press;
- Transparency and accountability; and
- A strong civil society

36

**Can we rely solely on Renewable Energy?**

**Is the future really going green?**

**Do renewables make economical sense?**

**谢谢**  
**THANK YOU!**

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37

