

Prevention First 2018 Symposium.

Renewable Energy Sources and Emerging Technologies

Identification of the barriers and to disseminate the decentralized renewable energy system in India

3:30pm – 4:30pm

Tuesday, September 25, 2018

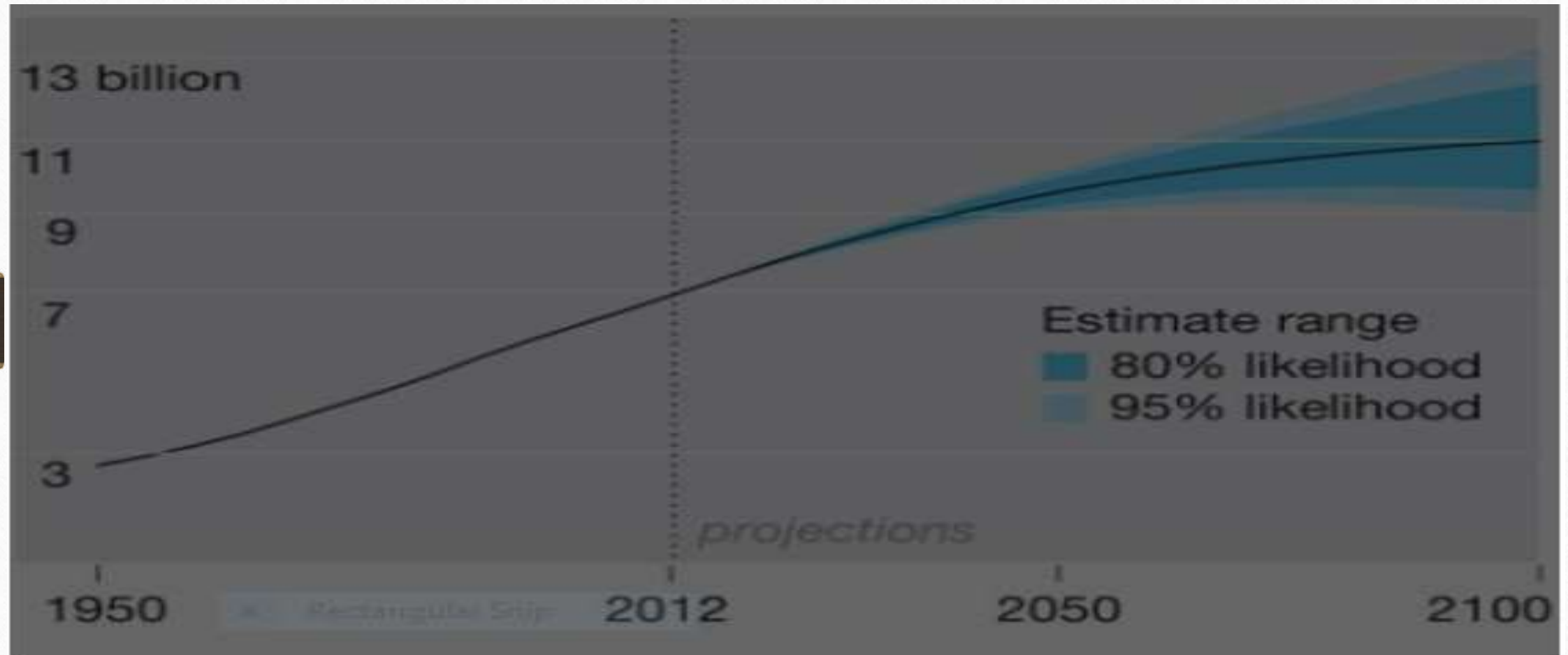
Shailendra Kumar Pokhriyal

HoD, Energy Management

School of Business

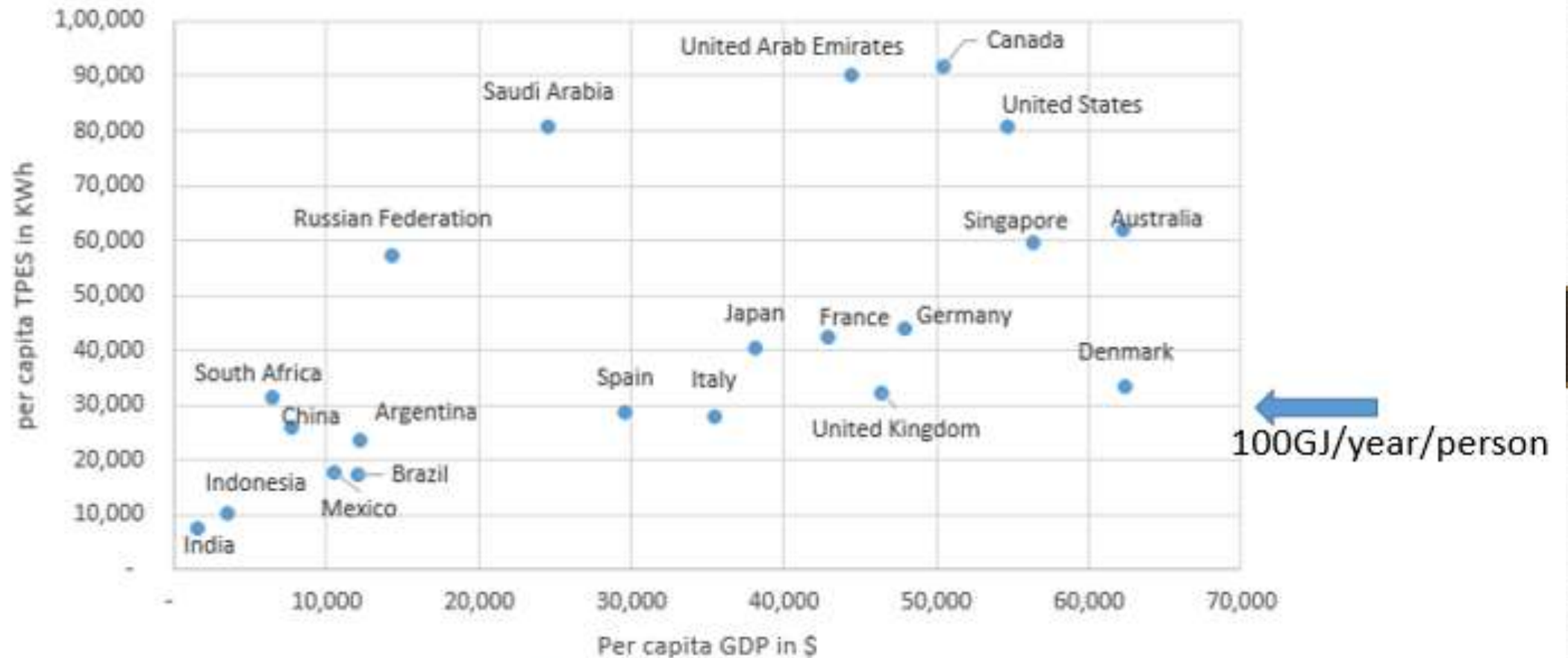
University of Petroleum & Energy Studies, Dehradun, India

Global Population Projections



Source: UN 2017 World Population Prospects

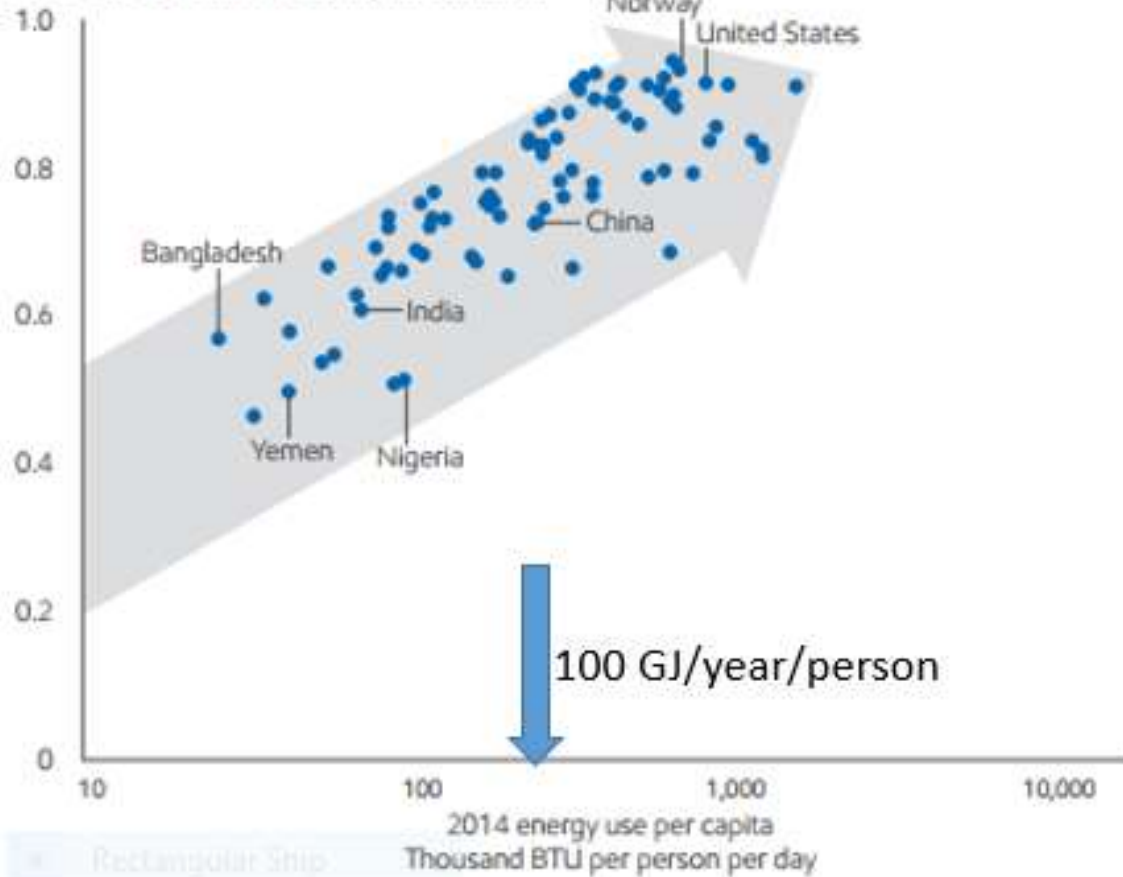
Energy Consumption and Economic Growth



Source: IEA for Total Primary Energy Supplies (2014); World Bank for GDP (2014)

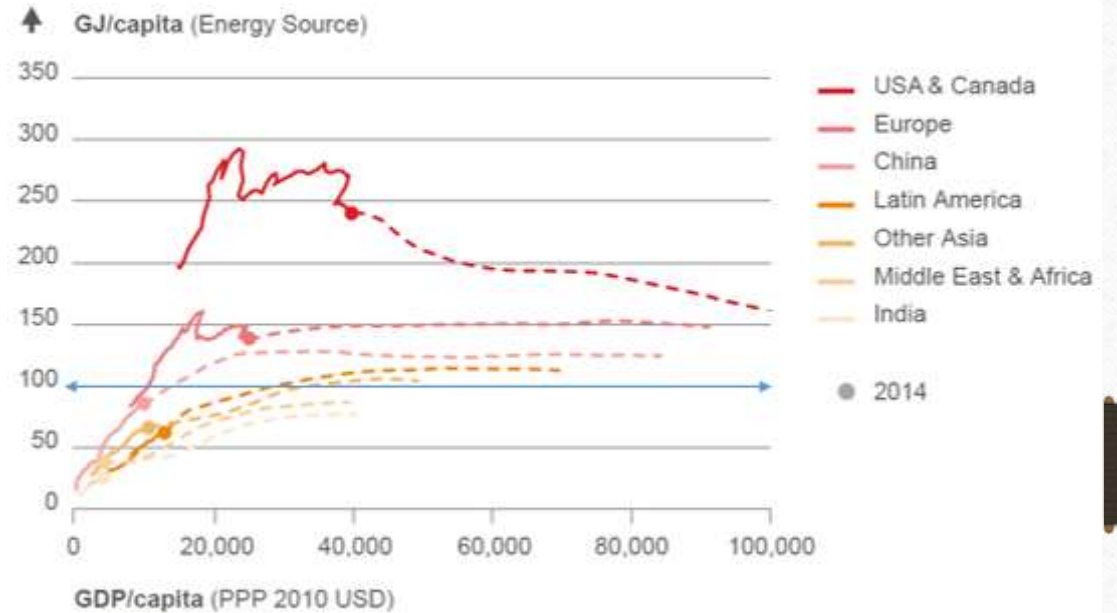
Energy fuels human development

2014 U.N. Human Development Index



Source: United Nations, ExxonMobil estimates

Income and energy use over the years



Source: Shell "The colours of Energy"

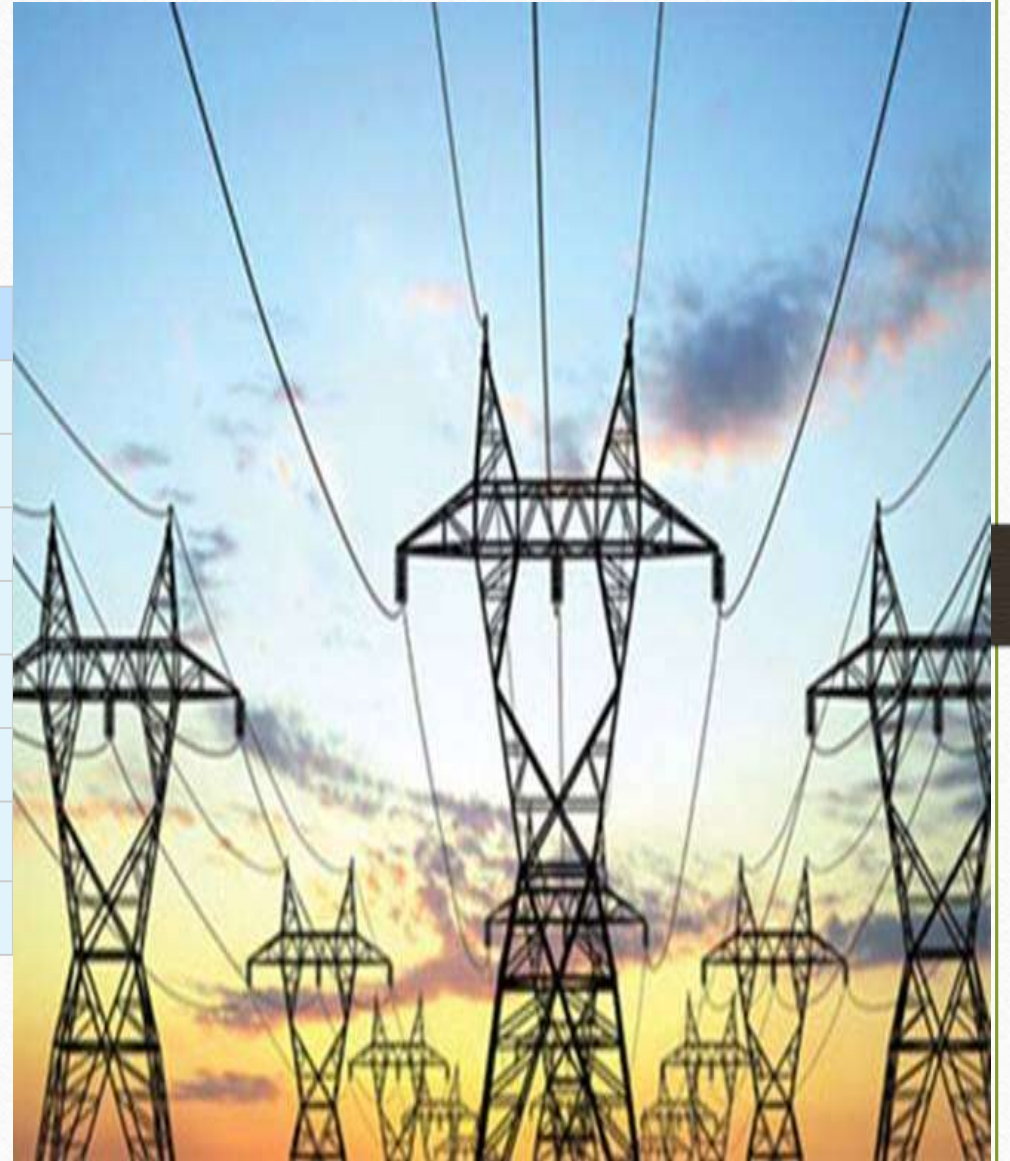
- Global Energy Demand to Double
- Energy Challenges of Urbanisation
- Sun- the ultimate source of most energy on earth

- Challenges of Solar and Wind Energy
- Huge Investment turnover for a switch to Renewables

Power Generation Capacity in India

Fuel	MW	% of Total
Thermal	2,22,693	64.8%
Coal	1,96,958	57.3%
Gas	24,897	7.2%
Oil	838	0.2%
Hydro (Renewable)	45,403	13.2%
Nuclear	6,780	2.0%
RES* (MNRE)	69,022	20.1%
Total	343,899	

Total Installed Capacity (As on 31.06.2018)
Source : Central Electricity Authority (CEA)



Demand and Supply Mismatch

Year	Energy				Peak			
	Requirement	Availability	Surplus(+)/Deficits(-)		Peak Demand	Peak Met	Surplus(+)/ Deficits(-)	
	(MU)	(MU)	(MU)	(%)	(MW)	(MW)	(MW)	(%)
2017-18	12,12,134	12,03,567	-8,567	-0.7	1,64,066	1,60,752	-3,314	-2.0
2018-19*	3,25,428	3,23,418	-2,009	-0.6	1,71,973	1,70,765	-1,208	-0.7

Source: Ministry of Power, GoI

Decentralized Distributed Generation Scheme of Ministry of Power

1. DDG projects can be taken up under RGGVY in remote villages where grid connectivity is either not feasible or not cost effective. The RGGVY in XI Plan has a financial outlay of Rs. 540 Crore for implementation of DDG projects.
2. All un-electrified revenue villages and hamlets (above 100 population) are eligible under DDG scheme of RGGVY.

Core Drivers for Renewables

- Energy security
- Electricity shortages
- Energy Access
- Climate change etc.

State-wise Grid Interactive Renewable Power Generation Installed Capacity under Various Renewable Energy Sources in India

State-wise Grid Interactive Renewable Power Generation Installed Capacity under Various Renewable Energy Sources in India (As on 30.06.2017)						
(In MW)						
Source	Small Hydro Power	Wind Power	Bio-Power		Solar Power	Total Capacity
			BM Power/ Cogen.	Waste to Energy		
India	4384.55	32508.17	8181.70	114.08	13114.85	58303.35

Source: Indiastat (Accessed on 2 Sep 2018)

State-wise Installation of Off-Grid/

Decentralised Renewable Energy Systems/Devices in India

State-wise Installation of Off-Grid/Decentralised Renewable Energy Systems/Devices in India

(As on 31.03.2017)

(Nos. in Lakh)

Source	Biogas Plants (In Nos.)	Water Pumping/ Wind Mills# (In Nos.)	SPV Pumps (In Nos.)	Solar Photovoltaic (SPV) Systems				Aerogen. Hybrid System (In KWP)	Solar Cooker # (In KWP)	Biomass Gasifiers (Rural+ Industrial) (In KWP)	Biomass (non bagasse) (In KWP)	Waste to Energy (In KWP)
				SLS (In Nos.)	HLS (In Nos.)	SL (In Nos.)	PP (In KWP)					
				Nos/Capacity	49.56	1418.08	114878.00					

Source: Indiastat (Accessed on 2 Sep 2018)

Potential for Renewable Energy in India

Resource-wise Estimated Medium-Term Potential for Renewable Energy in India (Up to 2032)

Resource	Estimated Potential* (In MW _{eq.})
Solar Power	>100000 ¹
Wind Power	49000 ²
Small Hydro Power (Upto 25 MW)	20000 ³
Bio-Power	
Agro-Residues	16000 ⁴
Cogeneration-Bagasse	5000 ⁵
Waste to Energy	
Municipal Solid Waste to Energy	1700 ⁶
Industrial Waste to Energy	1000
Total	192700 ⁷

Source: Ministry of Power, GoI

Decentralized System

Some of the renewable energy technologies that are used in villages and rural areas as decentralized systems are:

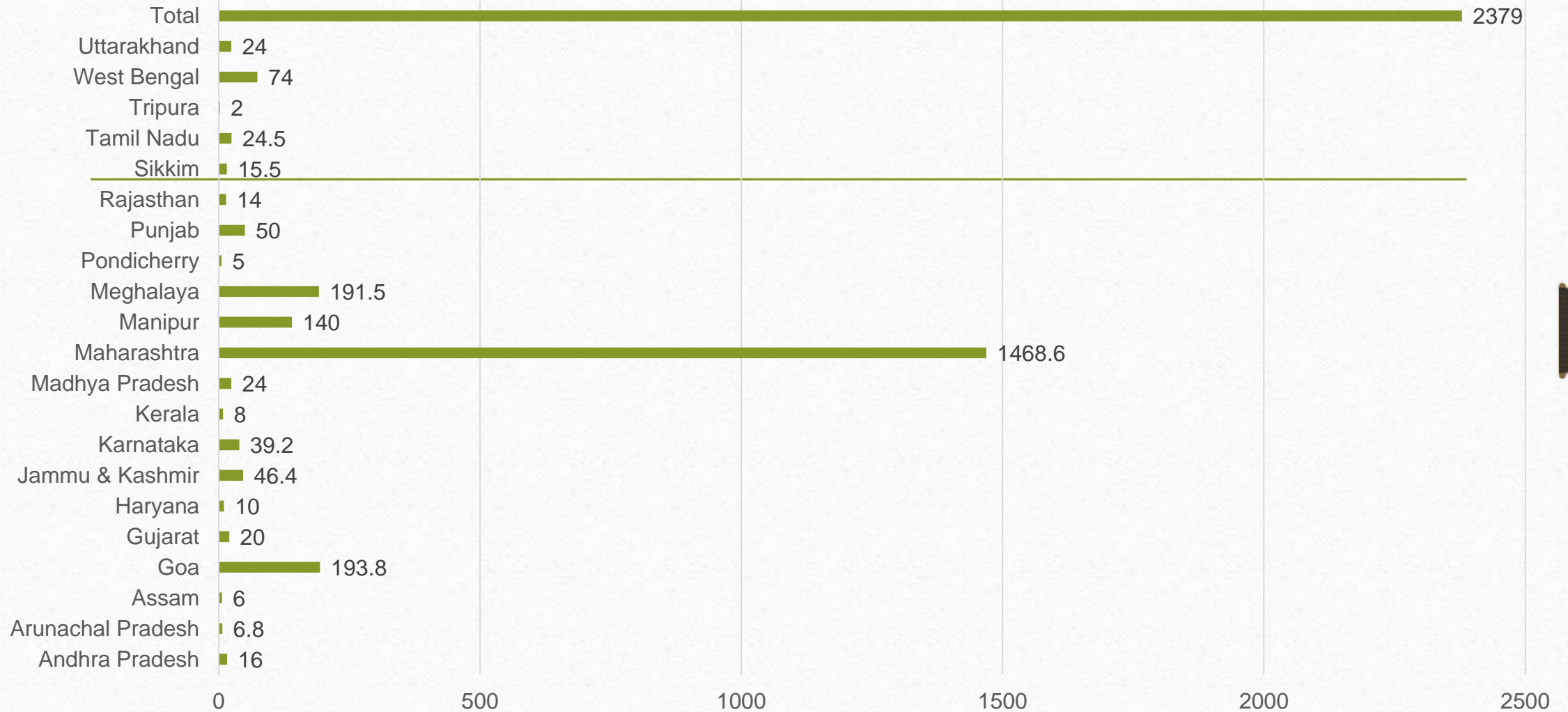
- Family-size biogas plants.
- Solar street lighting systems.
- Solar lanterns and solar home lighting systems.
- Solar water heating systems
- Solar cookers.
- Standalone solar/ biomass based power generators.
- Akshay Urja / Aditya Solar Shops
- Wind pumps.
- Micro-Hydel plants.

Decentralized System

- Decentralised/ Off – Grid Power
- Decentralised Wind Power
- Bio Mass Gasification
- Biogas Power (Off-grid) Programme
- Small Hydro
- Solar Power
- Waste to Energy

Achievements Since Inception

Installed Capacity (kWh)



Source: Indiastat (Accessed on 2 Sep 2018)

Challenges for Renewable System

1. High initial capital cost
2. Lack of financing mechanism
3. Transmission and distribution losses
4. Inefficient technology
5. Lack of subsidies
6. Lack of consumer awareness to technology
7. Lack of sufficient market base
8. Lack of paying capacity
9. Need for backup or storage device
10. Unavailability of solar radiation data
11. Lack of information technology resources
12. Lack of awareness of technology
13. Less efficiency
14. Technology complexity
15. Lack of research and development work
16. Lack of trained people and training institutes
17. Lack of local infrastructure
18. Lack of national infrastructure
19. Scarcity of natural and renewable resources
20. Geographic conditions
21. Unable to meet electricity power demand alone
22. Lack of experience
23. Rehabilitation controversies
24. Faith and beliefs
25. Lack of political commitment
26. Lack of adequate government policies
27. Lack of public interest litigations
28. Ecological issues

Source : (Luthra et al., 2015)

Barriers for Decentralised System

<i>Barrier</i>	<i>Sub-barriers</i>
Technical	Resource availability; technology (design, installation and performance); skill requirement for design and development, manufacturing, installation, operation and maintenance
Economic	Cost; market structure; energy pricing; incentives; purchasing power and spending priorities; financial issues; awareness and risk perception
Institutional	Policy and regulatory; infrastructure (institutions for research, design and after sales services); administrative
Socio-cultural	Societal structure; norms and value system; awareness and risk perception; behavioral or lifestyle issues
Environmental	Resources (land and water); pollution; esthetics

Source : (Yaqoot, Diwan and Kandpal, 2016)

Remedial Measures for Technical Barriers

<i>Sub-barrier</i>	<i>Remedial measure(s)</i>
Resource availability	Accurate resource assessment
Technology-design, installation and performance	Research and Development (R&D) International cooperation Indigenization of technology by studying local conditions and involving all stakeholders during product development Training for skill related to product development Introduction of standards and regulations during product development
Skill requirement for design and development, manufacturing, installation, operation and maintenance	Education and training

Source : (Yaqoot, Diwan and Kandpal, 2016)

Remedial Measures for Economic Barriers

<i>Sub-barrier</i>	<i>Remedial measure (s)</i>	<i>Sub-barrier</i>	<i>Remedial measure (s)</i>
Cost	<p>Incentives to DRES users or consumers (subsidy, tax rebate) R&D for cost reduction Funds for R&D on DRES</p> <p>Reduction in transaction cost (learning by doing effect)</p>	Market	<p>Innovative financing schemes (soft loans, grants, revolving fund, fee for service delivery model) Micro-credit facilities</p> <p>Internalization of externalities in cost of energy Withdrawal of subsidies to fossil fuels</p> <p>Quotas for DRES usage</p> <p>Incentives (subsidies, tax break, reduced import duty) to private sector or entrepreneurs (acting as manufacturers/project developers/distributors/retailers) Market intermediation by government Awareness or information dissemination programme</p>

Source : (Yaqoot, Diwan and Kandpal, 2016)

Remedial Measures for Institutional Barriers

<i>Sub-barrier</i>	<i>Remedial measure (s)</i>	<i>Sub-barrier</i>	<i>Remedial measure (s)</i>
Policy and regulatory	<p>Conducive long-term policies for all stakeholders</p> <p>Conducive regulatory framework</p> <p>Integration of DRES policies with developmental programmes</p>	Administrative	<p>Strong coordination between various agencies and stakeholders</p>
Infrastructure	<p>Policy involving incentives for DRES utilization</p> <p>Private sector participation</p> <p>Specialized institutions for R&D, financing, capacity building, marketing and commercialization of DRES</p> <p>After sales services infrastructure for training and extension programmes</p>		<p>Involvement of local stakeholders in planning and implementation of DRES programme</p> <p>Simplified approval procedures or single window clearance</p> <p>Support and facilitation by government from R&D to commercialization of DRES</p> <p>Effective project monitoring and evaluation</p>

Source : (Yaqoot, Diwan and Kandpal, 2016)

Remedial Measures for Socio-cultural Barriers

Remedial Measures for Environmental Barriers

<i>Sub-barrier</i>	<i>Remedial measure(s)</i>	<i>Sub-barrier</i>	<i>Remedial measure and reference(s)</i>
Societal structure, norms and value system	Comprehensive assessment of the perceived needs of the end user Involvement of local stakeholders in planning and promotion of DRES	Resources (land and water), pollution, esthetics	Life cycle analysis of the project R&D for development of efficient systems with minimum possible footprint Awareness generation among stakeholders
Awareness and perception	Awareness generation or information dissemination programmes Demonstration programmes		
Behavioral or life-style issues	Demonstration programmes		

Source : (Yaqoot, Diwan and Kandpal, 2016)

Achievements

1. 100% Rural Electrification Achieved on April 2018.
2. Government is on its way to achieving 175 GW target for installed Renewable Energy capacity by 2022.
3. India attains global 4th and 6th position in global Wind and Solar Power installed capacity.
4. By November 2017, a total of 62 GW Renewable Power installed, of which 27 GW installed since May 2014 and 11.79 GW since January 2017.
5. Historic Low Tariffs for Solar (Rs. 2.44/ unit) and Wind (Rs. 2.64/ unit) achieved through transparent bidding and facilitation.
6. Ambitious Bidding Trajectory for 100 GW capacity of Solar Energy and 60 GW capacity of Wind over the next 3 years laid down.

100% Rural Electrification in India

1. All 597,464 inhabited villages in the country now have access to Power.
2. Manipur's Leisang village became the last non-electrified inhabited village to join India's mainline supply.
3. The last inhabited village to be powered through the off-grid system — isolated supply networks, mostly with solar power plants — was Pakol, also in Manipur.



1 Lakh MW
Generation Capacity added



Expansion of Transmission grid by
1 Lakh ckm



35.5 GW to 69.7 GW
Capacity of Renewables doubled



107 Crore
LED bulbs distributed



4376 MW
Hydel capacity addition

NEW INDIA

ROSHAN INDIA

100% village electrification



Saubhagya
launched for
Universal electrification



More than
₹ 20,000 Crore
Interest cost saved
by Discoms under UDAY



DDUGJY & IPDS
Infrastructure works worth
₹ 1,40,000 Crore



India emerges as
Net exporter of Electricity



Thanks

Contributions : M. Yaqoot , Atul Agarwal, UPES, Dehradun, India