

Solar Energy Opportunity in Palestine

Prof Bassam Dally
Deputy Director



Delivering innovative technologies
for a **clean energy future**



PALESTINE

GAZA STRIP

WEST BANK

COMMUNITIES INHABITANTS

- 0 - 500
- 500 - 1000
- 100 - 10000
- 10000 - 50000
- 50000 - 100000
- 100000 - 449221

GAZA STRIP

ISRAEL

JORDAN

EGYPT

MEDITERRANEAN SEA

DEAD SEA

Beit Lahia

Jabalila

Beit Hanoun

Gaza

al-Mograg

an-Nusirat

Johr al_Diek

az-Zawida

al-Burij

al-Maghazi

al-Msadar

Deir al-Balah

Salga

al-Qarara

Khan Younis

Bani Suhaila

Abasan al-Sagira

Abasan al-kabira

Ga'a al-Grain

Khuza'a

Rafah

al-Bayuk

al-Fukhari

al-Shoka

Jenin

Tulkarm

Nablus

Tubas

Qalqiliya

Salfit

Ramallah and Al-Bireh

Jericho

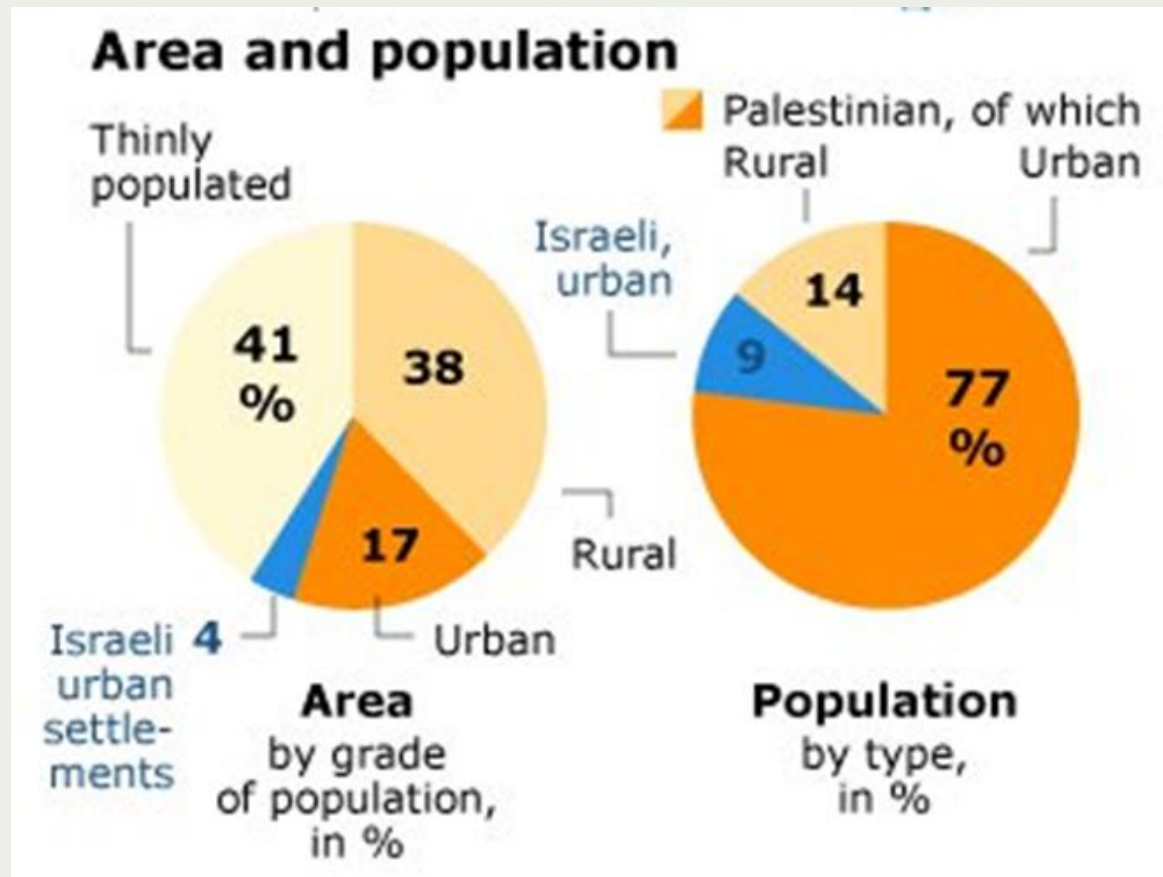
Jerusalem

Bethlehem

Hebron

Juaidi et al. Renewable and Sustainable Energy Reviews, Vol 65, Nov 2016, Pages 943-960

Population Density



Pull Factors for Solar Energy in Palestine

- Very good solar insolation of $\sim 5.4 \text{ kWh/m}^2/\text{day}$ (average);
- Very high number of sunshine hours a year ~ 3000 (average);
- Distributed generation suitable for isolated island mini-grids;
- Desire to reduce energy dependency on imports from Israel, Jordan and Egypt;
- A 'General Renewable Energy Strategy' for 2020, 10% of total domestic energy production and 5% of total energy consumption to come from renewable sources, amounting to 240 GWh;
- Interest from local energy companies to invest in solar energy

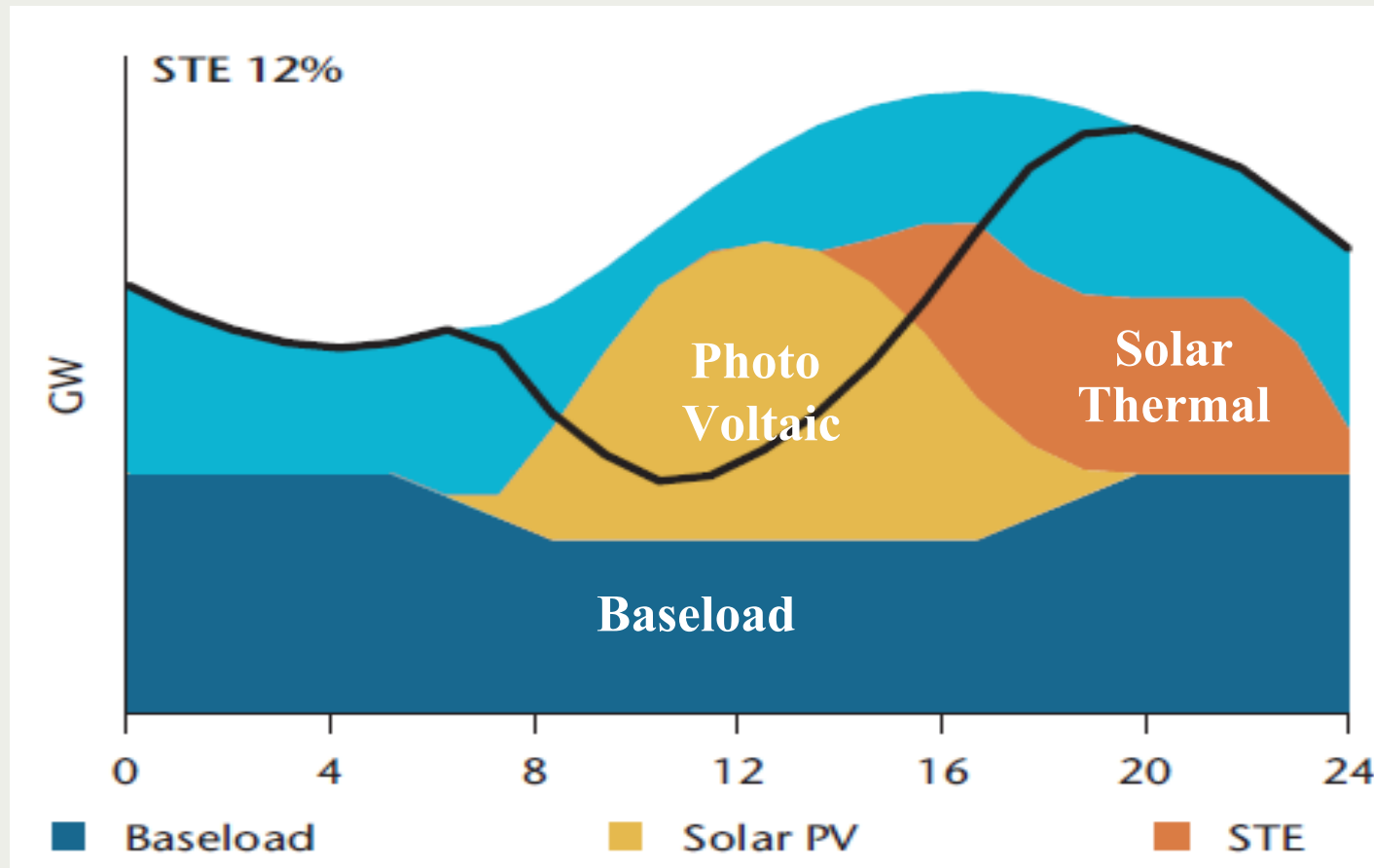


Impediments for Solar Energy in Palestine

- High population density in the Gaza Strip and general lack of available land for large scale installations;
- Isolated electrical distribution networks making it more vulnerable to voltage and frequency control;
- Lack of a national plan and regulation for increased penetration of renewable sources (voltage and frequency control);
- Low household income and low affordability of rooftop installations
- Israel's occupation of Palestine leading to sovereign risk and added expense to finance.



Duck Curve and the Role of CSP

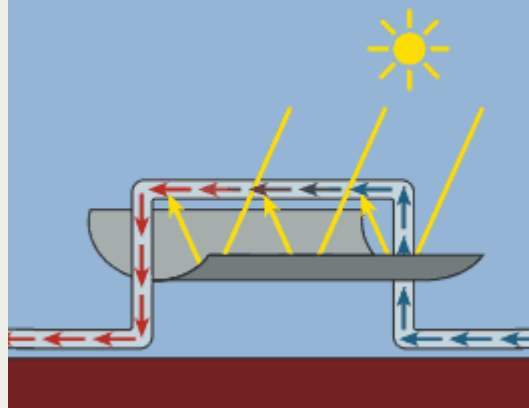


Typical daily contributions to load

Option of Concentrating Solar Thermal

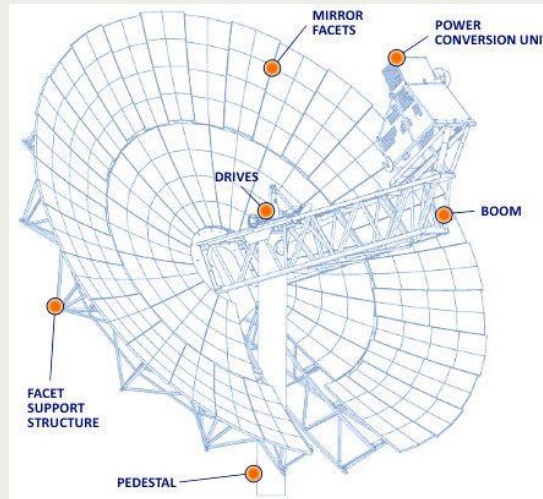
Solar Troughs

Low temperature
Moderate cost



Solar Dish

High temperature
High concentration
High cost



Concentrating Solar Thermal

Solar Tower

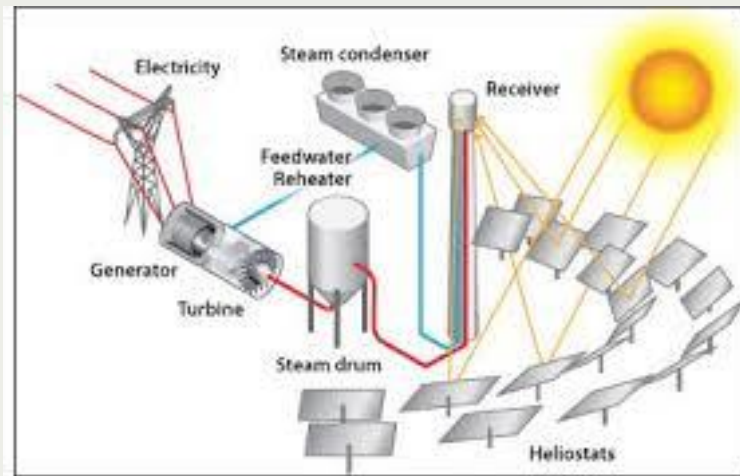
High temperature

Moderate cost

Thermal storage

Hybridisation option

Large and small scale



Opportunities and Enabling Steps

1. Incentify roof top solar water heaters as an effective and distributed approach to save energy. More than 30% of households, or around $\sim 300,000$, don't have a solar water heater.
 - At a saving of a minimum $\sim 14\text{GJ}$ per household per annum the potential is 4.2 TJ per annum.
 - One option is to subsidise solar water heaters for low socio-economic households and reduce payback to ~ 3 years



Opportunities and Enabling Steps

2. Holistic time dependent modelling of the networks in Palestine is needed in order to ensure supply reliability, avoid network instability and expensive solutions in the future.
 - Modelling the network and simulating the effect of local generation can avoid future problems with voltage and frequency control;
 - This can also help in the planning and incentivizing roof-top PV in certain areas as well as local battery storage for stability control.



Opportunities and Enabling Steps

3. Consider small scale Concentrated Solar Power with storage for isolated networks.
 - Cost effective CSP systems up to 30 Mwe, with 6 hour storage, have the potential to provide firm supply and be effective in covering low insolation days and afternoon peaks;
 - Needs long term investment by energy providers and power purchase agreement to make it viable.



Concluding Remarks

- There is a viable and real potential for solar energy utilization in Palestine at a meaningful scale and in a relatively short time;
- Incentifying roof-top water heaters seems to offer a quick and effective mean to reduce energy consumption, generate local jobs and increase solar energy utilization;
- A small scale Concentrated Solar Power system ($<30\text{MWe}$) with thermal storage (up to 6 hours) can offer localized solution for micro-grids in isolated areas;
- Modelling of each of the electric networks and running what if scenarios on sizeable PV cells installations is essential if to avoid network instability and expensive solutions in the future.



Further Information

Please feel free to contact me on:

Professor Bassam Dally

Deputy Director

Centre for Energy Technology

The University of Adelaide

South Australia, 5005 Australia



Email: bassam.dally@Adelaide.edu.au

WWW: <https://www.adelaide.edu.au/cet/>

