

Regional Consultation on Climate Services for the 3rd Pole and other High Mountain Areas

- Energy Sector

WMO Consultative Meeting

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B. Mukhopadhyay
IMD Pune



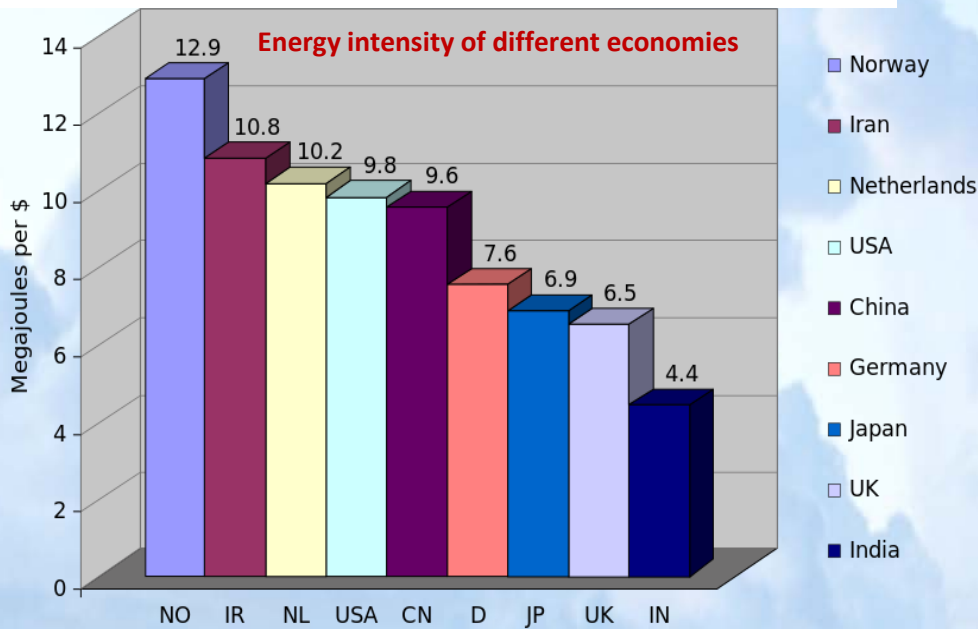
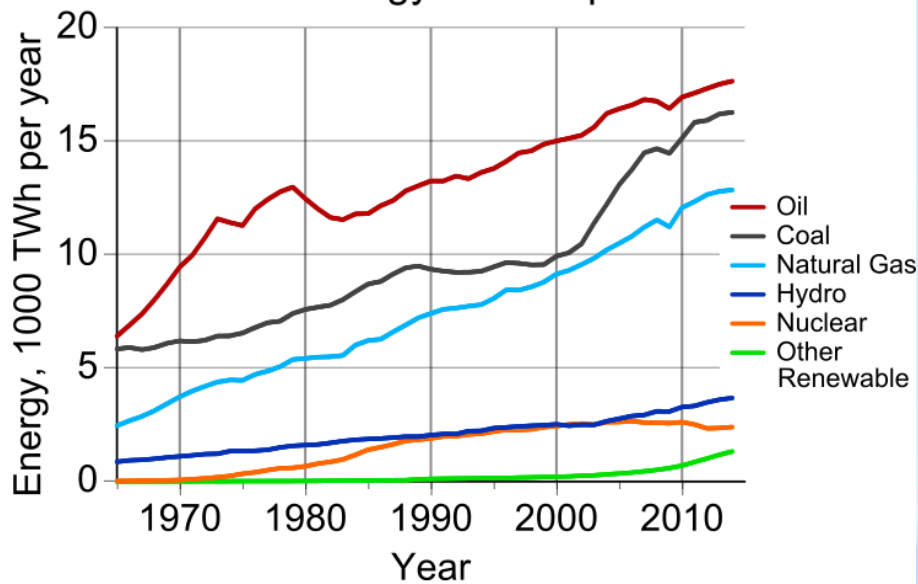
Scope of Climate Services for the Sector

Mitigation of climate change
Adaptations to climate change

- Estimate potential for power generation – investment planning
- Short Term predictions of productivity parameters
- Power consumption prediction for Grid management
- Efficient use of energy
- Capacity building

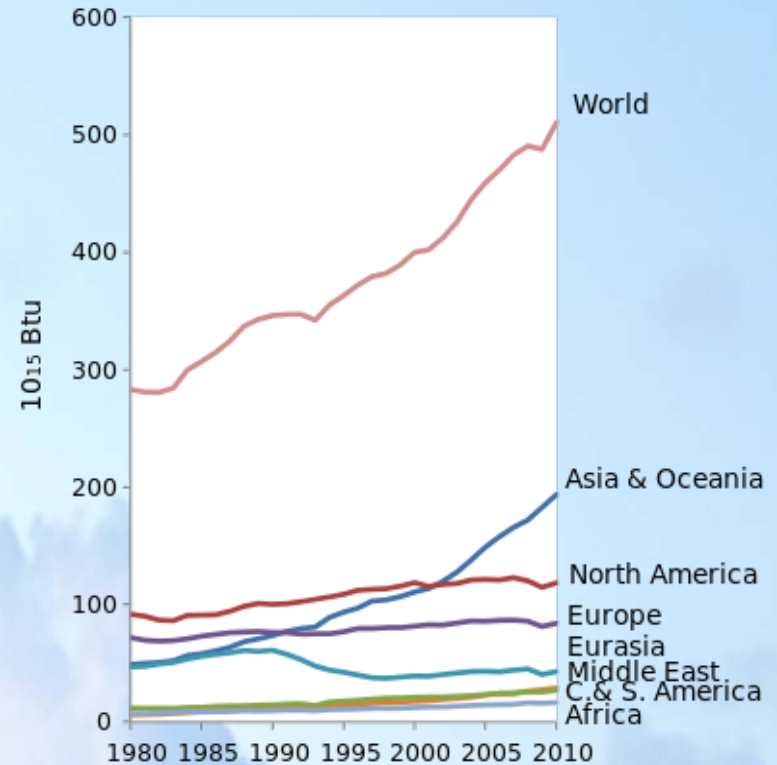


World energy consumption



The graph shows the ratio between energy usage and GDP for selected countries

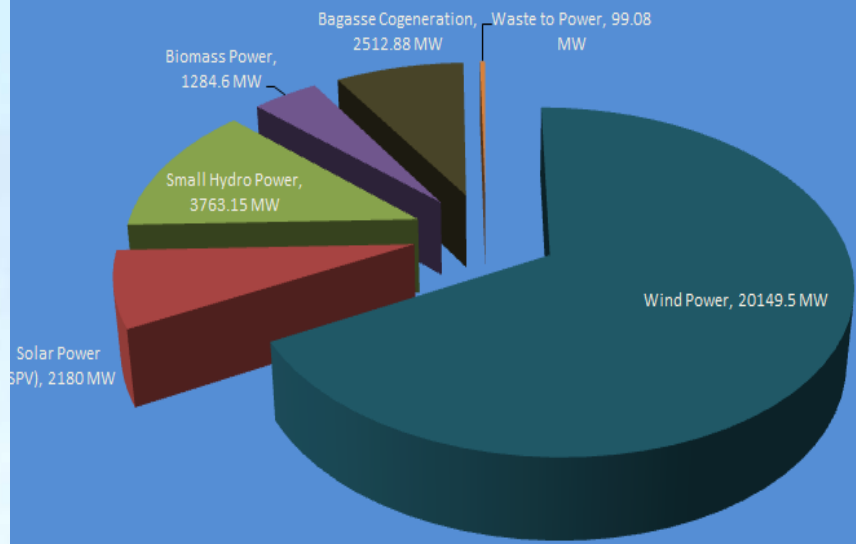
Annual Energy Demand by Region



The International Energy Agency (IEA) forecasts that world primary energy demand **between now and 2030 will increase by 1.5% per year**



Renewable Energy by Installed Capacity in India



Total Renewable Energy Installed Capacity (31 Nov 2015) ^[3]

Source	Total Installed Capacity (MW)
Wind Power	24,759.32
Solar Power (SPV)	4,684.74
Small Hydro Power	4,161.90
Biomass Power(Biomass & Gasification and Bagasse Cogeneration	4,550.55
Waste to Power	127.08
Total	38,283.59

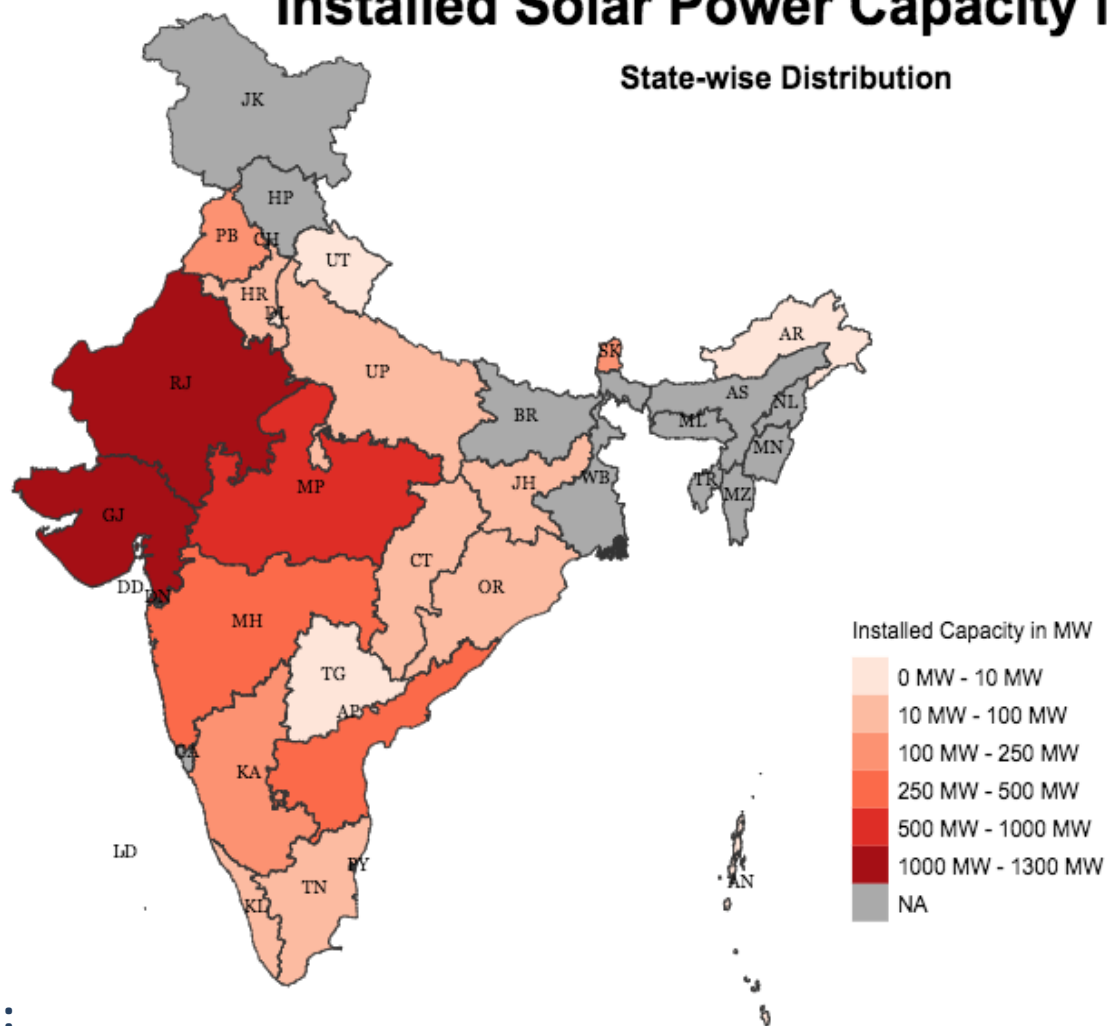


Installed solar PV on 31 March

Year	Cumulative Capacity (in MW)
2010	161
2011	461
2012	1,205
2013	2,319
2014	2,632
2015	3,743

Installed Solar Power Capacity in India

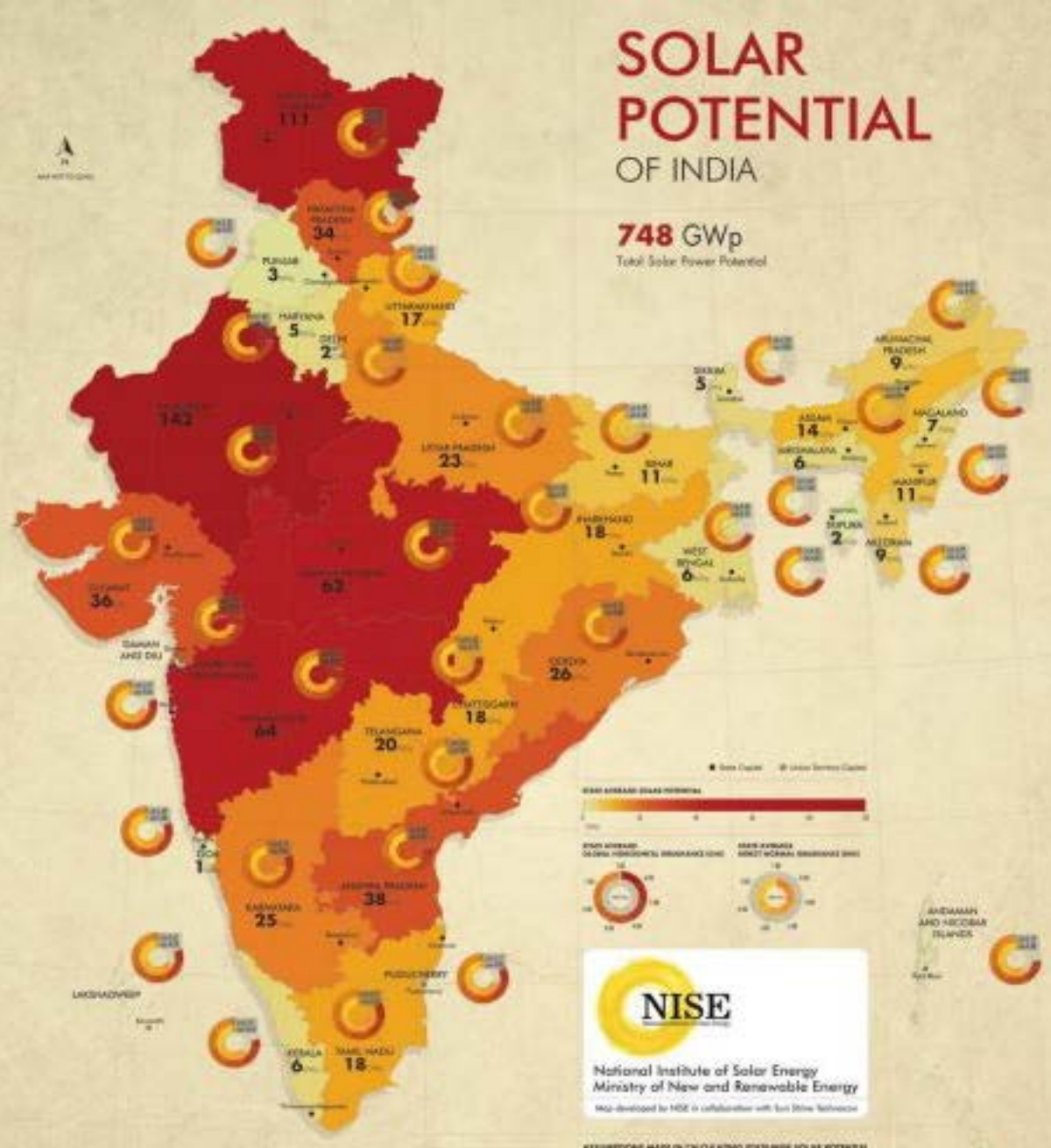
State-wise Distribution



socialcops

1. Accelerated Depreciation:
2. Capital Subsidies:
3. Renewable Energy Certificates:
4. Net Metering Incentives:
5. Assured Power Purchase Agreement (PPA):





- About 3% wasteland in the state has been planned to be used for SPV generation.
- In 1 sq km of wasteland area it is estimated that 50 MWp can be generated.



Class	Station Capacity in kW
Micro Hydro	Up to 100
Mini Hydro	101 to 2000
Small Hydro	2001 to 25000

Micro



Small

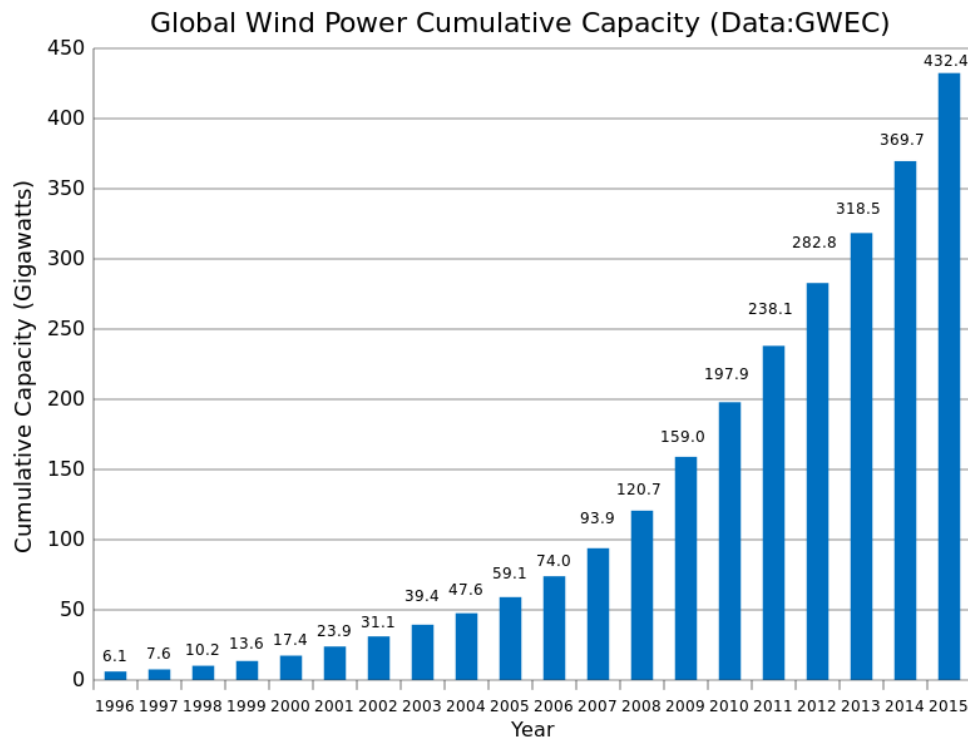


Water Mill: estimated 50,000 “gharats” exist



It has been estimated that there are more than 1.5 lakh potential water mill sites in the Himalayan regions of India. With the R&D efforts, improved designs of water mills have been developed for **mechanical as well as electricity generation of 3-5 kW.**





Year	Cumulative Capacity (in MW)
2005	6,270
2006	7,850
2007	9,587
2008	10,925
2009	13,064
2010	16,084
2011	18,421
2012	20,149
2013	21,264
2014	23,444

- Sustained wind speeds above a thresh hold
- No storage possible
- Grid linkage is essential

State	Capacity (MW), as of 31 March 2015 ^[13]
Tamil Nadu	7455.2
Gujarat	3645.4
Maharashtra	4450.8
Rajasthan	3307.2
Karnataka	2638.4
Andhra Pradesh	1031.4
Madhya Pradesh	879.7
Kerala	35.1
Others	4.3
Total	23447.5



How Climate Change can affect future energy generation and consumption projections?

- Altered nature of rainfall – more of the convective variety
 - Stream flow characteristics, hydel management issues
 - Water harvesting /conservation issues
- Altered nature of cloudiness – northward shift of Subtropical Jet Stream, increased westerly-easterly interactions
 - Available solar energy
- Increased gusty nature of wind
 - Variable wind power
- Higher ambient temperatures – adverse impact on comfort parameters
 - Higher energy consumption for comfort (over and above demand rise due to population)



Prospective Services – data and products

Climatology

- Solar Energy potential over the area
- Wind speeds at different levels (vertical wind shear) – wind energy potential
- Climatology of comfort indices
- Sector wise energy needs and projections

Prospects and new infrastructure

Estimation for the mountain region is lacking. 3 radiation stations of India exist

Wind field assessments for valleys and ridges yet to be done

Not available

Available but needs consolidation



Prospective Services – data and products

Weather predictions

- Cloudiness - Solar Energy potential over next 48 hrs
- Wind speeds at different levels (vertical wind shear) – wind energy potential
- Rainfall over specific water sheds and stream predictions

Prospects and new infrastructure

Satellite data and model predictions can give adequately accurate information

New observations required – can be generated at wind mill sites, downscaling from high resolution NWP using atmospheric stability, specific terrain flow models

Stream flow models at very high resolution



Prospective Services – Capacity building

Areas

- More representative and new types of observations
- Improved NWP system
- Climate analysis
- Specific studies related to Energy Sector knowledge gap areas

Prospects and new infrastructure

Better managed AWS network,
Higher increase of satellite data,
better initial conditions for NWP

To introduce terrain sensitive models, linking with climate system downscaling

Need consolidation and updation

Projects to be assigned



How to create a Framework for development and delivery of services?

- National level Framework for Climate Services to be developed and interlinked through a Regional Centre located suitably. Leadership required.
- Country level engagements with Energy Sector Stake holders, MoUs, standing arrangements, workshops etc
- Project prioritizing to be taken up by each National Framework in knowledge areas and observational augmentation
- Apex annual all Sector workshop and stock taking meeting should be held for the Region



Thanks

