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HVDC Transmission System in India: An Overview

by Sweet Ghosh, EE 4th Year

The industrial growth of a nation requires increased consumption of energy, particularly electrical energy. This has led to increase in the generation and transmission facilities to meet the increasing demand. In USA till the early seventies the demand doubled every ten years. In developing countries, like India, the demand doubles every seven years which requires considerable investment in electric power sector.

Remote generation and system interconnections lead to a search for efficient power transmission at increasing power levels. The increase in voltage levels is not always feasible. The problems of AC transmission particularly in long distance transmission have lead to the development of DC transmission.

High Voltage Direct Current (HVDC) Transmission has revolutionized with the existing power system in today's world. The biggest advantage being ease of long distance and bulk power transmission. It has also facilitated the transmission of electricity from power rich states to power deficit states to fulfil the power demand.

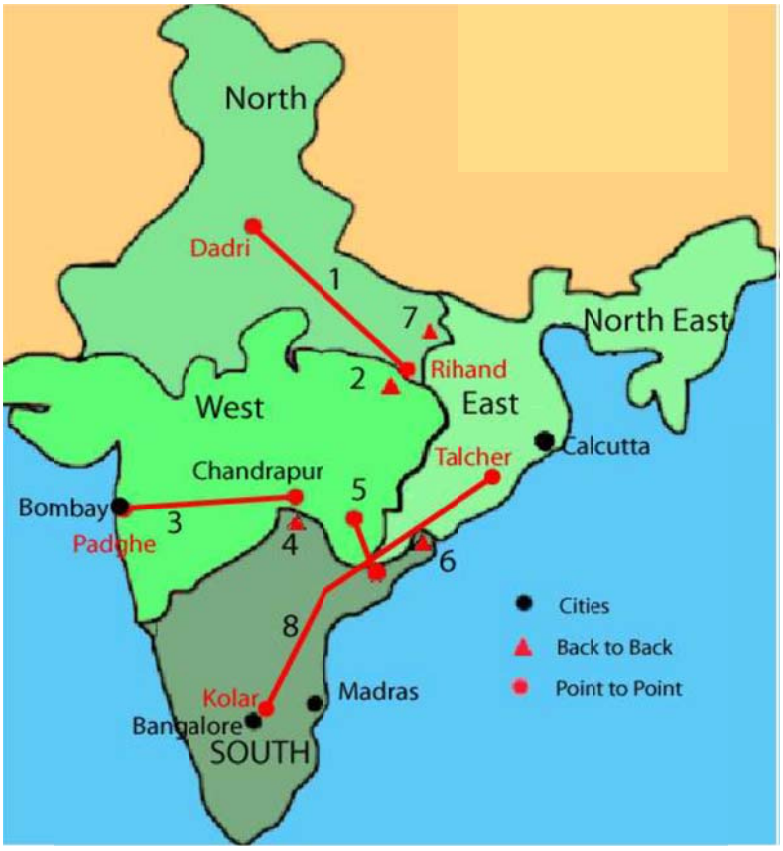
Milestones in the Development of HVDC Technology

- Hewitt´s mercury-vapour rectifier, which appeared in 1901.
- Experiments with thyratrons in America and mercury arc valves in Europe before 1940.
- First commercial HVDC transmission, Gotland in Sweden in 1954.
- First solid state semiconductor valves in 1970.
- First microcomputer based control equipment for HVDC in 1979.
- Highest DC transmission voltage (± 600 kV) in Itaipú, Brazil, 1984.
- First active DC filters for outstanding filtering performance in 1994.
- First Capacitor Commutated Converter (CCC) in Argentina-Brazil interconnection, 1998
- First Voltage Source Converter for transmission in Gotland, Sweden, 1999.

Advantages of HVDC System

- Long distance bulk power transmission is economical.
- Greater power per conductor and simpler line construction.
- No charging current and ground return is possible.
- DC line is a synchronous link and it can interconnect two rigid systems operating at different frequencies.
- Line losses are smaller.
- No reactive compensation of DC lines is required.
- Corona loss and radio interference are less as compared to AC.

HVDC System in India



1 – Rihand-Dadri (1500MW)

2 - Vindyachal (500MW)

3 - Chandrapur-Padghe (1500 MW)

4 - Chandrapur-Ramagundam (1000MW)

5 – Barsoor-Lower Sileru (200MW)

6 – Gazuwaka 1 & 2 (500MW each)

7 - Sasaram (500MW)

8 - Talcher-Kolar (2500MW)

9 – Balia – Bhiwadi (2500 MW)

10- Mundra-Mahendragarh (2500 MW)

[Source: www.powergridindia.com]

Renewable Energy in India

by Arup Ghosh, EE 4th Year

Power is one of the most vital components for the economic growth, strong security and development of any country. The existence and further development of infrastructure is essential for sustained growth of the economy.

India's power sector is one of the most diversified in the world. The conventional sources of energy like fossil fuels, nuclear etc would not be sufficient to meet the future demands due to the rapid development and industrialization of any country. Therefore, we have to think alternatives sources of energy like solar energy, Wind energy, Biomass energy, geothermal energy and many more.

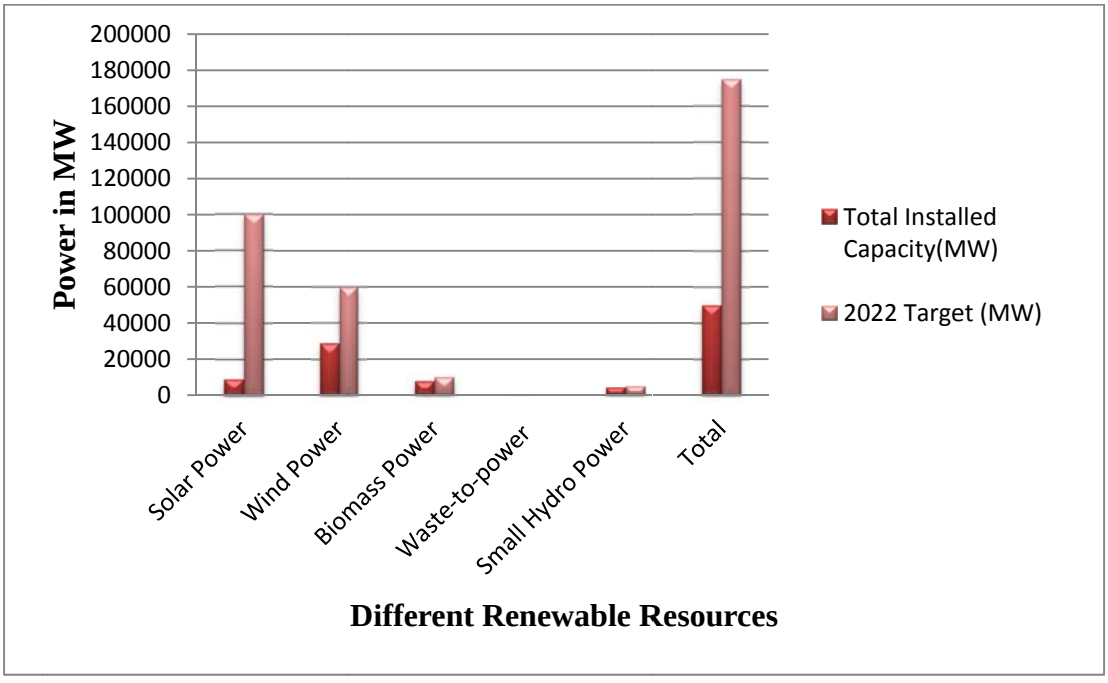
India was the first country to set up a ministry of non-conventional energy resources, in early 1980s in the world. In India, the Renewable energy Sector comes under the Ministry of New and Renewable Energy (MNRE). MNRE have fixed the target value of 43 GW in April, 2016 to 175 GW by the year 2022 which includes 100 GW from solar power, 60 GW from wind power, 10 GW from bio power and 5GW from small hydro power. The main aim is to become the leading producer of green energy in the world and to meet to energy deficiency in the country. The government of India have decided to achieve 40% cumulative electric power capacity from renewable energy sources by 2030.

Grid connected renewable electricity

Source	Total Installed Capacity(MW)	2022 Target (MW)
Solar Power	9012.66	100,000.00
Wind Power	28700.44	60,000.00
Biomass Power	7856.94	*10,000.00
Waste-to-power	114.08	
Small Hydro Power	4333.85	5000.00
Total	**50017.97**	**175000.00**

** The target is given for "bio-power" which includes biomass power and waste to power generation.*

[Source: Installed grid interactive renewable power capacity in India as of December 31, 2016 (RES MNRE)]



Smart Grid Technology

by Jishnu Thakur, EE 4th Year

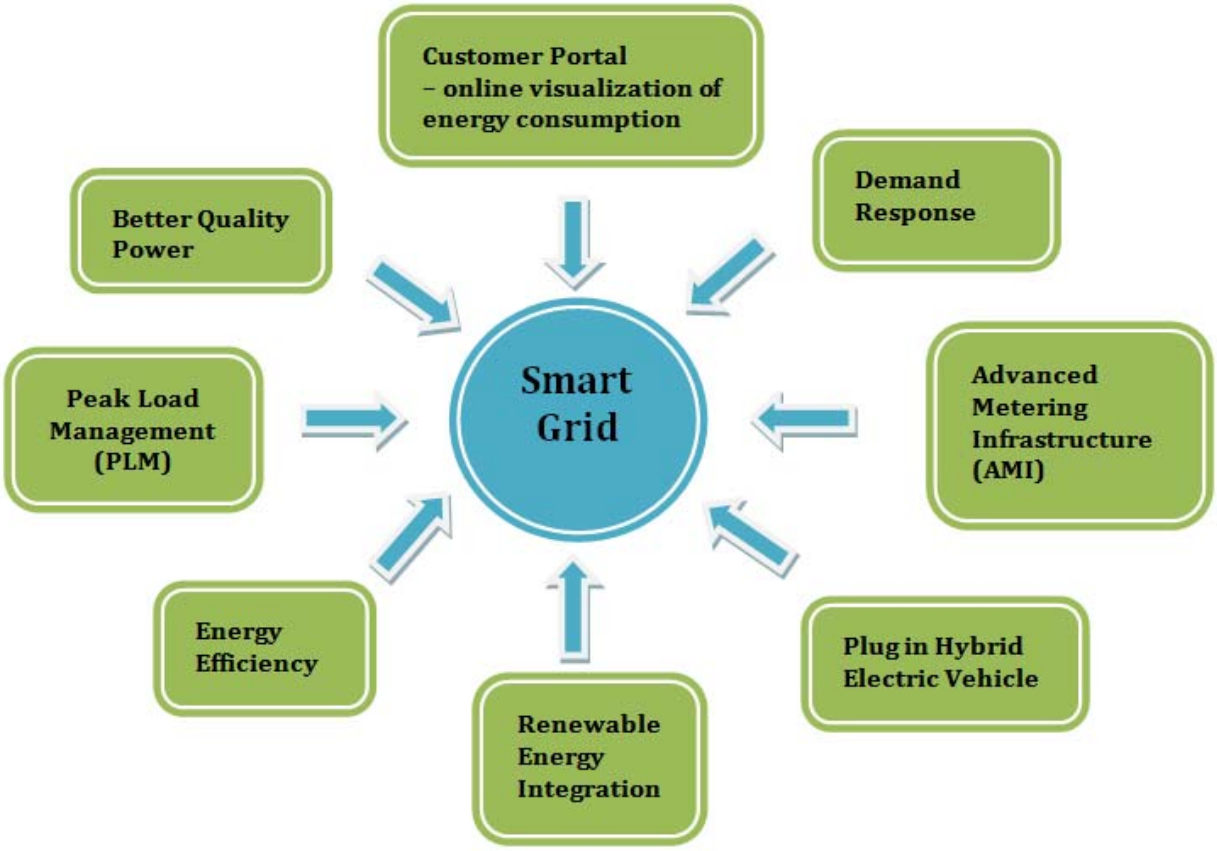
A Smart Grid is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics and sustainability of production and distribution of electricity.

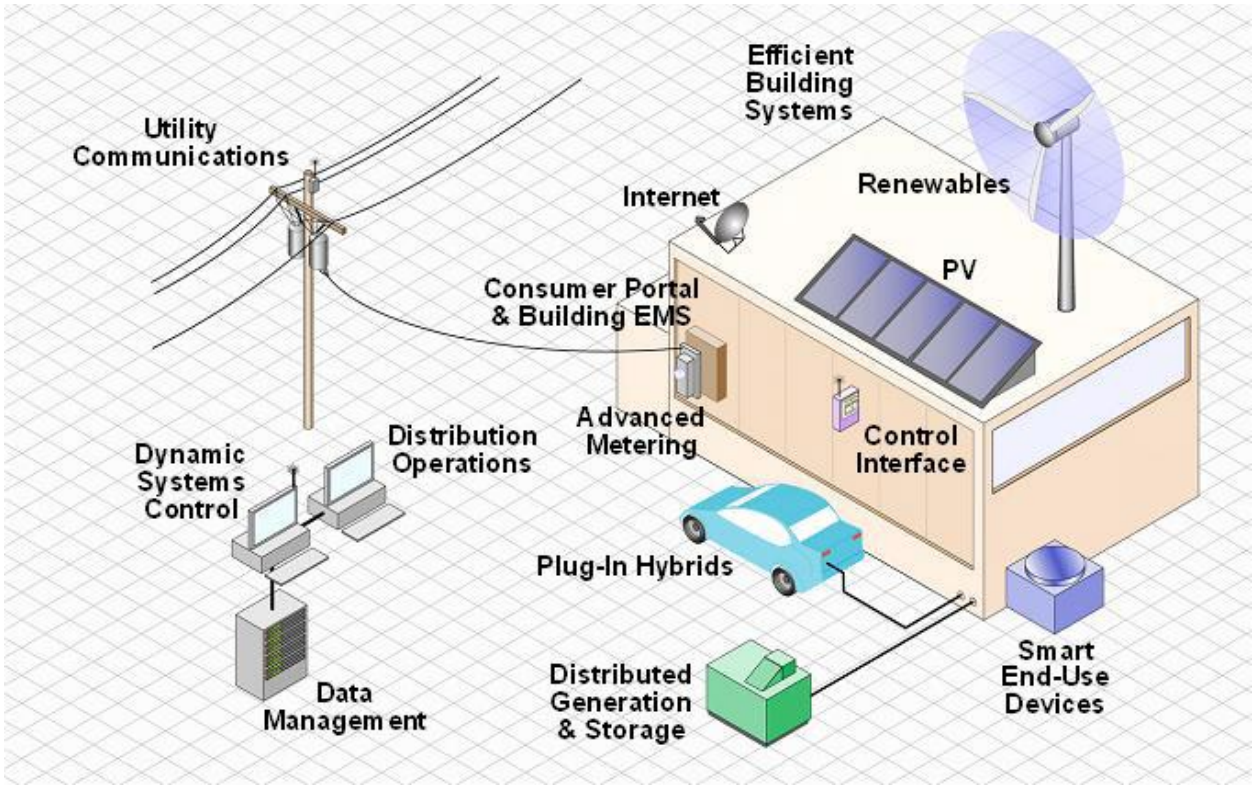
The concept of a Smart Grid began to emerge in the early 2000s. Each country has their own unique definition of what a Smart Grid is based on their own objectives (economic, societal, energy related, etc.). Therefore, every country approaches achieving a Smart Grid a little different. Europe, Australia, USA, Canada, China, India, Republic of Korea, South Africa, Brazil and Austria used smart grid technology in the world.

The Smart Grid represents an unprecedented opportunity to move the energy industry into a new era of reliability, availability, and efficiency that will contribute to our economic and environmental health. During the transition period, it will be critical to carry out testing, technology improvements, consumer education, development of standards and regulations, and information sharing between projects to ensure that the benefits we envision from the Smart Grid become a reality.

Advantages associated with the Smart Grid in comparison with existing grid

Existing Grid	Smart Grid
Mostly electro-mechanical	**Digital in nature**
One-way communication	**Two-way communication**
Mostly centralized generation	**Distributed generation**
Sensors are not widely used	**Sensors are widely used**
Lack of monitoring, only manual	**Digital Self- monitoring**
Failures and blackouts	**Adaptive and intelligent**
Lack of control	**Robust control technology**
Less energy efficient	**Energy efficient**
Usually not possible to integrate renewable energy	**Usually not possible to integrate renewable energy**
Customers have less scope to modify uses	**Customers can check uses and modify**





Smart Grid Structure