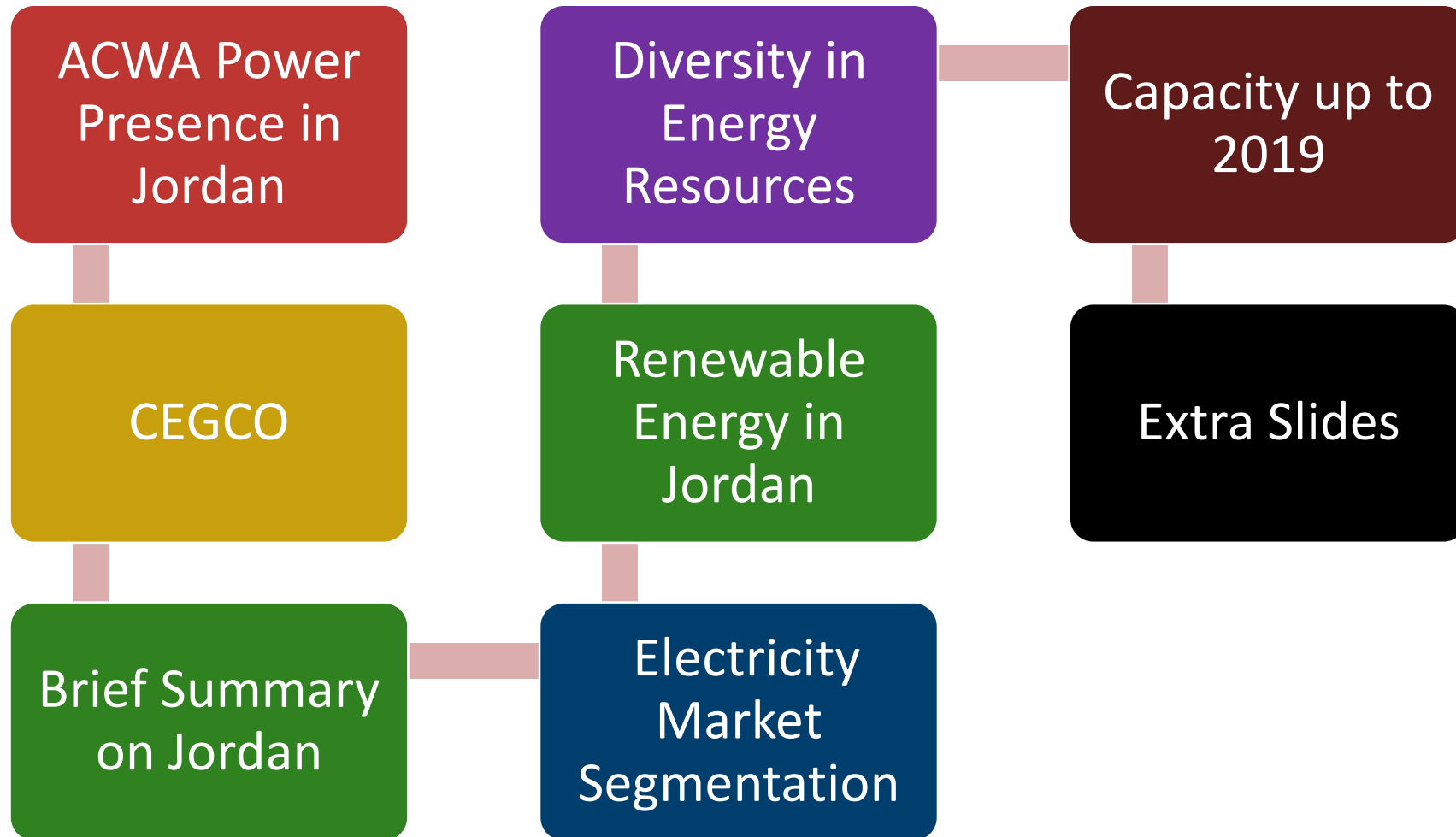




Solar energy opportunities in Jordan

By ACWA Power:
Ahmad Masoud
Yousef Alzuhair

April 2019



In **10+ years** we have become the **largest power & water developer** in the **GCC region**, and a name to **contend** with **internationally**



29+
GW Power *



4.8
Mm³ per day
desalinated water *



51
Assets *



11
Countries



\$45+bn
USD of Assets*



22%
Portfolio in Renewable Energy
based on share of project cost



3,500+
Employees



30+
Nationalities



~60%
Local Employment
in projects



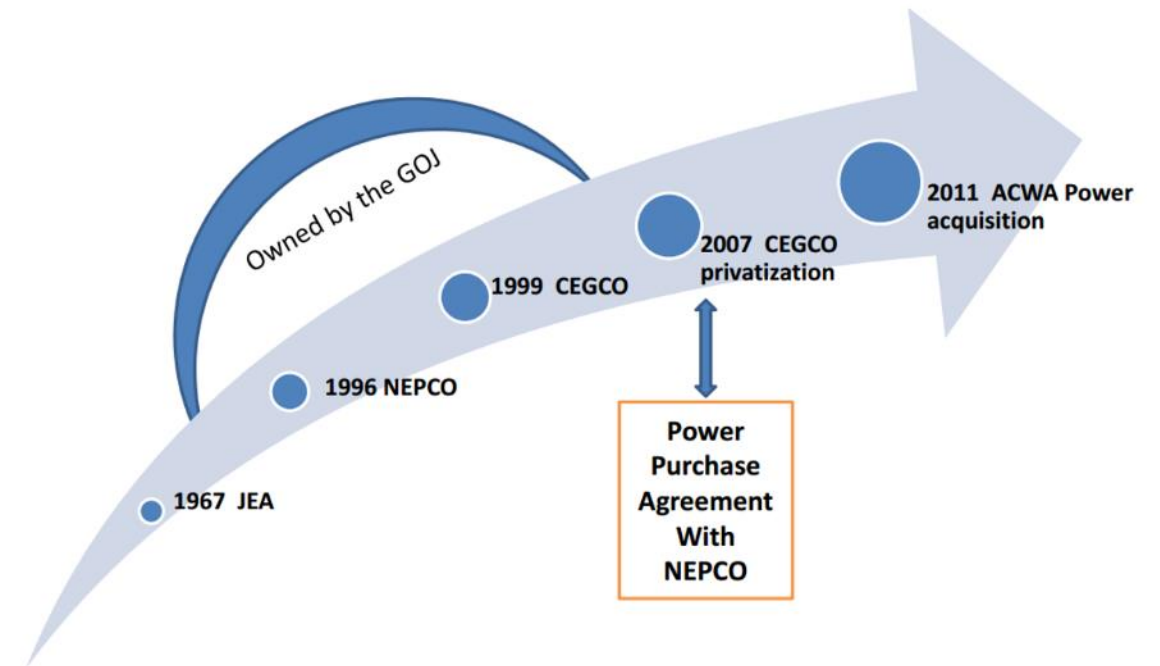
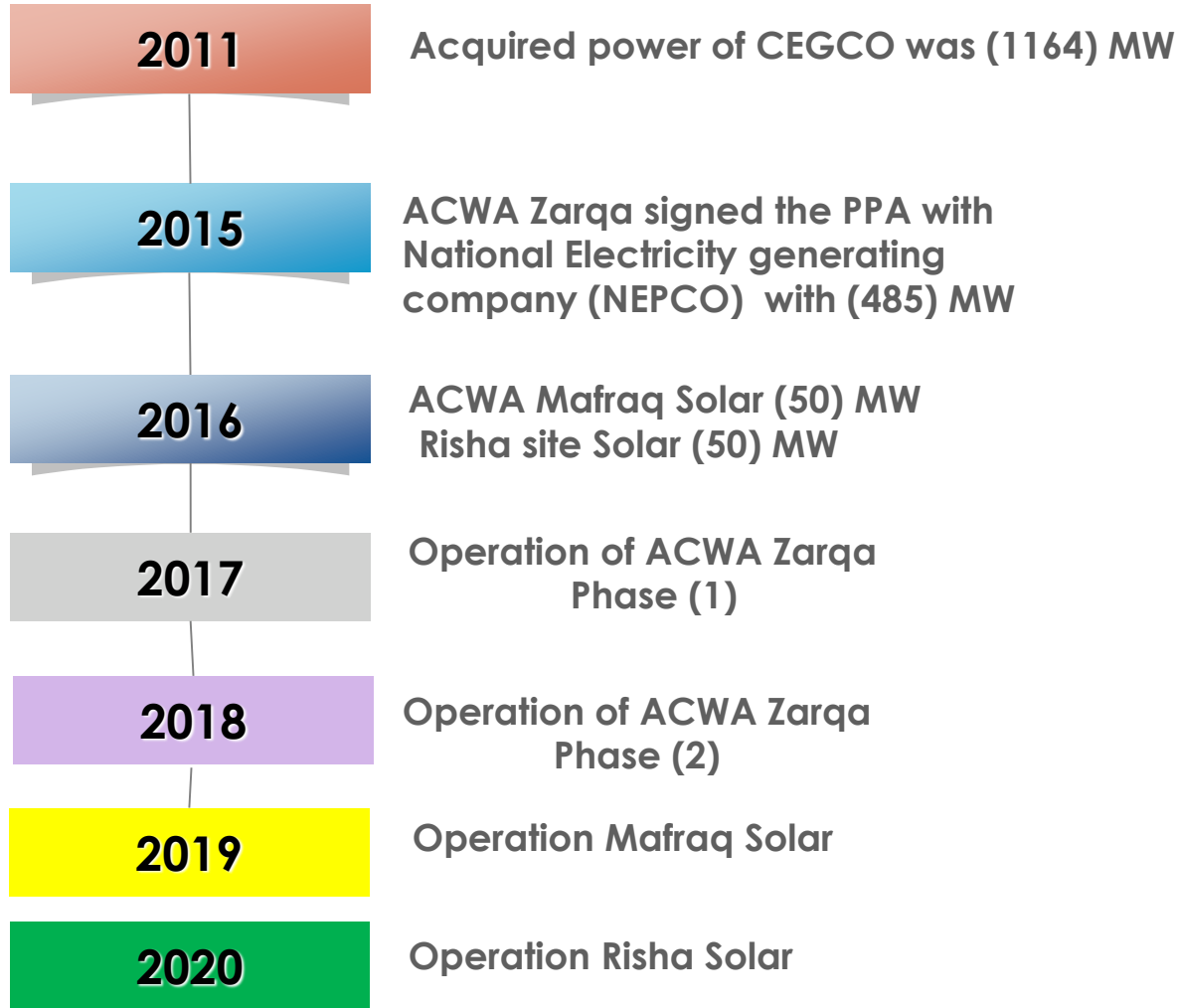
Saudi Arabia
2004

Oman, Jordan
2008-2010

Morocco, South
Africa, Turkey
2012 - 2014

UAE, Egypt,
Vietnam,
Bahrain
2015 - ...

* Figures inclusive of advanced development projects



**JEA
1967**

**NEPCO
1996**

**CEGCO
1999**



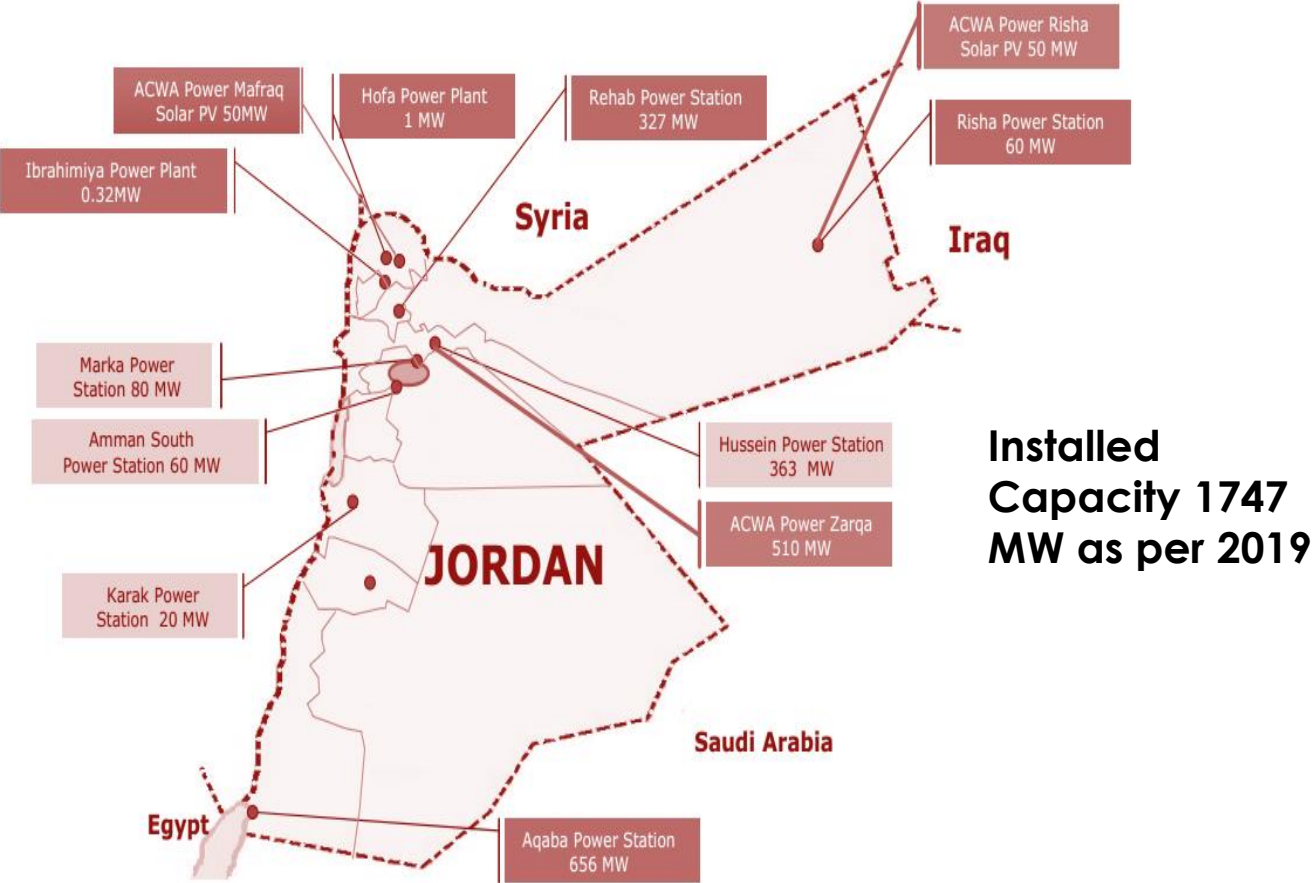
CEGCO was established in 1999 as a part of the restructuring of the Jordan Electricity authority and NEPCO's generation, transmission and distribution assets:

CEGCO Consisted of 7 Power plants in addition to (2) Wind Plants :

- Aqaba Thermal Power Station
- Hussein Thermal Power Station
- Rehab CCGT Station
- Risha SCGT Station
- Marka SCGT station
- Amman South SCGT station
- Karak SCGT station
- Ibrahemya & Hofa (Pilot Wind)



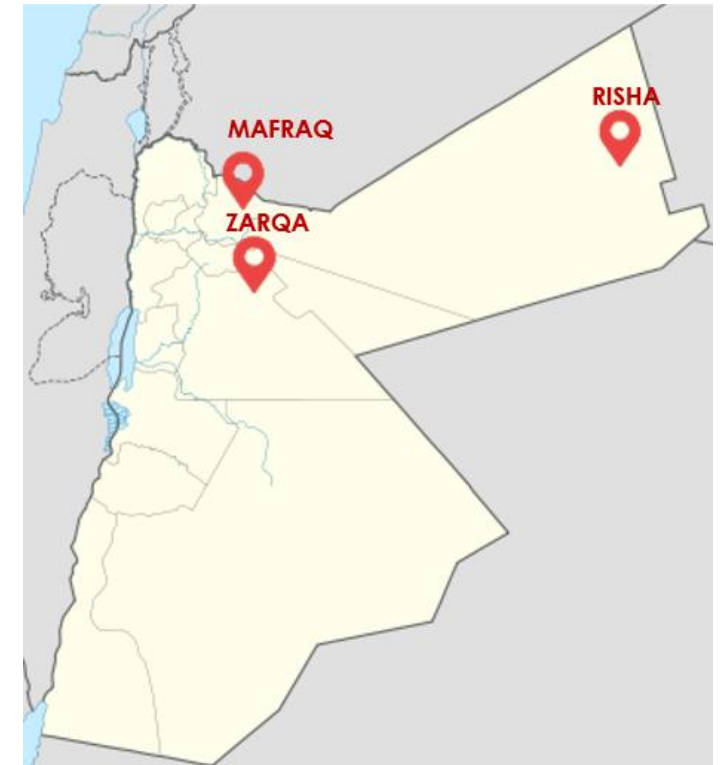
CEGCO plants across Jordan:



Power plant	Unit
ATPS	Steam 1
	Steam 2
	Steam 3
	Steam 4
	Steam 5
HIPS	Steam 1
	Steam 2
	Steam 3
	Steam 4
	Steam 5
	Steam 6
	Steam 7
	GT 1
Rehab	GT 2
	GT 10
	GT 11
	GT 12
	GT 13
Risha	Steam 14
	GT 1
	GT 2
	GT 3
	GT 4
Marka	GT 5
	GT 3
	GT 4
	GT 5
	GT 6
	Diesel Engine
Amman	GT 8
South	GT 9
Karak	GT 7
Aqaba Central	Diesel Engine
	Diesel Engine

- CEGCO's sales of electric power has reached **(1749.3) GWh** in year 2018
- In addition to operating its own facilities CEGCO have signed O&M Agreements with ACWA Power, where CEGCO will be in charge of all the activities and related process to the daily Operation and Maintenance to ACWA power projects in Jordan where this will include :

Project	Capacity (MW)	Technology	Operation
ACWA Zarqa	485	Combined Cycle	2018
ACWA Mafraq	50	Solar	2019
ACWA Risha	50	Solar	Expected 2020



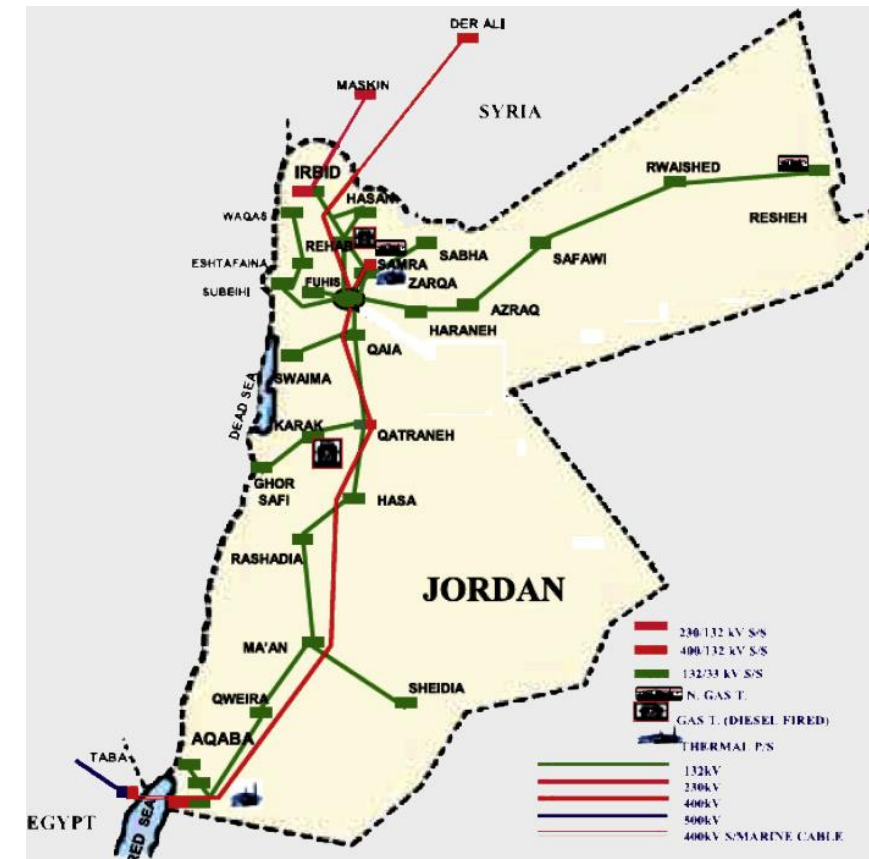
The interconnected system in Jordan consists of :

1. Generating power stations
2. Transmission Network (132 kV & 400 kV) which interconnects the power stations with the load centers and different areas in the kingdom.

- The system also includes :

- 230 kV, 400 kV tie lines with Syria with capacity of (700 MW)
- 400 kV tie line with Egypt with (550) MW capacity.

National Electric Power Company (“**NEPCO**”) currently owns the National Control Center and the Transmission network which consists of main substation with total capacity of 10,023 MVA and high voltage transmission lines (132 kV and above) with total length of 4121 km-circuit.

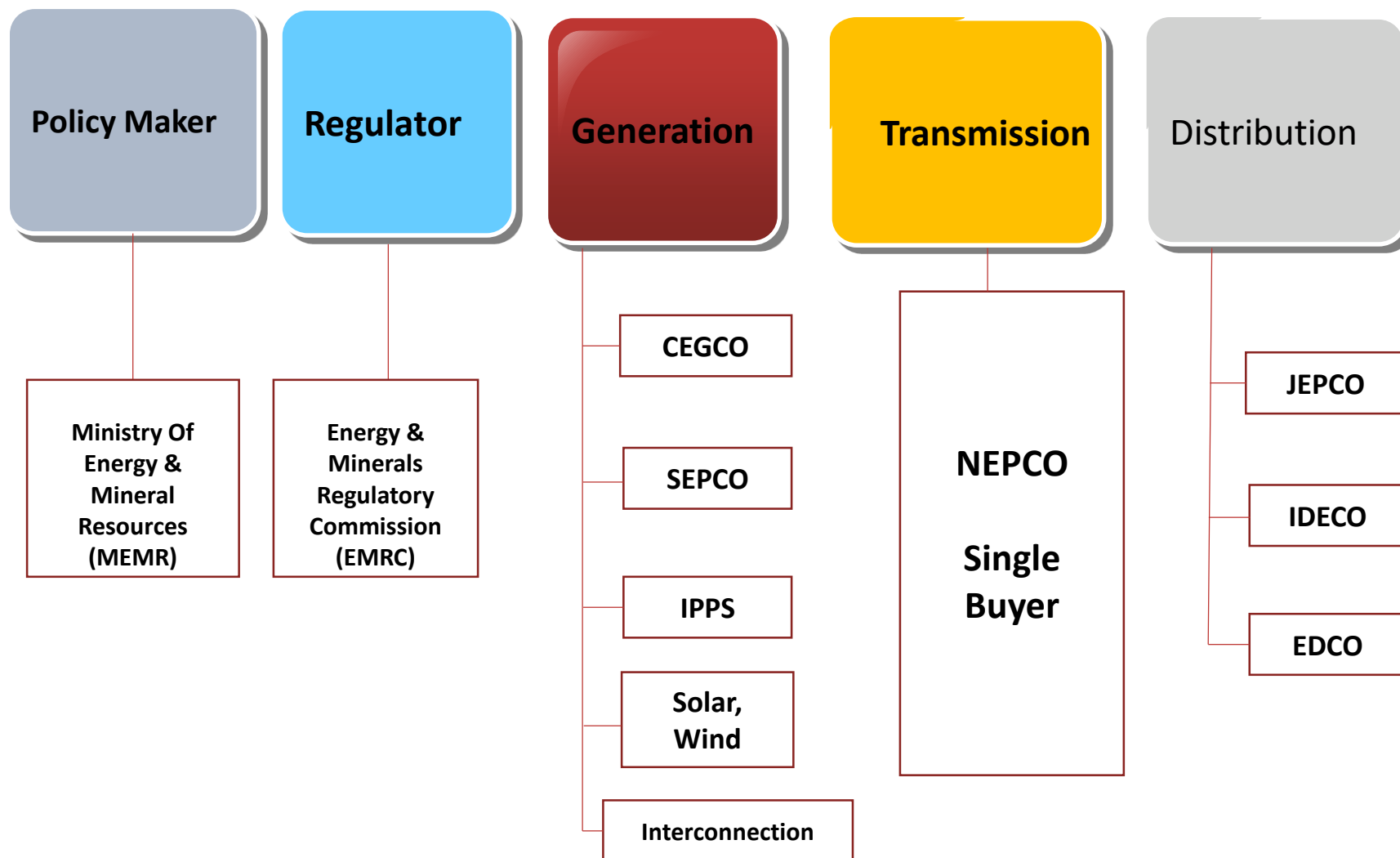


Source: NEPCO



Electricity Sector in Jordan is composed of the following entities each having a specific role (shown to the right).

CEGCO: Central Electricity Generation Company
SEPCO: Samra Electric Power Co
IPPS: Independent Power Producers
JEPCO: Jordan Electric Power Company
IDECO: Irbid District Electricity Company
EDCO: Electricity Distribution Company

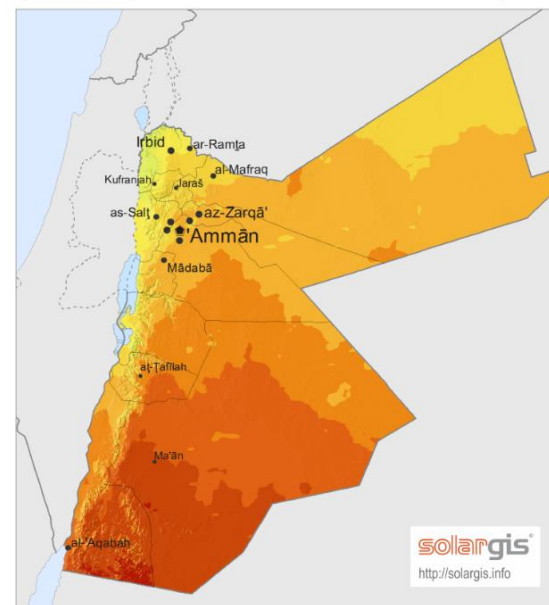


- According to the **National Energy Strategy**, covering Jordan's energy requirements from 2015-2025, Jordan needs to increase its energy supply security and reduce its dependence on external energy sources by leveraging national resources such as renewable energy and oil shale. **The energy strategy aims to increase the contribution of oil shale sources to 10% by 2025 while reducing of imported energy sources.**
- **Ma'an and Aqaba** area (south of Jordan), have a very **high solar** insolation worldwide and has the lowest values of diffuse irradiance. The region has on average more than **300 days of sunshine per year**, making it an ideal location for solar energy generation. The average annual sum of period from 1994 -2010 of around **2250 kWh/m²** as shown in the image by SolarGIS to the right.
- **Wind speeds** in the Kingdom can be as high as **7.5 meters** to 11.5 meters per second in hilly areas (specially in the southern region towards Tafilah) making it having one of the greatest wind resources in the region.



Global Horizontal Irradiation

Jordan



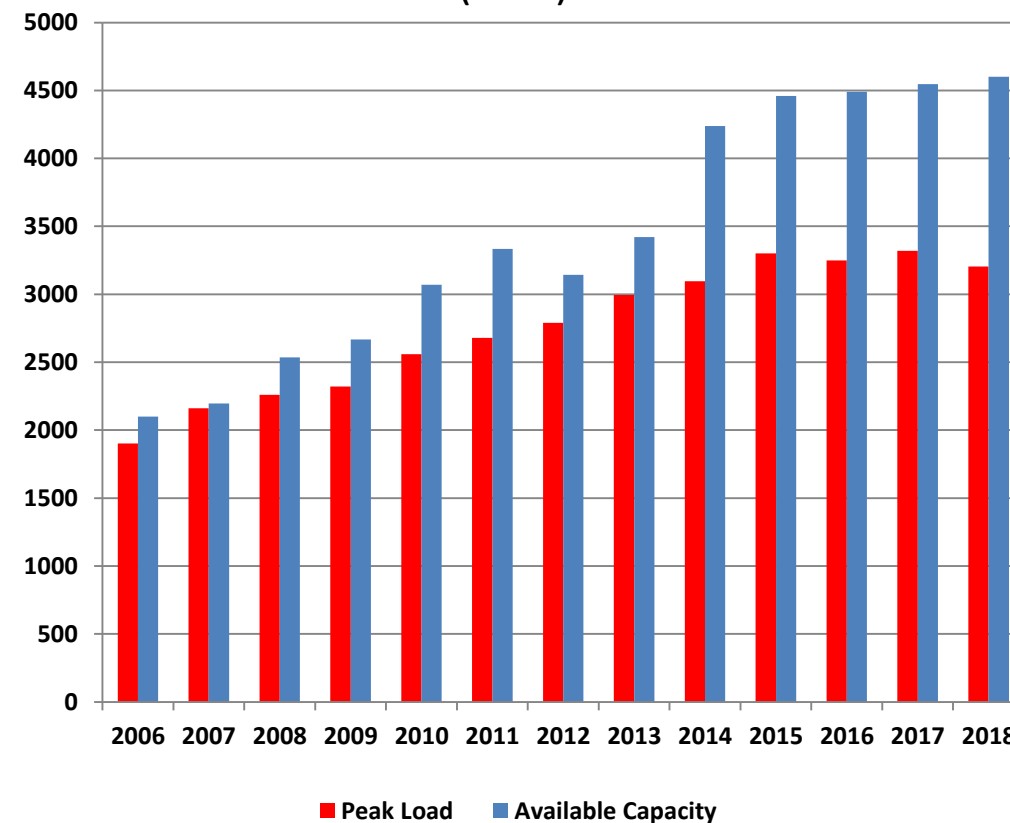
Average annual sum, period 1994-2010
< 1900 2000 2100 2200 2300 > kWh/m²
SolarGIS © 2014 GeoModel Solar



Current Power Plants in Operational Phase by 2019

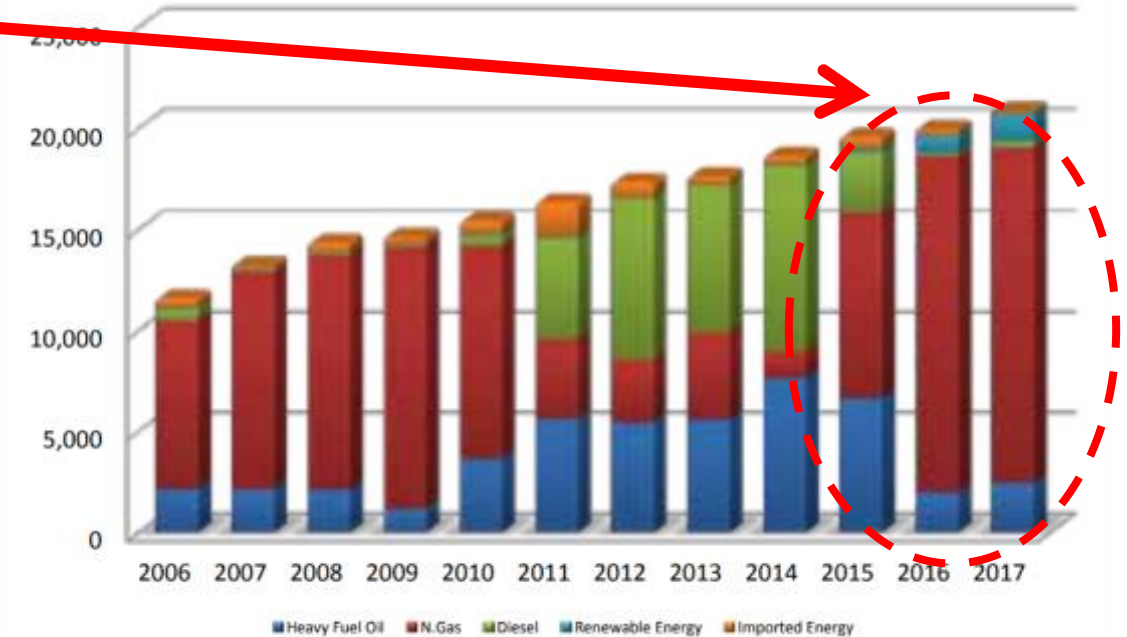
Company	Gross Capacity (MWh)	Net Capacity (MWh)	Technology	Location
CEGCO	1044	962	GT+ST	Noth, South and East of Jordan
SEPCO	1260	1143	GT + Combined	Al-Zarqa
AES	400	370	Combined	East of Amman
Al Qatraneh	400	373	Combined	Al-Qatraneh, Middle of Jordan
IPP 3	600	573	GT	Al Manakher, 30 km from Amman
AES Levant IPP 4	250	241	GT	East of Amma
ACWA Zarqa	485	485	GT + Combined	Al-Zarka (Hashimiyah)
King Talal Dam	6	6	Hydro	27 Km north of Amman
Jordan Biogas Company	3.5 + 6	3.5 + 6	Bio Gas	Rusayfeh and Samra
Renewable	1090	1090	Wind + Solar	Different Locations
Total	5538.5	5252.5		

Available Capacity & Peak Load (MW)



- Despite Jordan being well known for the development of Solar and Wind, A look at Jordan's mix of energy sources for Electricity shows a **growing heavy reliance on Natural Gas**. So more renewable is needed with storage.

Electrical Energy Production by Type of Fuel in Jordan (GWh)



	Power Plant	Unit	Available Capacity (sent out) [MW]	Location	Commissioning Year	Retirement date
CEGCO	ATPS	ST 1	121	Aqaba	1985	31/12/2019
	ATPS	ST 2	121		1985	31/12/2019
	ATPS	ST 3	121		1996	31/12/2030
	ATPS	ST 4	121		1996	31/12/2030
	ATPS	ST 5	121		1999	31/12/2030
	HTPS	ST 4	48	Zarqa	1980	31/12/2015
	HTPS	ST 5	48		1980	31/12/2015
	HTPS	ST 7	48		1984	31/12/2015
	Risha	GT 1	25	Risha	1989	31/12/2016
	Risha	GT 2	25		1989	31/12/2016
	Risha	GT 3	25		1984	31/12/2015
	Risha	GT 4	25		1994	31/12/2016
	Risha	GT 5	25		2005	31/12/2030
	Rehab	GT 10	26	Irbid	1994	31/12/2017
	Rehab	GT 11	26		1995	31/12/2019
	Rehab	CC	260		1996-2005	31/12/2025
SEPGCO	Amman South	GT 9	26	Amman	1995	31/12/2016
	Samra I	CC	270	Zarqa	2005-2010	31/12/2033
	Samra II	CC	270		2005-2010	31/12/2034
	Samra III	CC	400		2011-2015	31/12/2035
	Samra IV	GT 7	145		2013	31/12/2038
IPP	AES (IPP1)	CC	360	Amman East	2009	31/12/2034
	Qatrania (IPP2)	CC	360	Qatranah-Karak	2011	31/12/2037
	IPP 3	DE	573	Amman East	2014	31/12/2039
	IPP 4	DE	241	Amman East	2014	31/12/2039
Available Capacity [MW]			3831			

Table (7): Available Capacity of Generating Plants (MW)

Year	Steam	Gas Turbines		Combined Cycle	Diesel*	Wind	Hydro	Biogas	Solar**	Total Power System	Industrial Sector	Total All Jordan
		Diesel	N. Gas									
2014	787	27	618	1614	814	1.44	12	3.5	--	3876.9	188.3	4065.2
2015	787	27	332	2044	814	118.4	12	3.5	5	4142.9	194.3	4337.2
2016	605	--	307	2044	814	198.4	12	3.5	285.5	4269.4	195.1	4464.5
2017	605	--	228	2044	814	198.4	12	3.5	395.5	4300.4	228.1	4528.5

*Working on (N.Gas + Diesel + Fuel Oil)

** Include (200) MW, on distribution network/2017

Regulatory Framework

- The **Renewable Energy and Energy Efficiency Law (REEE Law)** was passed and approved by the Parliament of Jordan as a permanent Law in April 2012.
- This law, was the first in the region that allows investors to identify and develop grid-connected electricity production projects through the so called unsolicited or direct proposal submission.
- the **Jordan Renewable Energy and Energy Efficiency Fund** is established, which aims to channel financial resources to that end.
- **A target of 10% renewable energy input into the energy mix by 2020 is was in the National Energy Strategy, mainly aiming for about 1000MW of Wind and 600MW Solar.**
- A well-founded reference price list (ceiling prices) for different Renewable technologies was set by the Energy & Minerals Regulatory Commission (EMRC)
- **Net- Metering for small Renewable Energy “RE” Systems (Roof Tops)** with Fixed Purchase Prices for Excess Power was set and regulated by EMRC
- Tax Incentive regime , a By-Law was issued on Tax exemptions for RE and EE systems and Equipment.



Jordan started the powering of 6,000 mosques with Solar PV initiative in 2015.

- **Rooftop systems** have been installed since then using government funding and private investment with tenders floated to install systems at other mosques around the country
- **Jordan's government invests over JD50 million (£46m)** on mosques annually which includes utility bills, renovation, staff salaries, and building new mosques.
- **Almost all the mosques** here in Jordan now cover 100 percent of their energy needs” with renewable power, said Yazan Ismail, an energy auditor at ETA-max (Energy and Environmental Solutions, a green consultancy in Jordan) Said on 10th October 2018.



Jordan Renewable Energy Portfolio as per Mid 2018

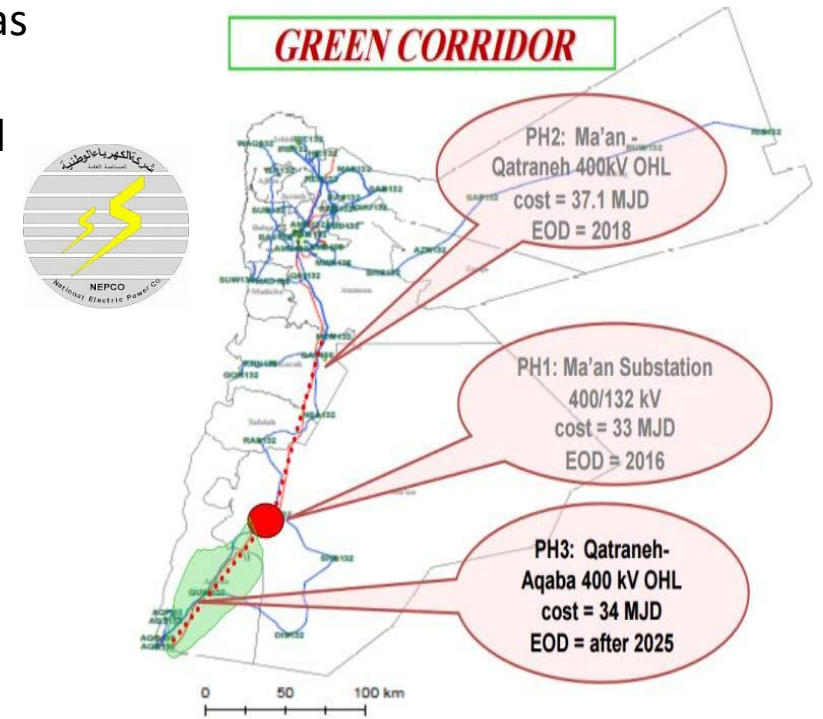
In Operation		In Construction		In Financial Close	
Solar PV	Wind	Solar PV	Wind	Solar PV	Wind
533MW	179MW	720MW	316MW	50MW	100MW



- 800MW Wind + 800 Solar PV were committed in the future programs, including round III.
- In addition to the 533MW mentioned in table above, Currently ACWA Power's MAFRAQ 50 MW PV Plant entered in Commercial Operation on January 2019 which increases total Solar PV capacity an aggregate of 583MW.



- The **Green Corridor project** which is considered as Backbone grid project, was established in the southern region of the Kingdom at a **total cost of \$172 million**, is among major schemes aimed at accommodating power generated by renewable energy sources.
- The first tender agreement included building a new sub-station in Maan, 220km south of Amman, and was awarded to a Saudi company at a cost of JD19 million - *Ex NEPCO Director General Abdel Fattah Daradkeh Said*.
- He added that the second agreement entails providing and installing converters at the Maan sub-station, and was awarded to an affiliate of an international company at a cost of JD3.4 million.
- The third tender included installing connections between the Maan sub-station and the Qatraneh sub-station at 400KV as part 1 and connection between Qatraneh Substation and Queen Alia International Airport Substation at 132KV.
- **Green Corridor** has already upgraded the grid capacity from 500MW to handle 1400MW. As Eng. Amani Al-Azzam (Secretary General, MEMR) announced in the MENA Clean Energy Summit 2018 in Dubai



THE JORDAN TIMES

Round I, Round II and Round III of Renewable Energy Under Direct Proposals Summary.

Particular	Round 1	Round 2	Round 3 (ongoing)
Date	May 2013	May 2015	PV – April 2018 Wind – December 2018
Total Capacity Procured/ Planned to be Procured	615 MW (Solar PV – 200, Wind 415)	200MW, Solar PV (4 Projects)	200 MW (Solar PV -150, Wind 50)
No. of Companies	Approved – 18 (Solar PV -12, Wind – 6)	24 (all solar PV)	No. of Bidders – 20 (Solar PV- 14, Wind -6)
Tariff (USD Cent per kWh)	14.8 -16.9	6.80 (Average of lowest four bids)	2.488

Round 2 of renewable auction witnessed significant drop (lowest tariff in Round 2 was 50% lower compared to Round 1 and Round 3 Tariff even dropped more at 35% of Round 2's Tariff !

Jordan 2018 Tenders in Renewable Energy

- After the auction of Round III Solar PV, another auction of **50MW Wind** was issued and bidders submitted their proposals on 3rd of December 2018. bids are currently under technical evaluation with no commercial Tariff announcement yet.
- The first auction in Middle East to have ever implemented **Electrical Energy Storage** using Batteries on a stand-alone basis was issued on **July 2018** where the project is expected to reach COD by **Q1 2020**. the bid is also currently under technical evaluation with no commercial Tariff announcement yet.



- AMMAN — The Ministry of Energy and Mineral Resources on **29th January 2019** decided to **temporarily hold** renewable energy tenders until the National Electric Power Company (NEPCO) conducts a comprehensive study that shows the capacity of the grid to absorb the output of these projects, according to the Ministry of Energy and Mineral Resources.
- It is expected that renewable procurement will resume after conclusion of above study.
- The ministry official acknowledged that the national grid has experienced “technical challenges” related to its capacity to cope with the increasing production of power via unconventional sources (Renewables).
- The Cabinet excluded the third phase of renewable energy tenders from the decision, as well as projects that produce less than 1 megawatt (MW).
- According to MEMR, power generated from renewable energy plants will reach a capacity of (2350MW) in 2020 after operating the second and third phases of wind and solar power projects, and will constitute 20 per cent of the total energy mix, which is above the anticipated ratio in the National Energy Strategy.



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Je vous remercie Danke obrigado
mihi koe paqmet cizre አመሰግናለሁ
Teşekkürler شكرا
நன்றி
謝謝
Asante
Dякую
धन्यवाद
Thank you
Terima kasih Ngiyabonga Tak
спасибо
ありがとうございます

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