

<b>Integration Between Various Sources of Renewable Energy – Audit Course</b>		
<b>Sr. No.</b>	<b>TOPICS</b>	<b>Required time</b>
1	Introduction, Availability of Various Sources of Renewable Energy in India & World Perspective	3 Hrs
2	Hydro , Marine, Geothermal - Renewable Energy Sources - Present & Future Installations Scenario - Present & Future Installations [ Potential & Achievement of RE in India (as on 31.12.2015) ]	3 Hrs
3	Solar , Wind, Biomass - Renewable Energy Sources - Present & Future Installations Scenario - Present & Future Installations [ Potential & Achievement of RE in India (as on 31.12.2015)	3 Hrs
4	Complexity of Power System Processes, On-Going Transformation and Grid Integration	4 Hrs
5	Challenges for Energy Integration and Mitigating Measures - Capital, land and Other Requirement,	4 hHs
6	Smarter Electricity System, Energy Storage Systems, Operational Flexibility, Modelling and Analysis	3 Hrs
	Total	20 Hrs

### **Module Overview:**

Today Renewable Energy Key Words and Vital for India's Economy. Energy Security is an Area of Prime Concern for INDIA.

Hence we Must Promote Renewable Energy & Integration Between Various Sources of Renewable Energy.

Introduction, Availability of Various Sources of Renewable Energy in India & World Perspective. [Potential & Achievement of RE in India (as on 31.12.2015)

**Solar , Wind, Biomass** - Renewable Energy Sources - Present & Future Installations Scenario - Present & Future Installations. Solar Energy :- Solar PV, Concentrating Solar Power, Solar

Heating ; Wind Energy :- Off-Shore , On-Shore ; Biomass Energy:- Bio=Energy for Electricity and Heat, Bio-Fuel.

**Hydro , Marine, Geothermal** - Renewable Energy Sources - Present & Future Installations Scenario - Present & Future Installations. Hydro Energy - Run of the River, Reservoir, Pump Storage. Marine Energy:- Waves, Tidal Range, Tidal Current, Ocean Current, Ocean Thermal, Salinity Gradient Geothermal Energy - Convective System, Conductive System, Deep Aquifer

### **INDIA's Solar Power Potential: 750 GW**

(use of 3% wasteland area assumed) - National Institute of Solar Energy in India India's current solar power installed capacity: 4879 MW (0.6% of the estimated potential)

- Solar radiation is high 4.5-5.5 kWh/m<sup>2</sup> in most of the regions (>300 days of Sunshine)
- High radiation areas, Large tract of wasteland
- Not constrained by location
- Environmentally friendly, Greater Energy Security

### **Other Challenges**

- Capital requirement** –Need to develop the Corporate bond market in the country , –Need to provide long term currency hedges
  - Land requirement and other approvals** –Need simple land acquisition process , –Single Window Clearance
  - Developing domestic manufacturing capability** –Need enabling policies to encourage indigenous manufacturing
  - Uniformity in Policies, Regulations & Bidding Guidelines**
  - Discoms Financial health** –Discoms debt restructuring , –Convert Ag pumps into solar pumps, –Leveraging solar mini/micro grid for rural energy access
- Challenges for RE Integration and Mitigating Measures :**
- Intermittency – Problem of scheduling: CERC notified Forecasting and Scheduling Regulations for inter-State, SERCs to adopt the same for intra-State transaction;
  - Need flexible power for balancing : CERC notified Ancillary Services Regulations, Need to expand the scope of it for DSM, DR, Energy Storage, and market based AS;
  - Grid Stability – High penetration of a large number of distributed RE generators : Development of REMC at RLDCs and SLDCs level;
  - Low Gestation period of Generation (9-12 Months) than development of Transmission Strengthening (24-36 Months) : Green Energy Corridor already planned with strong grid interconnection to enlarge balancing areas.

**References :**

[ 1 ] Website of Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. # Govt. Of India Ministry New of Renewable Energy . Report -- Developments in Renewable Energy - Current Trends & Future Prospects # Power Market in India – Way Forward , IIT Kanpur Dated ,2nd March, 2016

[ 2 ] Websites of US -State Department... & Various US - States on Renewable Energy

[ 3 ] Websites of European-State Department