

GENERATION USING SOLAR THERMAL OBLIGATION

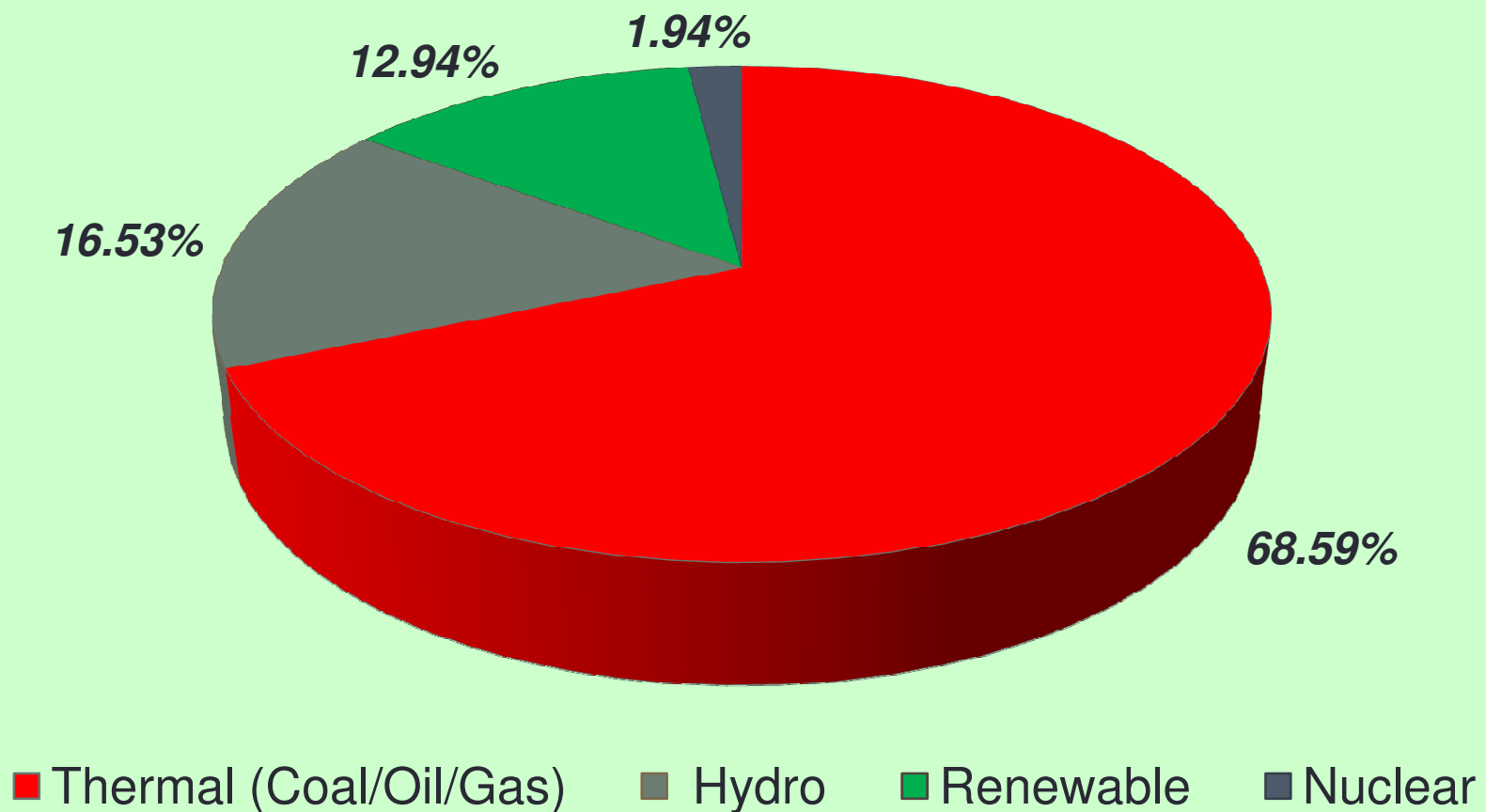
Jaideep N. Malaviya (Secretary General)

Solar Thermal Federation of India

www.stfi.org.in

India Energy Scenario

India Power Scenario



Types - Solar Thermal Systems

Low Temperature up to 80°C



Medium to High Temperature up to 300 °C



Indian Solar Thermal Achievement/Target

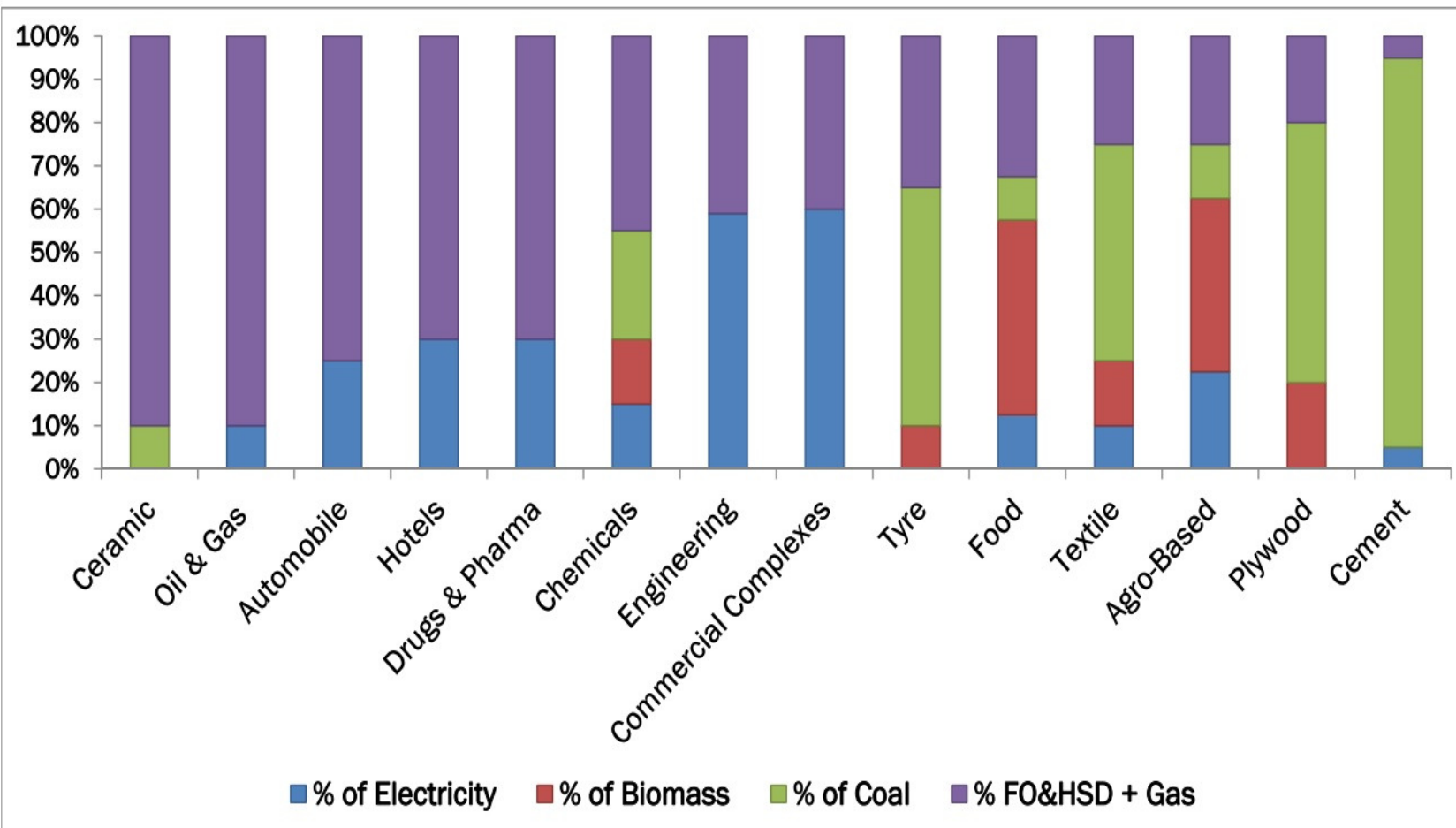
Low Temp. Solar Collector	20 mil.m ² (likely to be revised to 30 mil.m ²) by 2022	10mil m ² until 2015
Med. & High Temp. Under UNDP	45,000 m ² until March 2017	20,000 m ² until 2015
Med. & High Temp. Under UNIDO	45,000 m ² until March 2020	Programme just started

India is a unique example in the world for variety of medium to high temperature solar thermal systems for various process heat applications and perhaps the **LEADER**

Industrial Heat in India

- India's consumption of refined fossil fuels 166.87 million tonnes anticipated in 2015/16
- Over 15 mil. tonnes of oil annually in industries for temp. up to 250°C
- About 5,000 trillion kWh annually for heating water/air alone
- Over 50,000 MW installed capacity consumed for space cooling

Fuel Consumption Pattern in Indian Industries



Industrial OIL consumption in India

(2014-15), source Ministry of Petroleum & Natural Gas

LDO	54.63	tonnes
LPG	1050.98	tonnes
LSHS/ HHS	103.54	tonnes
HSDO	793.77	tonnes
FO/ LSHS	1748.42	tonnes
SKD	51.53	tonnes
Nat. Gas	395	Mil. metric Std. Cub. mtr.

Targeted Establishments



Establishment	Application	Temperature range	Fuel & Device
Hostels, Ashrams, Para-Military/ Defence units, Prisons, Hotels, Hospitals, Industrial canteens, etc	Community Cooking	300-500C in direct heating . Steam cooking popular in rice eating areas (120-150C)	Cook stoves/ boilers using LPG, firewood/ kerosene/ diesel
Dairy, Textile, Pharmaceutical, Chemical, Metal treatment, Food processing industries, Hotels, Hospitals	Process heat/ Laundry	50-350 C depending on application in the form of hot air/ water/oil/steam	Mostly boilers using diesel/ furnace oil
All establishments where power cuts are high & fuel oil being used for cooling	Space Cooling	Steam/ pressurized hot water (120-200 C)	VCM / VAM using electricity/ diesel

Project Supported under UNDP-GEF CSHP



Demonstration Projects (150 m2 & above)

Application	Number	Area (Sqm)
Process Heat	23	9890
Cooking	3	2866
Space Cooling	2	2064
Total	28	14,820 (A)

Replication & Other Projects

Process Heat	11	1923
Cooking	32	4407
Total	43	6,330 (B)

Repair & Renovation

Space Cooling	1	1250
Cooking	7	1840
Total	8	3,090 (C)
GRAND TOTAL	79	24,240 (A+B+C)

What is RPO & SPO?

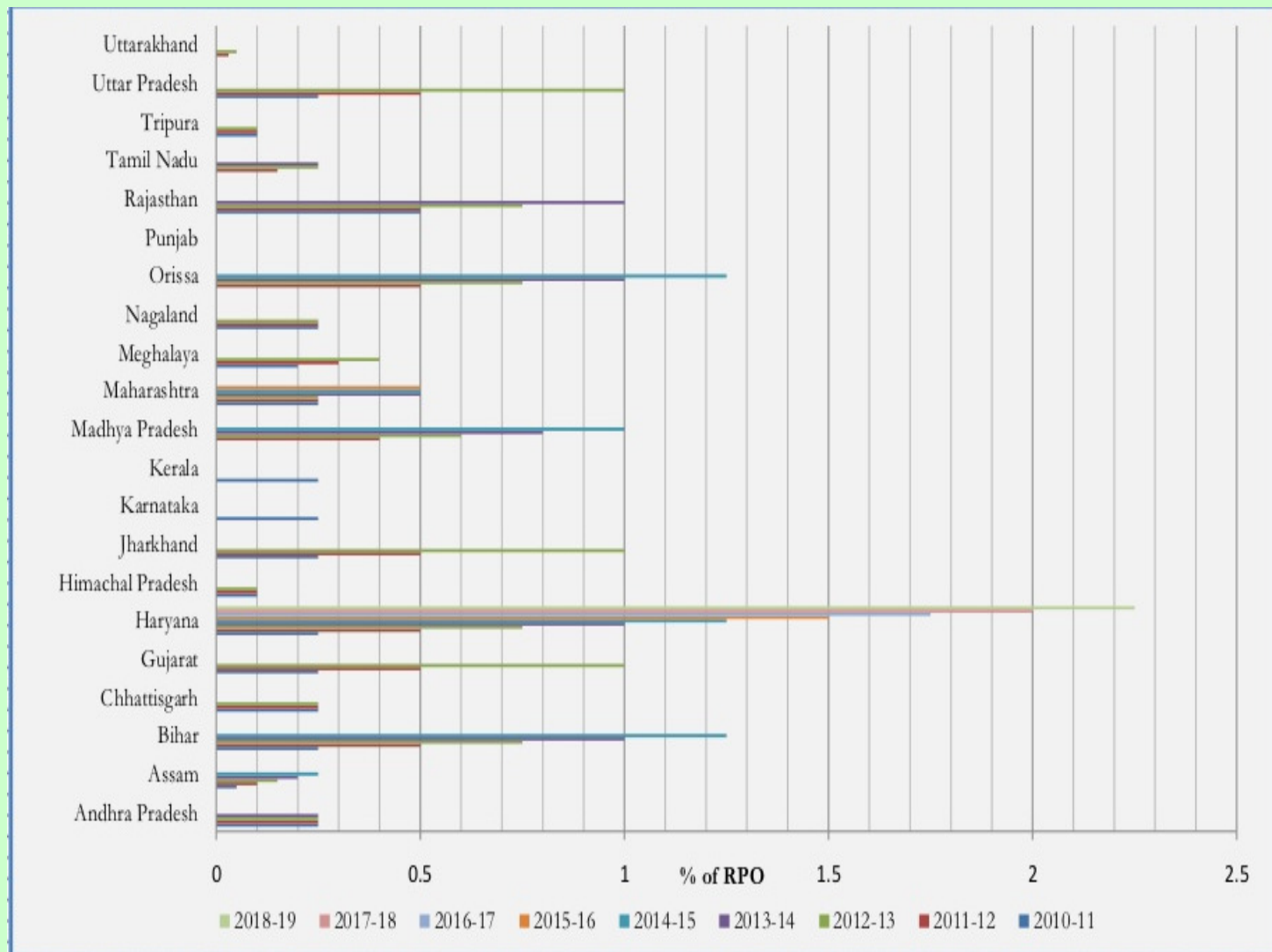
Renewable Purchase Obligation(RPO) – A mandate for obligated entities to purchase a percentage of the total electricity consumption under Electricity Act 2003

- *Section 86(1)(e) – The State Electricity Regulatory Commission (SERC) should specify for purchase of electricity from renewable energy sources, a percentage of total electricity consumption in the area of distribution licensee*
- *Section 61(h) – The CERC shall specify the terms and conditions for the determination of tariff and shall be guided by the promotion of co-generation of electricity from renewable sources of energy*
- *Section 66 – The CERC shall endeavor to promote the development of a market (including trading) in power in such manner as may be specified and shall be guided by the National Electricity Policy*

Under RPO a certain% of electricity must be met using solar energy technologies termed as Solar Purchase Obligation (SPO)

Who is Eligible?

- Obligated Entities (OE)
 - Distribution Companies
 - Open Access Consumers
 - Industries consuming captive power
- To meet the RPO, OEs can
 - Generate their own renewable energy
 - Purchase energy from RE sources that comply with RPO regulations
 - Purchase Renewable Energy Certificates (RECs)



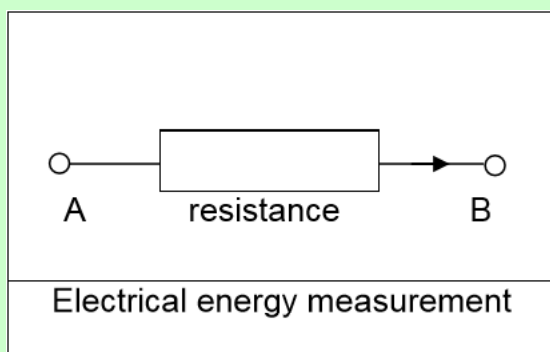
Renewable Energy Certificate (REC)



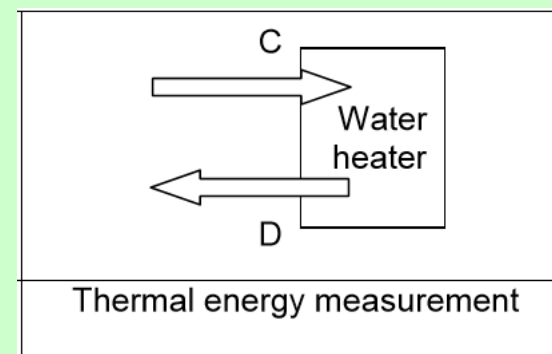
- 1 REC equivalent to 1 Mega Watthour (MWh)
- Can be traded on Power Exchanges using floor or forbearance price
- Cannot be banked or borrowed



Measuring PV & Thermal



The electrical energy [Wh] consumed in the resistance is calculated from the potential difference [V] measured between point A and B, and the flow of electrons, current [A]



The equivalent to consumed thermal energy is calculated from the temperature difference between point C and D [°C] and the flow of water [m³/s]

Methodology to compute Heat Power

Using Flow meter and temp sensors the heat generated can be measured and converted to equivalent power

$$\text{Heat power } P \text{ [kW]} = \rho \times c_p \times V \times (T_{in} - T_{out})$$

- ρ : the density [kg/m^3]
- c_p : the specific heat capacity [$\text{J}/(\text{kg}^\circ\text{C})$]
- V : Volume of mass heated
- T_{in} : in temperature t_{in} [$^\circ\text{C}$]
- T_{out} : out temperature t_{out} [$^\circ\text{C}$]

$$\text{Daily heat power generated 'Q'} = P \times t$$

Where t – time in minutes



Estimating net kWh/day

Concentrated Solar Thermal

- Each m² of concentrator dish saves close to 4,68,700 kcal equivalent power annually
- Assuming 25,000 m² area used for process heat, it translates to 105 million kWh annually

Low Temp Solar Collector

- Each m² of solar collector saves close to 6,00,000 kcal or 700 kWh annually
- Assuming 10% of the 10 million solar collector installed for process heat, it translates to 700 million kWh annually

GUSTO

- Solar Photovoltaics (PV) is easy to measure power generated so as to qualify for SPO targets. Contrary solar thermal system **SAVES ELECTRICITY/OIL** hence never found as a measurable parameter for SPO.
- A new mechanism Generation Using Solar Thermal Obligation (**GUSTO**) suggested for industrial/ commercial solar thermal systems
- Heat generated/saved be translated to equivalent kWh and qualify for SPO as well as REC

Enabling under REC

- Measuring the effective kWh saved through solar thermal should be considered as kWh generated and Renewable Energy Certificates (REC) be issued for such projects
- A minimum size of 150 m² or bundling of several projects to qualify
- Distribution Companies with Obligation Compliance to suitably allow large scale industrial/commercial solar thermal projects as part of SPO or buy in form of REC's
- Best way to mandate is use the route of **AVOIDED EMISSION SAVINGS** rather than ENERGY SAVINGS as a Climate Change Obligation and help meet the target set under COP 21

Advantages of GUSTO

- Given the fact that India is a unique example to the world for industrial solar thermal projects, GUSTO is apt and can be part of the SPO.
- Even if 5% of industrial heat is targeted under GUSTO, sufficient enough to meet the UNDP & UNIDO targets
- Will enable achieve economies of scale and make systems cheaper due to volumes of scale
- With close to 100,000 m² Industrial/Commercial solar heating projects targeted they be made to qualify under SPO and give admiration to solar thermal technology

Thank you



Jaideep N. Malaviya (Secretary General)

Solar Thermal Federation of India



info@stfi.org.in

www.stfi.org.in