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Energy Storage & Transmission

By



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Lecture (8)
15– 04 - 2019





Egypt



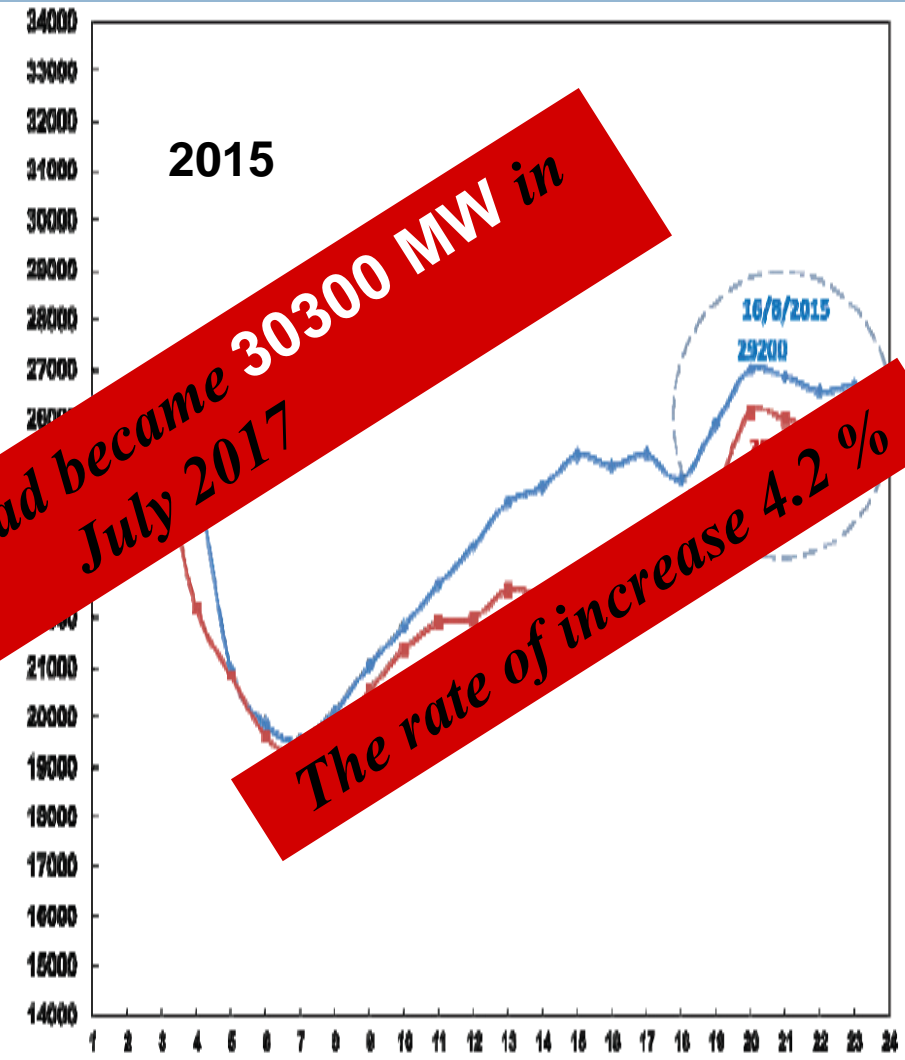
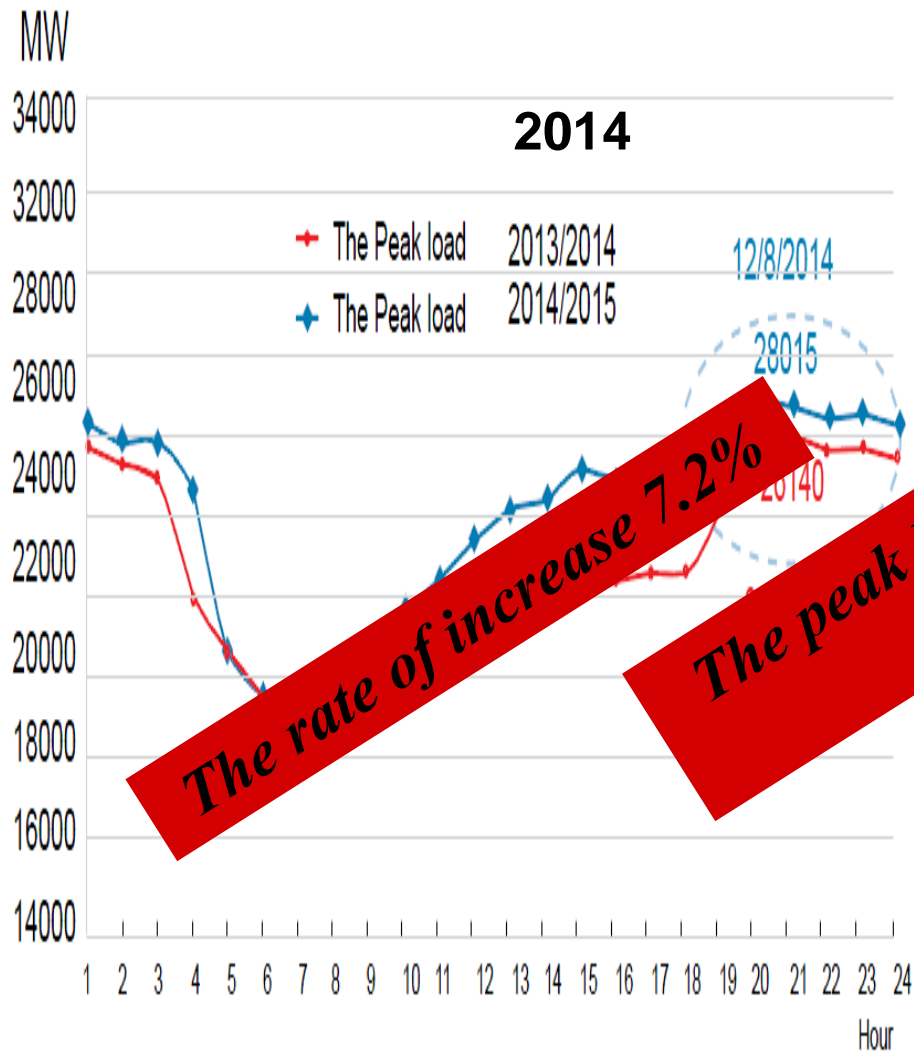
Present and Future of Renewable Energy in Egypt and Challenges

Egypt

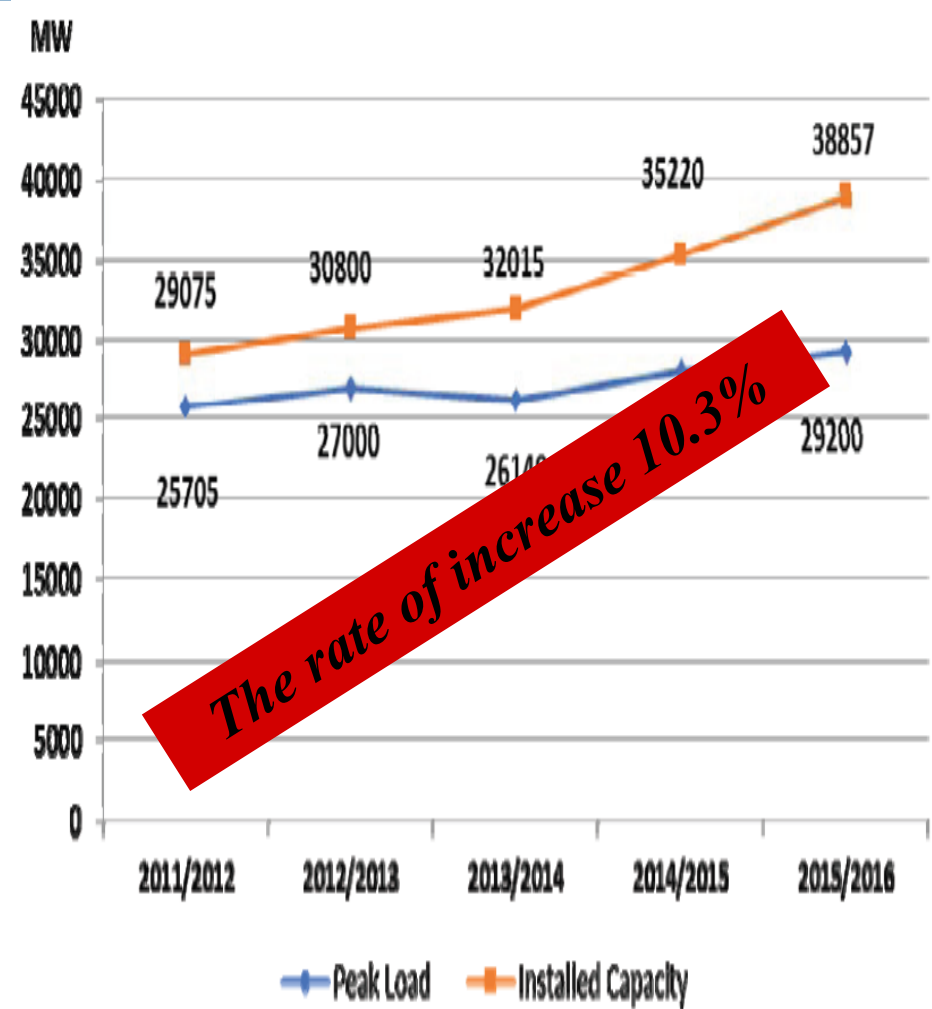
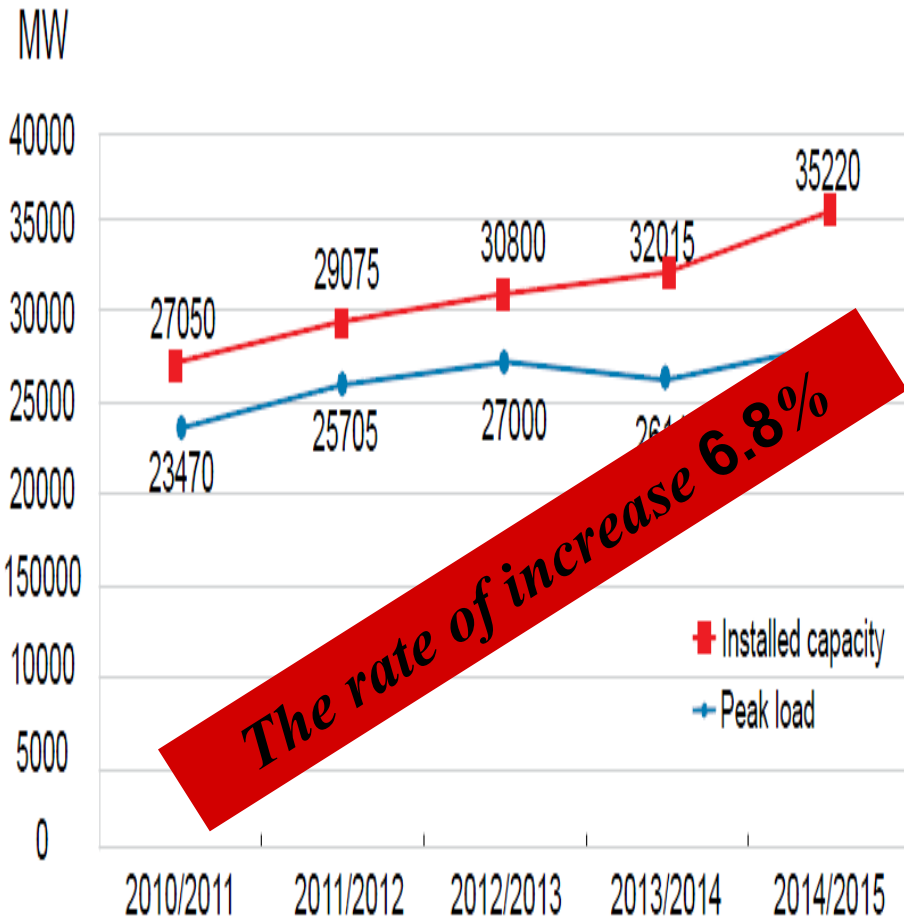
- Area: 1002450 km².
- Population (local): 94798827 person
- Population (overseas): 9.4 million person



The Peak Electrical load



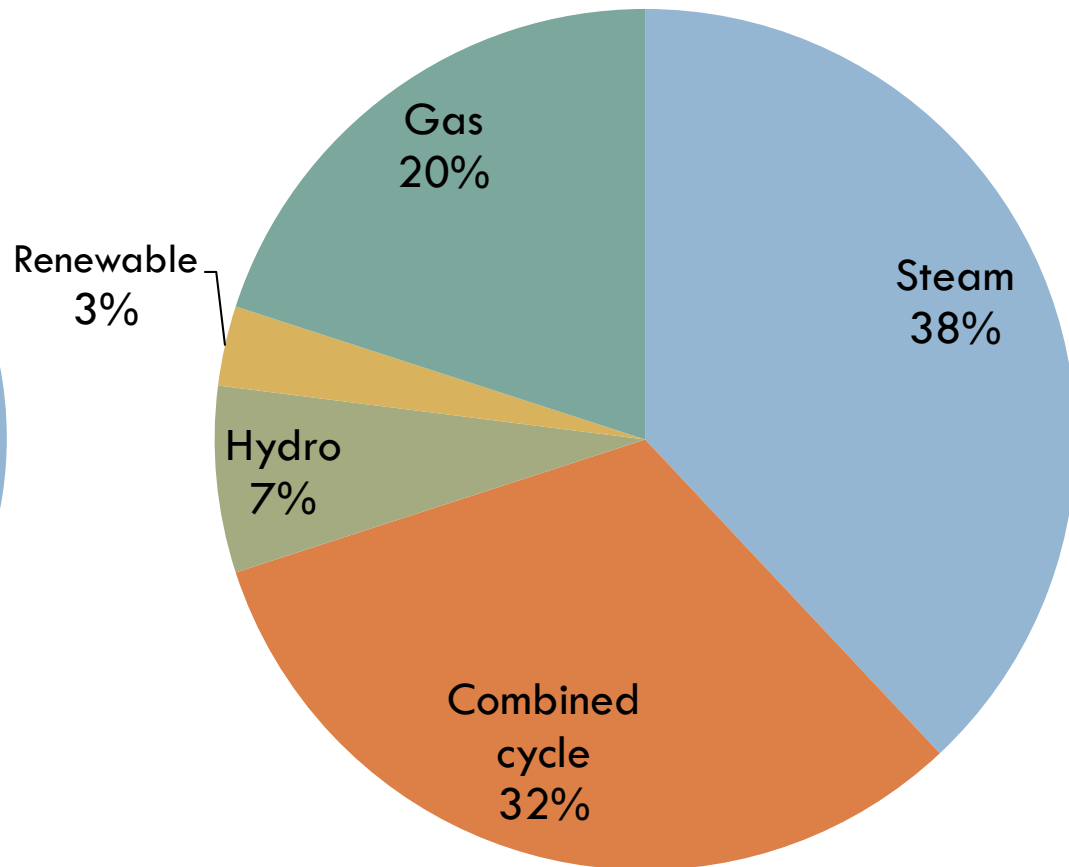
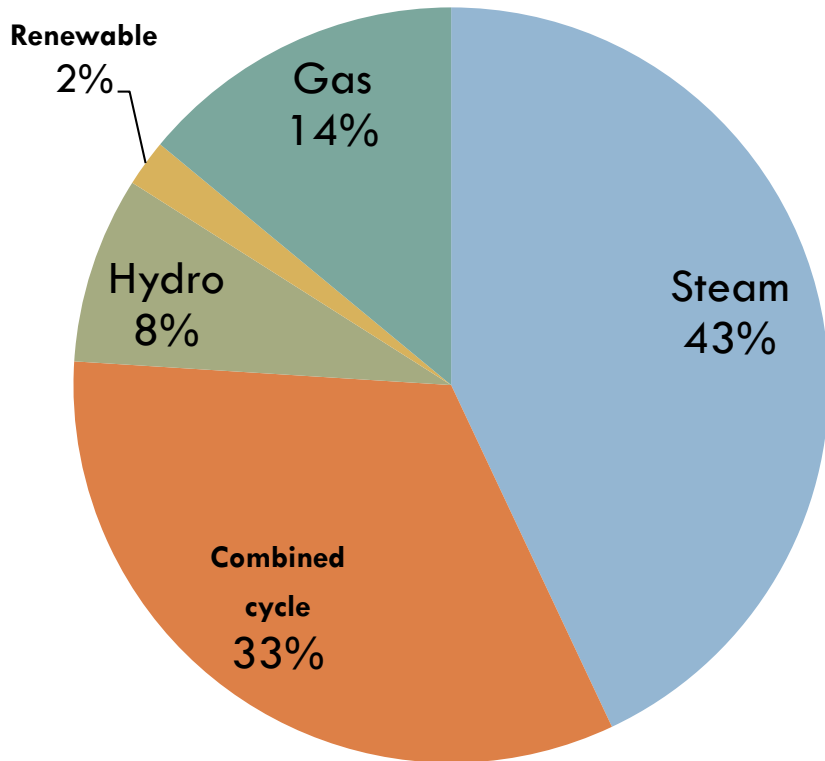
The Installed capacity



Energy share

2014-2015

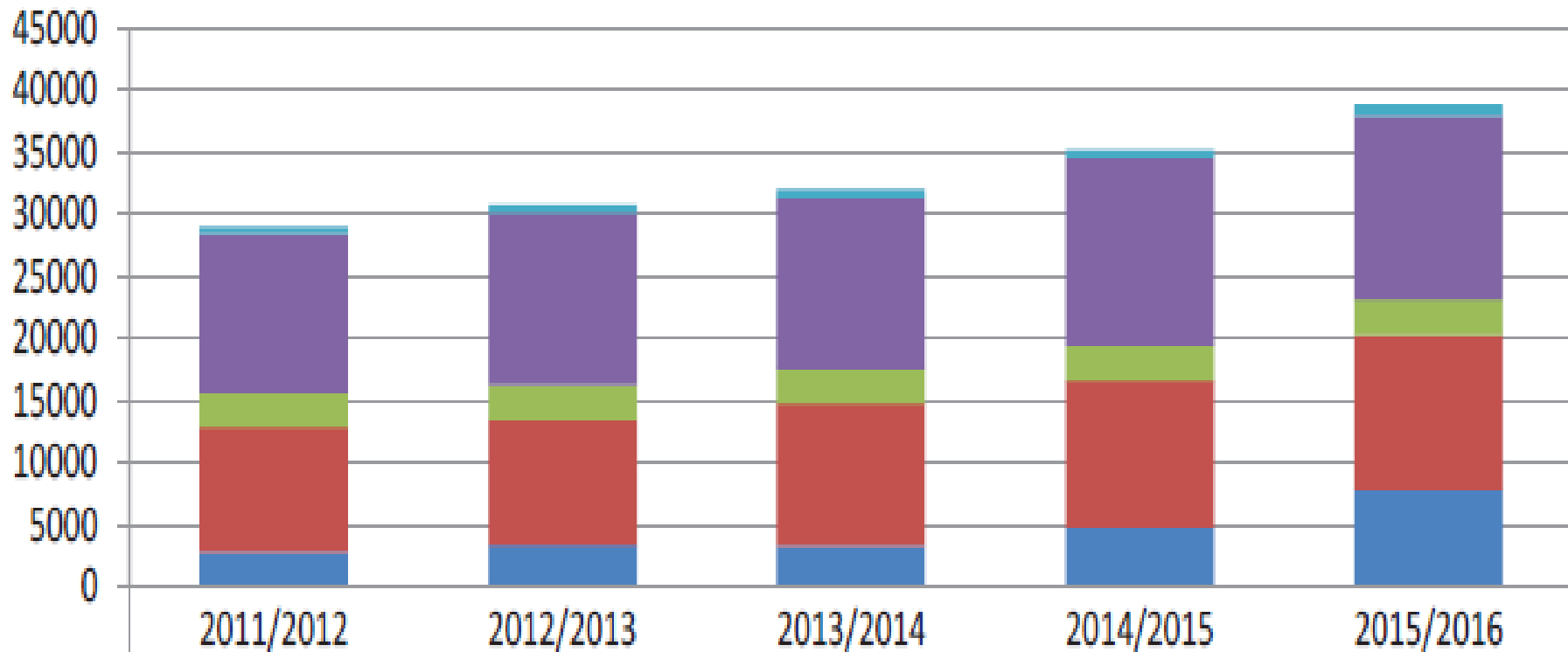
2015-2016



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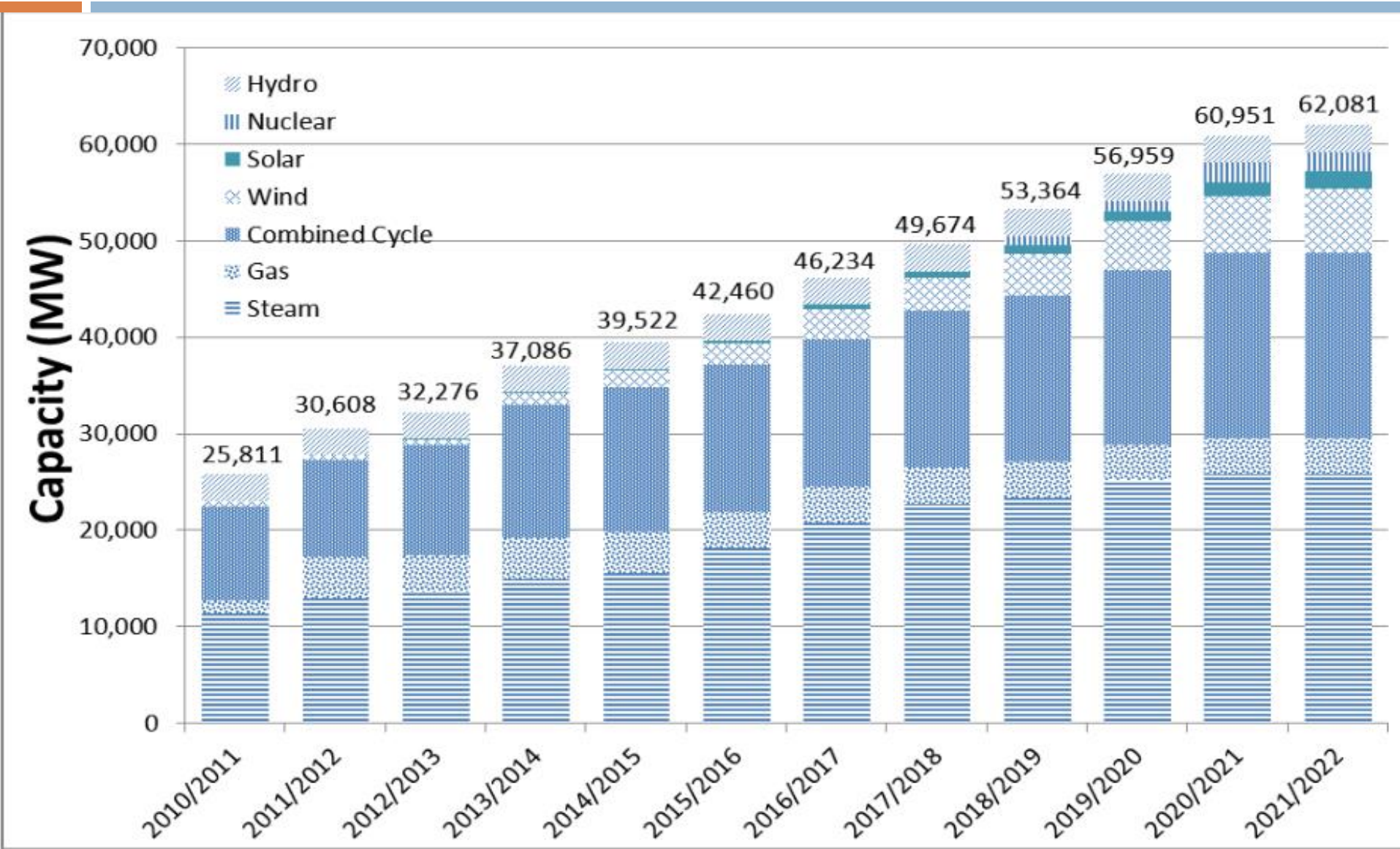
Installed Capacity Development by type of Generation

MW



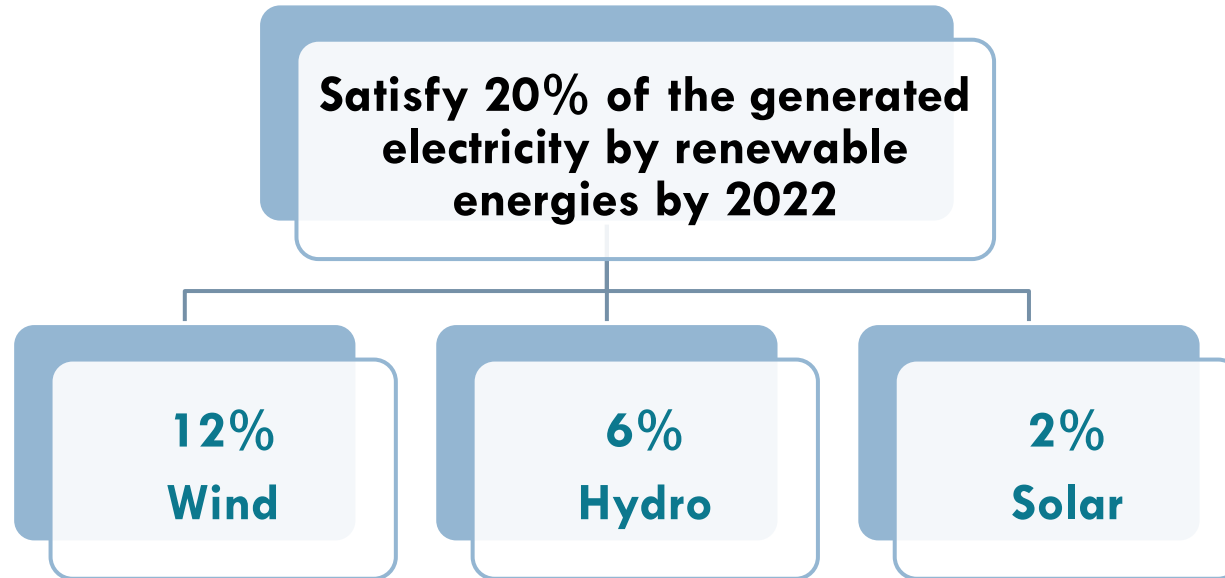
Renewables	687	687	687	687	887
Steam	12685	13808	13783	15082	14798
Hydro	2800	2800	2800	2800	2800
C Cycle	10077	10080	11330	11777	12527
Gas	2826	3425	3415	4874	7845
Total	29075	30800	32015	35220	38857

Expected capacity until 2022



NREA Strategy

In February 2008, the Supreme Council of Energy approved an ambitious plan to:



- In July 2012, an Egyptian Solar Plan has been approved by the Cabinet which targeting to install about 3500 MW by 2027.
- The strategy includes the construction of wind projects with the participation of the private sector to bring the total installed capacity to 7200 MW by 2022.

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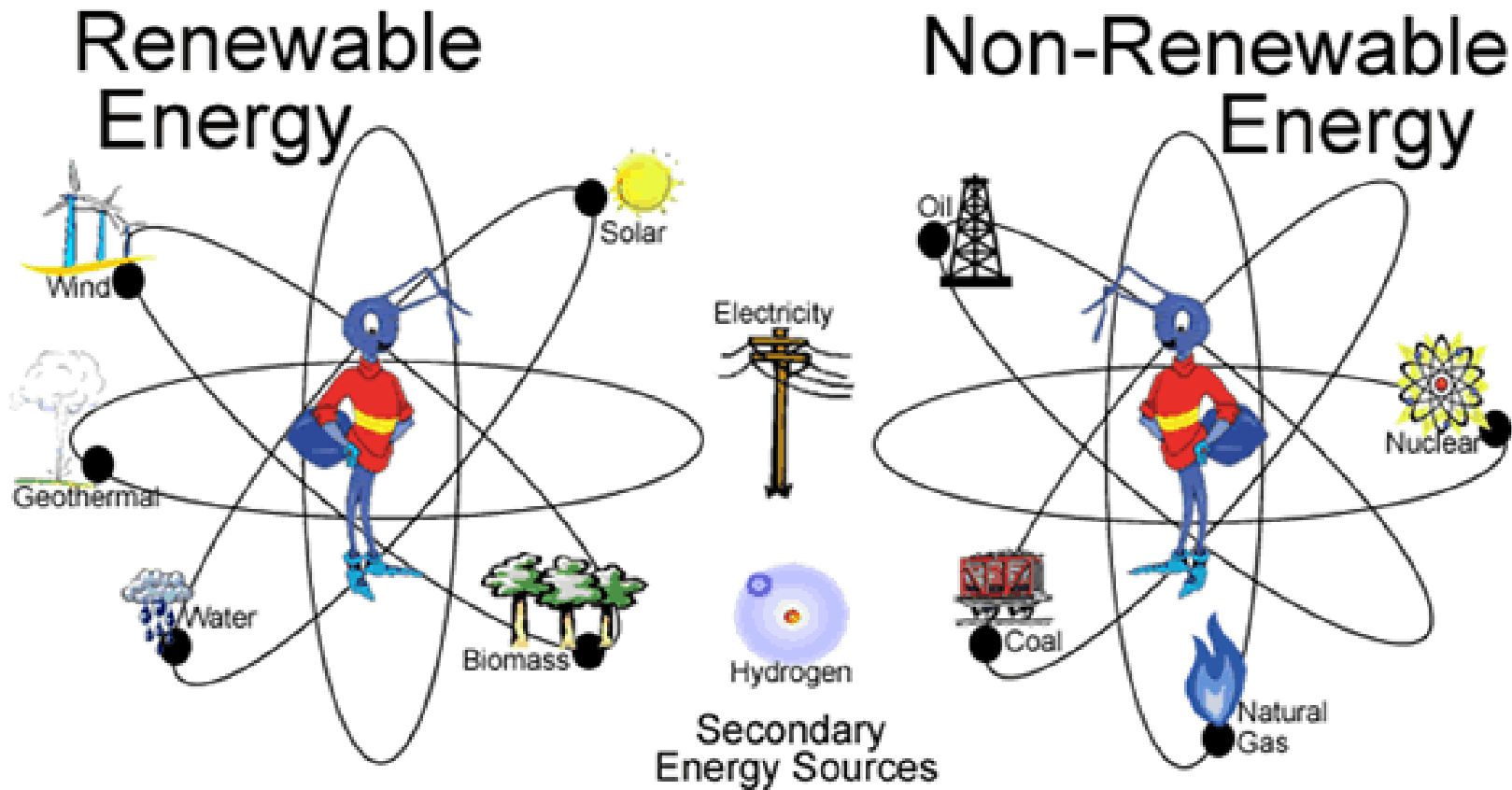
The Egyptian Electricity Holding Company is coordinating with the New and Renewable Energy Authority (NREA) in the following fields:

- 1- Wind energy project 250 MW at the Gulf of Suez.
- 2- Two Solar power plants 200 MW project at Kom Ombo.
- 3- Renewable Energy Projects with total capacity of 550 MW at west of the Nile River as follows:
 - 250 MW wind energy.
 - 200 MW Photo Voltaic (PV).
 - 100 MW from concentrated solar thermal (CSP).

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Why Renewable Energy?

Sources of Energy



1- Finite Resources of the convention energy sources

- | | | |
|-----------------------|----------------------|------------------|
| 1- Oil | enough for | 30 years |
| 2- Natural gas | enough for | 60 years |
| 3- Coal | enough for | 100 years |
| 4- Nuclear | enough for | 85 years |
| 5- Renewable | Last for ever | |

2- The Environmental Impact of Conventional Energy Use

All fossil fuels (oil, natural gas and coal) create carbon dioxide.

Carbon dioxide increases in the earth atmosphere.

Nitrogen oxides, NO_x + Sulfur, SO_x creates acid rain.

Global warming is predicted as a result of carbon dioxide concentration increases in the earth atmosphere.

3- Action to be Taken to Stabilize Climate Change

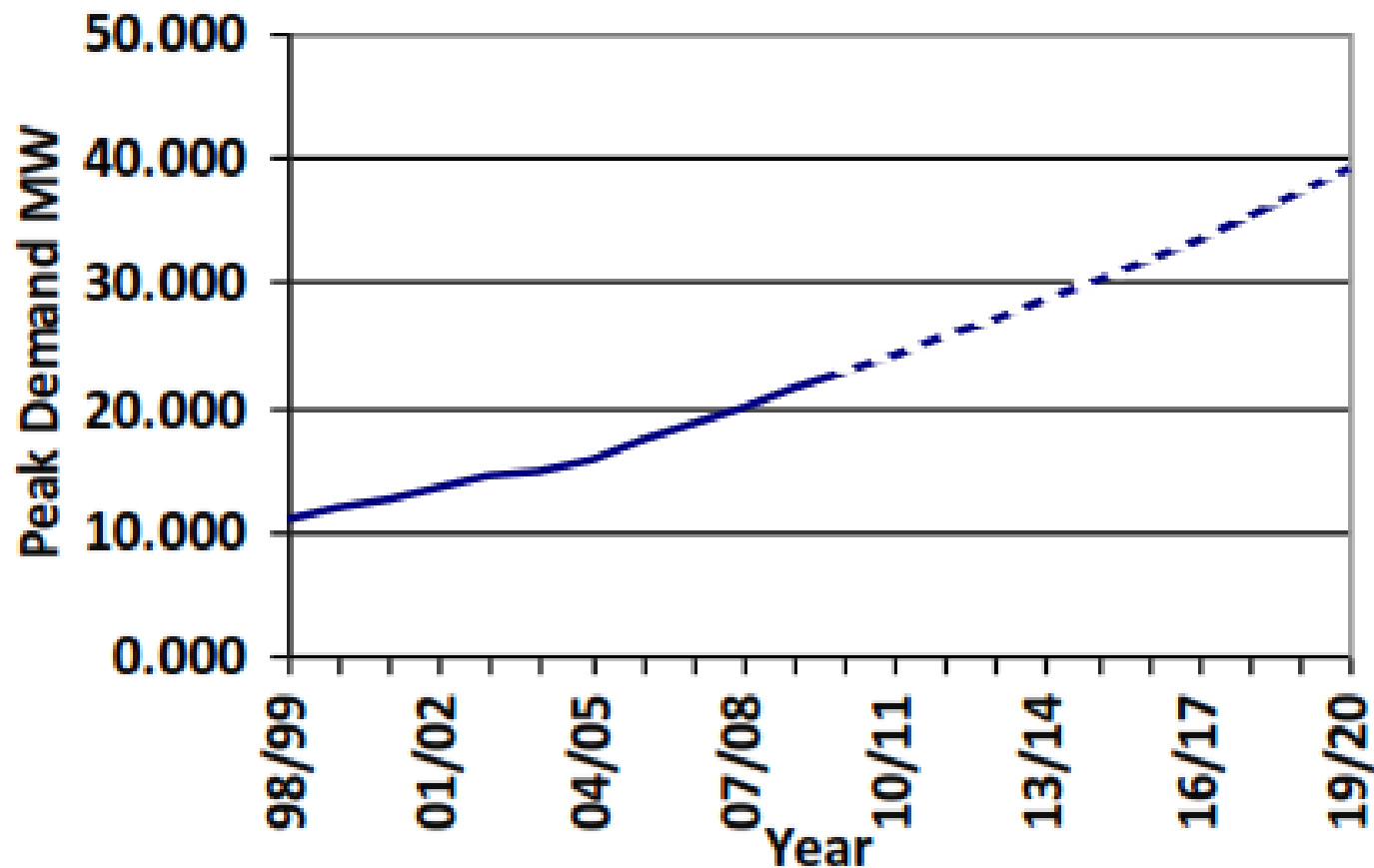
1- Increase in efficiency of energy use.

2- Strict emissions trading rules to support the transition to low carbon development paths.

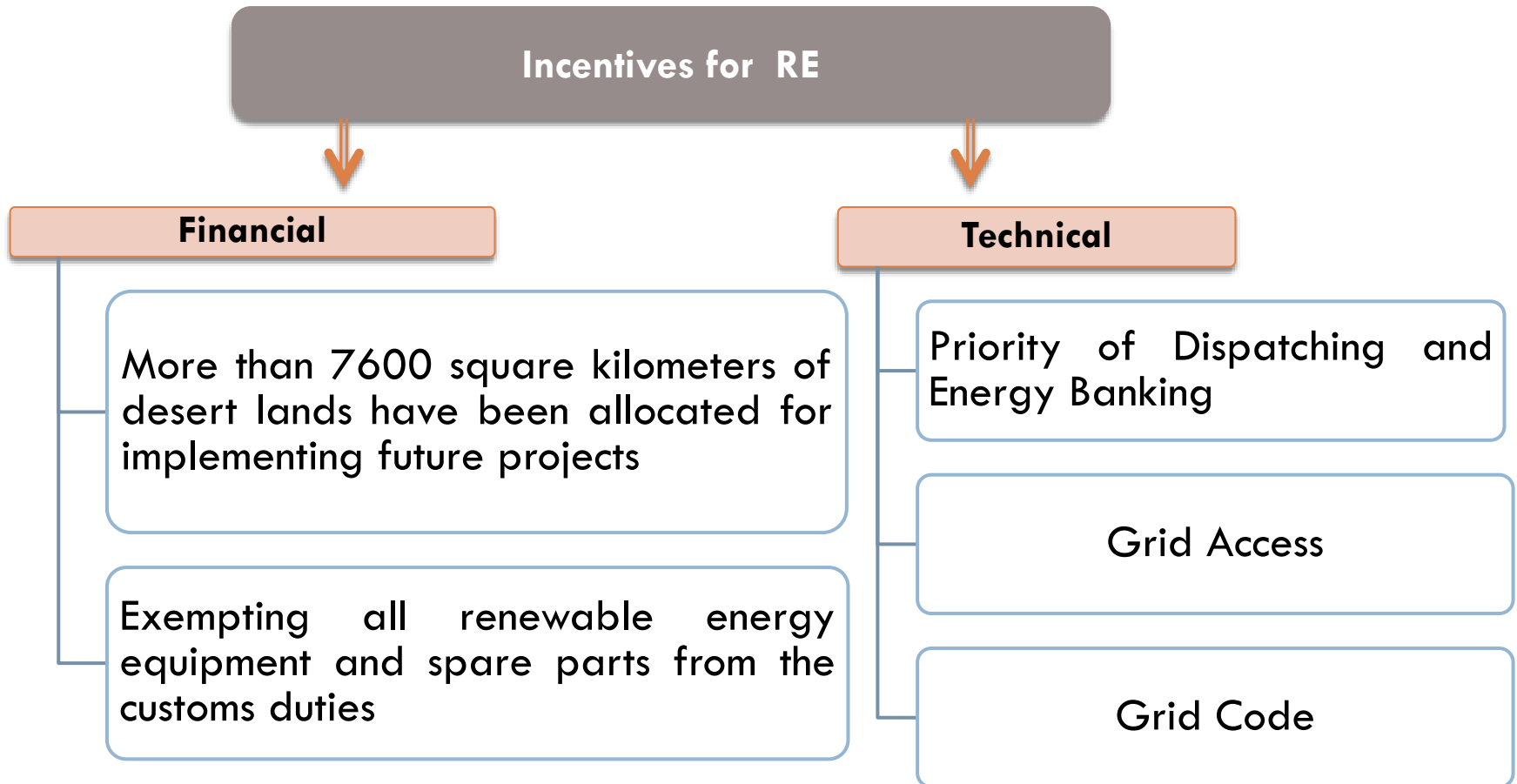
3- Extensive use of renewable and other low carbon technologies.

4- R & D to increase low carbon technologies.

Max Demand of Electricity in Egypt



Incentives for Renewable Energy in Egypt



Energy market motivations, challenges

- High energy demand and gross rates.
- Limited finance.
- Captive market.
- Pre mature commercial rules

Renewable Installed Generation Capacity in Egypt

Installed Generation Capacity 2013	
Gas & Oil	27.5 GW
Hydro	2.9 GW
Wind	552 MW
Solar	20 MW
Total	31 GW

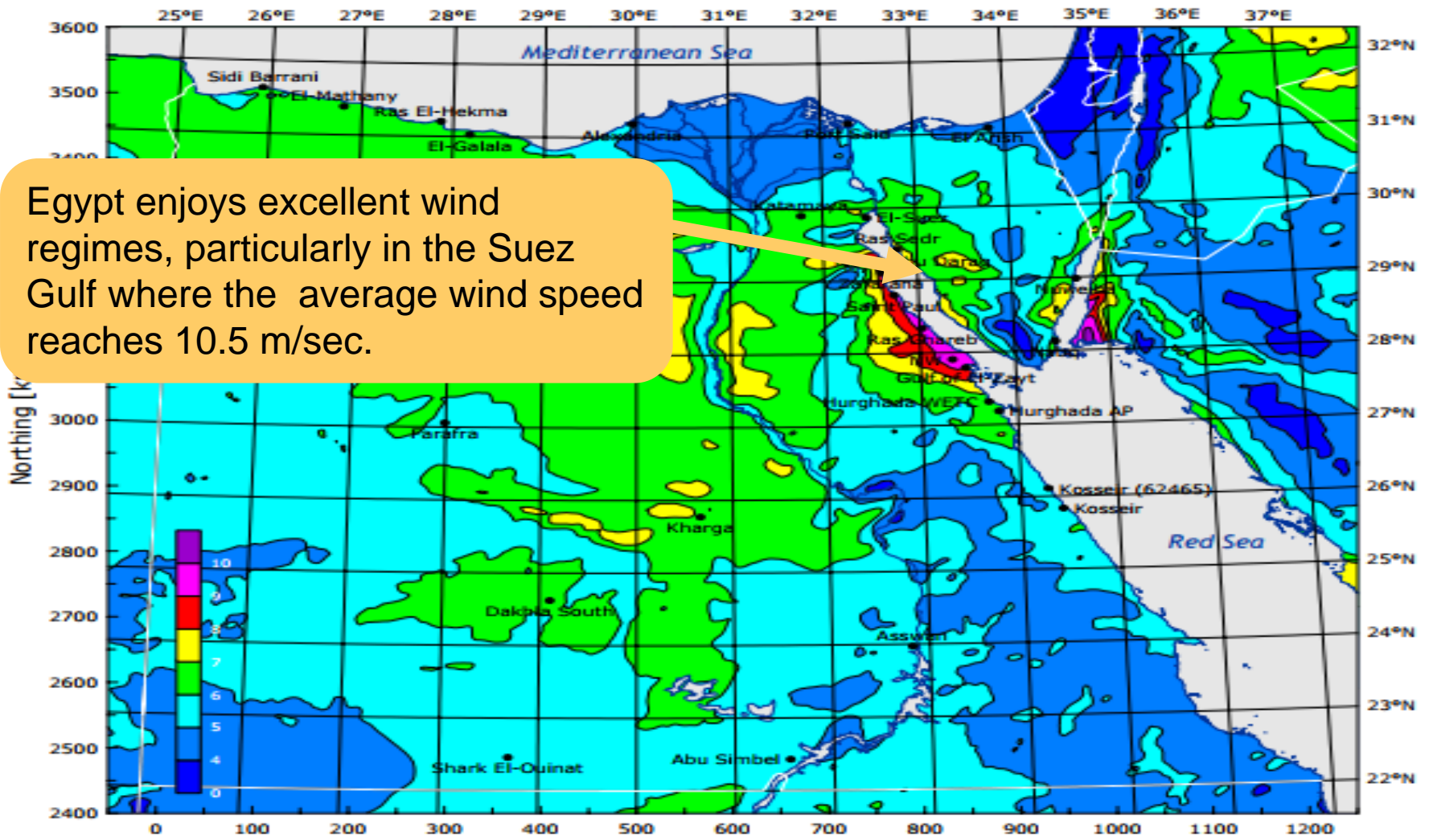


It's a Matter of Where, How and What??

1. Wind Energy

- In December 2005 the Egyptian Wind Atlas was issued in cooperation with the Danish RISO Laboratories and the Egyptian Meteorological Authority (EMA) to indicate appropriate and promising areas to benefit from wind energy in generating electricity.

Wind Atlas of Egypt



Egypt enjoys excellent wind regimes, particularly in the Suez Gulf where the average wind speed reaches 10.5 m/sec.

Wind Farms

1. **Hurghada wind farm (5 MW):**
 - Hurghada wind farm has been operated since 1993.
 - it includes wind turbines with different technologies (double and triple blades).
 - The local manufacturing share of some components reached to about 40.
 - The capacity of wind turbines ranges between 100 - 300 kW.



2. **Zafarana Wind Farms (545 MW):**

- The total installed capacities in Zafarana wind farm is 545 MW.
- The wind farms includes 700 turbines from different models (600 kW, 660 kW, 850 kW).



Future Projects for Wind Energy

Future Projects for Wind Energy

Egyptian Electricity Transmission Company is committed to purchase all the generated electricity

Governmental Project (1340 MW)

Funds and technical assistance were provided through mutual governmental agreements and in cooperation with development partners..

Competitive Bids (750 MW)

Issuing tenders internationally requesting private sector to supply power from wind energy projects.

Feed-in-tariff:

System will be applied taking into consideration the prices achieved in Competitive Bids

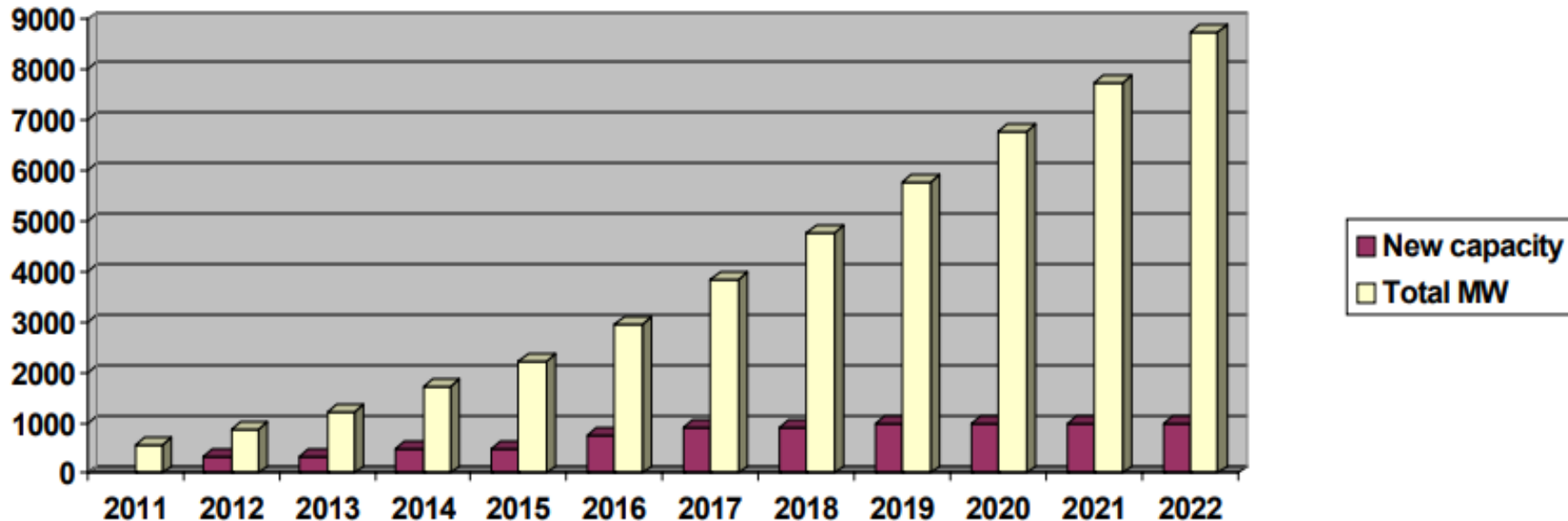
The developers will sell the generated electricity directly to the consumers

IPP Project (720 MW)

The investor shall sell the electricity generated to his own consumers or feed his own loads

Wind Energy Development Plan

Year		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
New capacity	NREA & Private		320	220 120	500	500	750	900	900	1000	10 00	1000	1000
Total MW		550	870	1210	1710	2210	2960	3860	4760	5760	6760	7760	8760



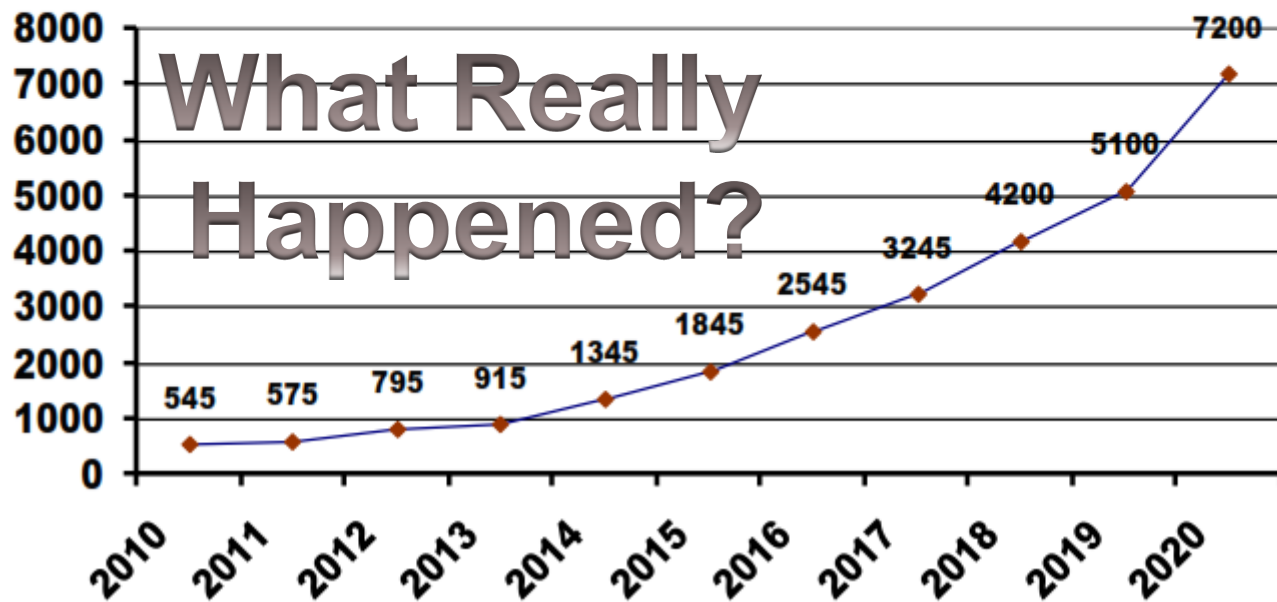
Main Features of Wind Energy in Egypt

- High wind speed resources but concentrated in some area.
- Most of the sites with high wind speed are in remote areas.

Egypt Plan for Wind

Recently on Sep. 2009, the Government of Egypt has allocated an area more than six thousand Km² East and West of the Nile Valley at upper Egypt dedicated for wind energy projects. This area can host wind projects having total capacity of 30.000MW.

Fig. 6 illustrates Egypt's recent plans till the year 2020 for wind energy including public and private sector wind farms having total capacity about 7200MW.



Egypt Plan for Wind

B) Private Sector Projects :

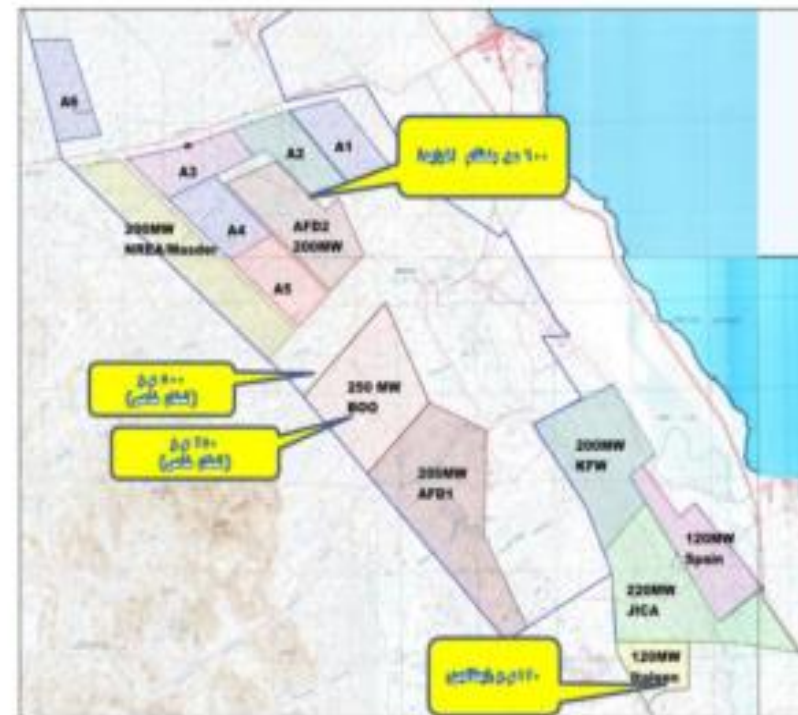
Firstly : Private sector will implement wind energy projects through competitive bidding with total capacity 750 MW as follows :-

250 MW Wind Farm (Private Sector) on BOO basis in the Gulf of Suez :

- 10 developers were short listed in Dec., 2009.
- Since November 2010 till June 2013, wind speed measurements has been campaigned in the site.
- The shortlist developers will submit their offers by May 18th 2014.
- It is planned to be operated in 2016.

500 MW Wind Farm (Private Sector) on a BOO basis in the Gulf of Suez :

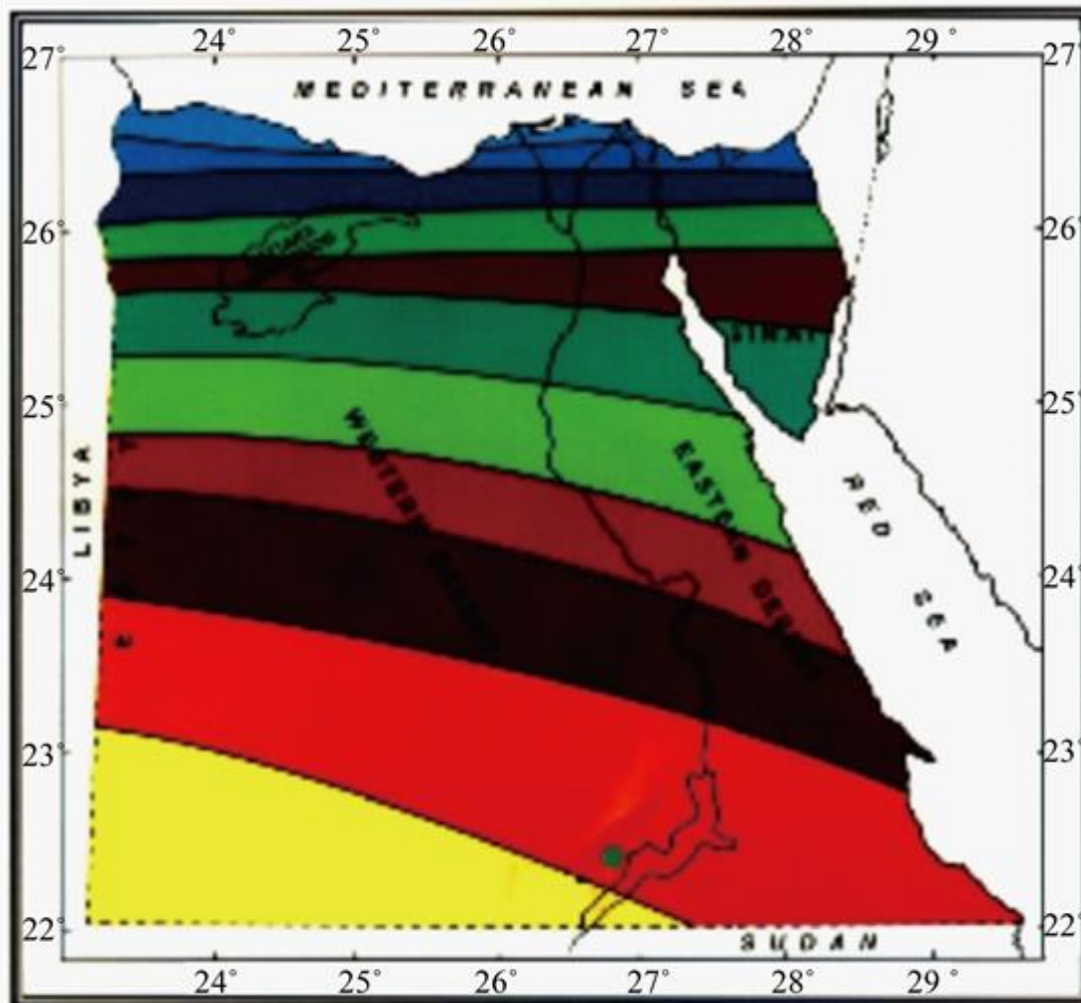
- Egyptian Electricity Transmission Company and NREA are preparing to issue a tender of capacity about 500 MW within two phases (2 × 250 MW) to use BOO system.
- It is planned to be operated in 2017/2018.



Solar Energy

- Egypt is one of the sunbelt countries that enjoys with high solar radiation.
- Solar energy has much potential in Egypt, approximately 325 days of sun in a year and approximately 2,400 hours annually for potential solar operations, compared to Spain and Greece, the next sunniest countries, which have 1,900 hours annually.
- So Egypt is one of the largest potentials of solar energy applications.
- The sunshine duration ranges between 9 – 11 hr/day.
- The solar Atlas was issued in 1991, indicated that the average direct normal solar radiation ranges between 2000 – 3200 kWh/m²/year from North to South with very few cloudy days.

Solar Atlas of Egypt



Solar Energy



Solar Energy can be utilized in two forms:

1- Thermal Solar Energy

2- Photovoltaic

Two Main Categories:

Solar Thermal



Water heating and cooking

Solar Photovoltaic (PV)



Electricity production

a) Solar Thermal Water Heater

- The total installed area in Egypt is about 750 thousand m².



□ Solar Thermal Active Projects:

1. Disseminating Solar Water Heaters Project in Hotels located in Red Sea and South Sinai Governorates (EGYSOL).

- The project aims to:

- * Install of about 5000 m² of water solar heating system.
- * Save about 4000 tons of oil equivalent.
- * Reduce of about 12000 Tons CO₂ annually.



Thermal Solar Power Plant in Egypt

Kuraymat 140 MW Integrated Solar Combined Cycle Power Plant.

The capacity of the project is 140 MW including solar share of 20 MW.

The total area of the integrated solar field is about 644 thousand square meters.



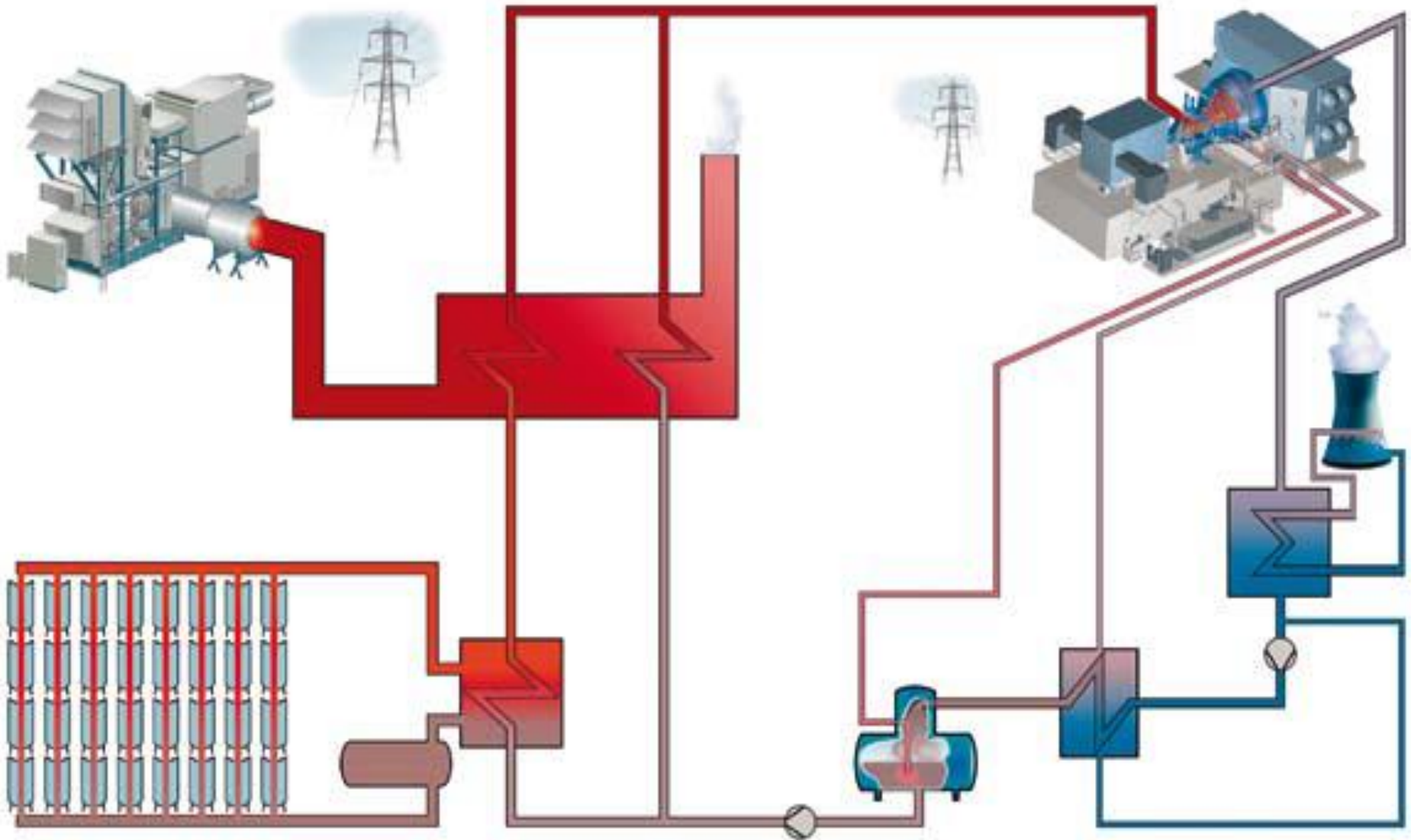
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The 126 MW ISCC plant, located about 90 km south of Cairo on the eastern side of the river Nile,



KURAYMAT, Egypt

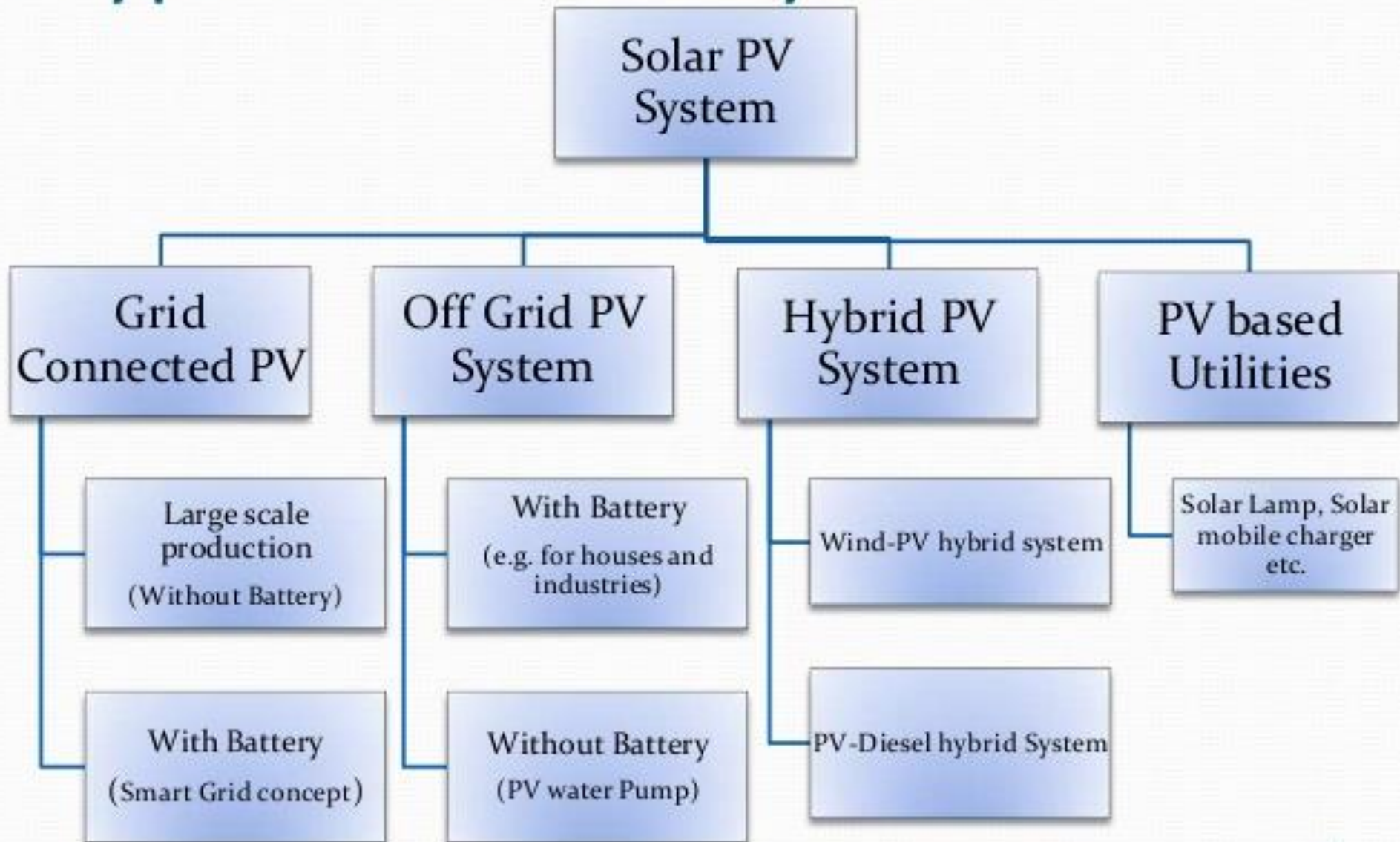
Integrated Solar Combined Cycle (ISCC) plant 126 MW(e)



Part II

Photovoltaic **Convert Sun Light Into Electricity**

Type of Solar PV System



Photovoltaic Systems

- Photovoltaic systems applications has been spread for lighting, water pumping, telecommunications, cooling and advertisements purposes on the commercial scale in Egypt.
- Several projects has been implemented or under preparation by the Ministry of Electricity & Renewable Energy and (**NREA**).



□ Solar Photovoltaic Projects:

1. Electrifying the of Kourymat Solar Power Plant Fence by Photovoltaic system

- **The project aims to:**

- * In the framework of fruitful co-operation between China and Egypt, the Chinese Government has provided a Grant to electrify the fence of the Kourymat solar thermal power plant by 300 street lighting.

2. Electrifying 40 Houses by photovoltaic system in Cooperation with the Indian Government.

- * A cooperation protocol was signed between the Egyptian and Indian Governments.
- * The project has been selected in Matrouh Governorate includes 40 Houses with total capacity of 8.8 kW to be electrified by PV Systems.

3. Electrifying Remote Villages by Photovoltaic System in Siwa, Matrouh Governorat

- **The project has been operated since December 2010, and it has included:**
 - * Electrifying (100) houses.
 - * (40) Street Lamp Poles.
 - * Electrifying (1) school and (3) mosques.
 - * Electrifying (2) medical clinic units.



EEHC and its affiliated companies have taken the initiative to install solar photo voltaic (PV) systems on the top roof of their administrative buildings, where the following has been achieved.

- 80 solar PV systems have been mounted with a total capacity of 1800 kW on the top roof of EEHC and its affiliated companies' buildings, 48 solar photo voltaic (PV) systems are under implementation with a total capacity of 1020 kW.
- In addition, some of the customers have implemented 51 photo voltaic plants totaling 1650 kW interconnected to the grid benefiting from the feed-in-tariff, other 33 plants with a total of 2390 kW are expected to be implemented.



The Future of the Photovoltaic

Photovoltaic Power Plant

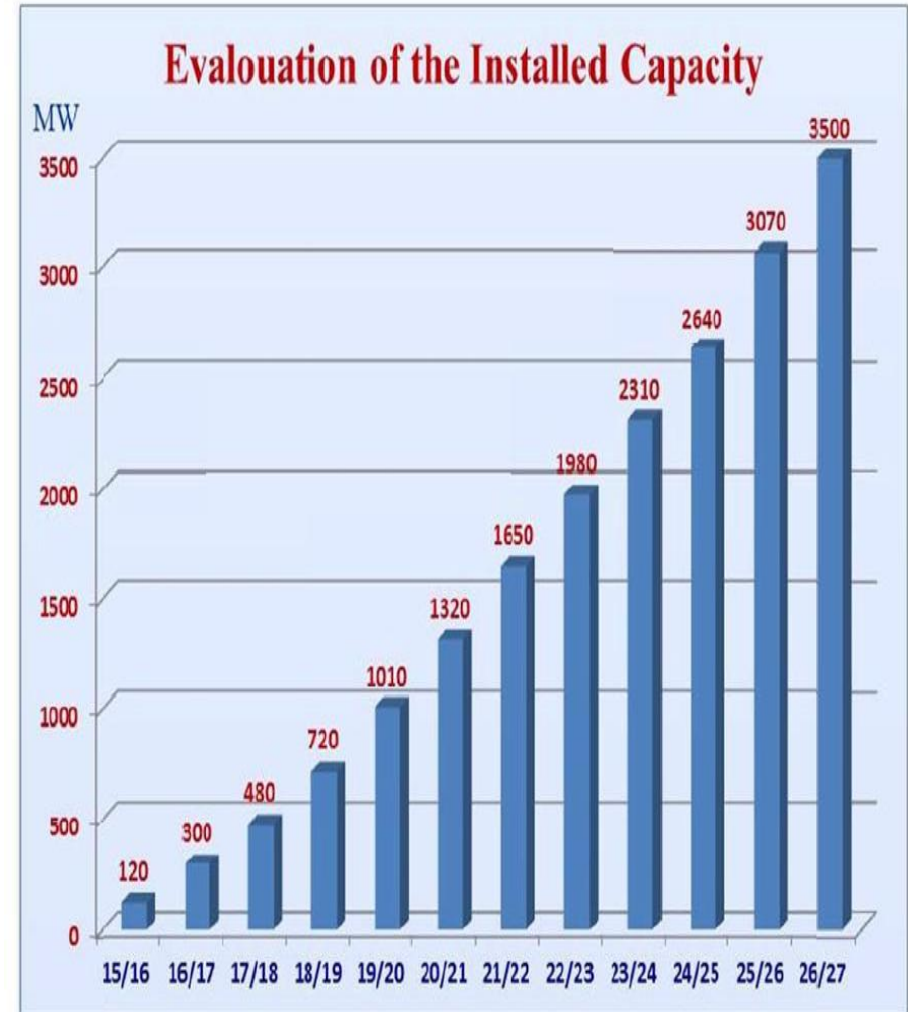
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Future Solar projects (3500 MW)

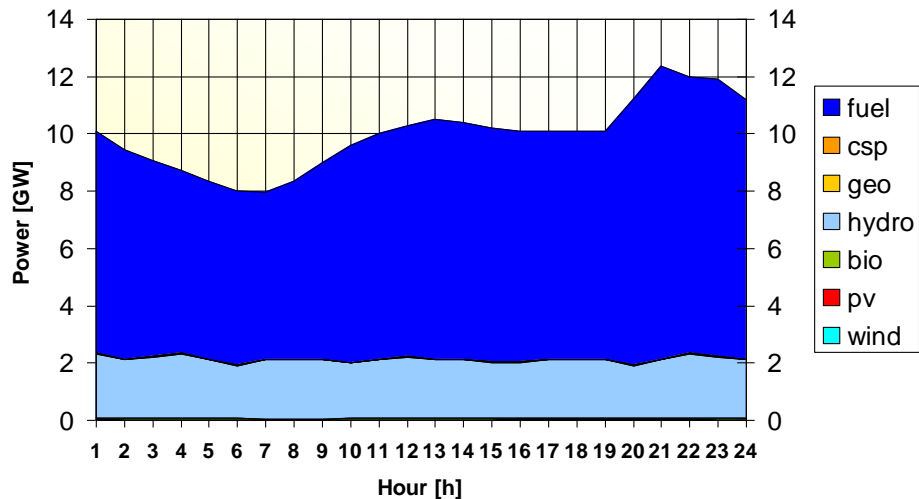
❖ Target is to install about 3500 MW by 2027 of combined capacity as follows :

❖ 2800 MW CSP

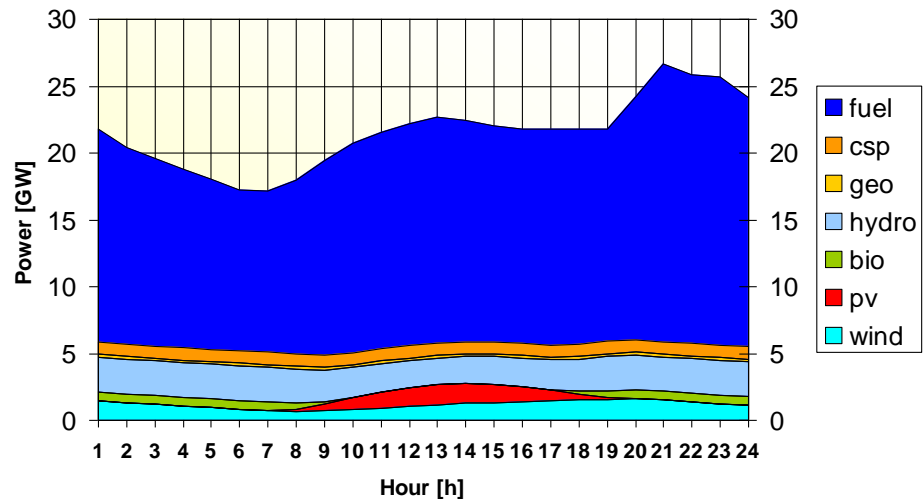
❖ 700 MW PV



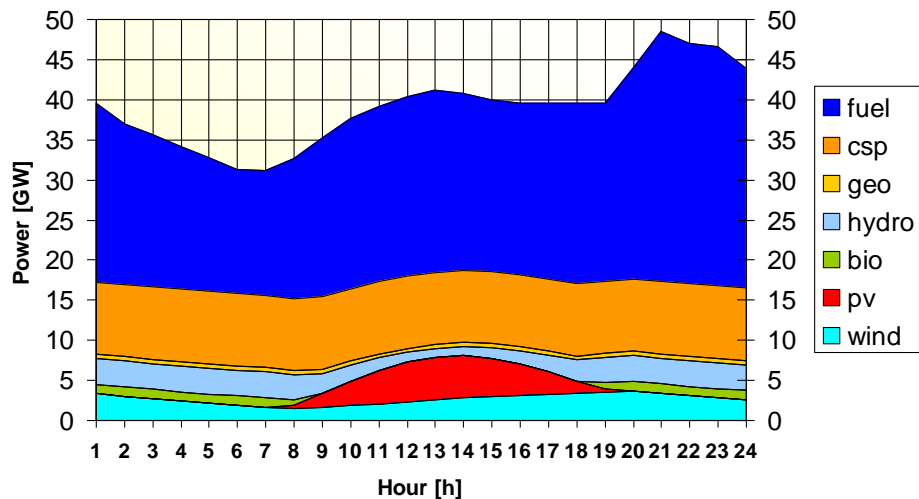
Peak Load Day in Egypt 2001 - Scenario CG/HE



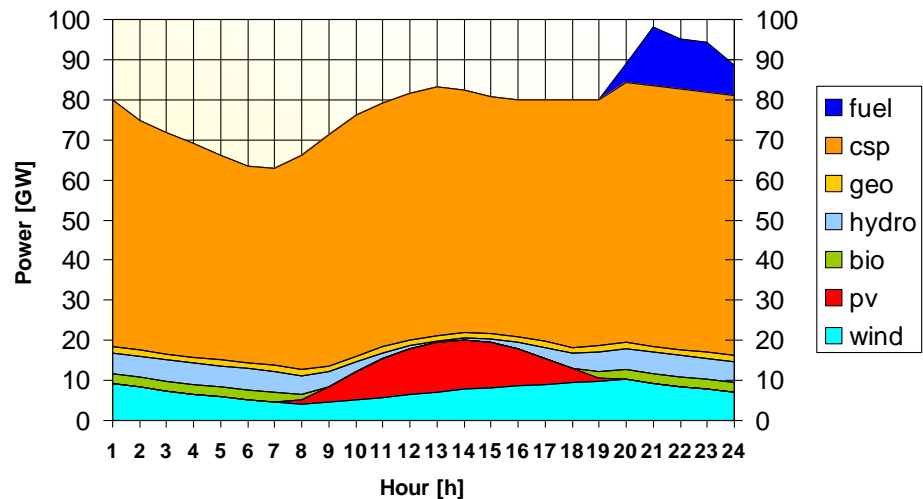
Peak Load Day in Egypt 2020 - Scenario CG/HE



Peak Load Day in Egypt 2030 - Scenario CG/HE



Peak Load Day in Egypt 2050 - Scenario CG/HE



- 1- PV systems for Residential and Commercial Buildings.**
- 2- Solar Water Heater .**
- 3- Solar Water Pumping.**
- 4- Solar Sea Water Desalination.**
- 5- Solar street lights.**
- 6- Centralized Thermal and Photovoltaic Power Plants.**
- 7- Warehouse (Panels, Inverters, Mounting Structure, Monitoring, etc.).**
- 8- Training Courses and Academic Degrees in Renewable Energy.**

Thank
you

