

# THE ENERGY – FUTURISTIC DEVELOPMENTS





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# THE GLOBAL SCENARIO

**Positive developments show that the renewable energy transition is possible, but advances so far are uneven across sectors.**

The year 2017 was another record-breaking one for renewable energy, characterised by the largest ever increase in renewable power capacity, falling costs, increases in investment and advances in enabling technologies. Many developments during the year impacted the deployment of renewable energy, including the lowest-ever bids for renewable power in tenders throughout the world, a significant increase in attention to electrification of transport, increasing digitalisation, jurisdictions pledging to become coal-free, new policies and partnerships on carbon pricing, and new initiatives and goals set by groups of governments at all levels. Increasingly, sub-national governments are becoming leaders in renewable energy and energy efficiency initiatives. At the same time, many developing and emerging countries are expanding their deployment of and investment in renewables and related infrastructure. The private sector is also increasingly playing a role in driving the deployment of renewable energy through its procurement and investment decisions. As of 2016, renewable energy accounted for an estimated 18.2% of global total final energy consumption, with modern renewables representing 10.4%. The number of countries with renewable energy targets and support policies increased again in 2017, and several

jurisdictions made their existing targets more ambitious.



Strong growth continued in the renewable power sector, while other renewable sectors grew very slowly. Solar photovoltaic (PV) capacity installations were remarkable – nearly double those of wind power (in second place) – adding more net capacity than coal, natural gas and nuclear power combined.

In the transport sector, the use of biofuels is still held back by sustainability debates, policy uncertainty and slow technological progress in advanced fuels, such as for aviation. Similarly, renewable heating and cooling continues to lag behind.



Both sectors receive much less attention from policy makers than does renewable power generation. However, lack of policy attention does not reflect relative importance, as heating and cooling account for 48%

of final energy use, transport for 32% and electricity for 20%. The interconnection of power, heating and cooling, and transport in order to integrate higher shares of renewable energy gained increased attention during the year, in particular the electrification of both heating and transport.

### **HEATING AND COOLING**

There is slow progress in renewable energy uptake in heating and cooling. Modern renewable energy supplied approximately 10.3% of total global energy consumption for heat in 2015. Another 16.4% was supplied by traditional biomass, predominantly for cooking and heating in the developing world. While additional bio-heat, geothermal direct use and solar thermal capacities were added, growth was very slow. Energy demand for cooling is growing rapidly, and access to cooling is an issue for health and well-being. Renewables currently play a small role in providing cooling services, although there is considerable potential.

### **TRANSPORT**

Renewable energy progress in the transport sector remains slow. Biofuels provide most of the current renewable energy contribution, although electrification is gaining attention. The renewable energy share of transport continues to be low (3.1%), with more than 90% provided by liquid biofuels. Electrification of the transport sector expanded in 2017 – with electric vehicles (EVs) exceeding 1% of global light vehicle sales– and a number of countries announced plans to phase out sales of petrol and diesel vehicles. There are signs that the shipping and aviation sectors also may become open to electrification. Further electrification of the transport sector has the potential to create a new market for renewable energy and to facilitate the integration of higher shares of variable renewable energy, provided that the policy and market settings are suitable.

### **POWER**

The electricity transition is well under way, due mostly to increases in installed capacity and in the cost competitiveness of solar PV and wind power. Renewable power generating capacity saw its largest annual increase ever in 2017, raising total capacity by almost 9% over 2016. Overall, renewables accounted for an estimated 70% of net additions to global power capacity in 2017, due in large part to continued improvements in the cost-competitiveness of solar PV and wind power. Solar PV led the way, accounting for nearly 55% of newly installed renewable power capacity in 2017. More solar PV capacity was added than the net additions of fossil fuels and nuclear power combined. Wind (29%) and hydropower (11%) accounted for most of the remaining capacity additions. Several countries are successfully integrating increasingly larger shares of variable renewable power into electricity systems.

Renewable-based stand-alone and off-grid single home or mini-grid systems represented about 6% of new electricity connections worldwide between 2012 and 2016.

***Four countries (Brazil, China, India and the US) could account for half of global use of renewable energy by 2030.***

# INDIAN ENERGY SCENARIO

With one of the world's largest and most ambitious renewable energy programmes, India can take a leading role in a renewable energy transformation both regionally and globally.



India's energy needs are rising fast, with growth in electricity demand and other energy uses among the highest in the world. In one direction lies a future heavily reliant on fossil fuels; and in the other, a more diverse energy mix based on greater use of renewables. The government, contemplating a better path, has taken steps to increase renewables and move the country towards a sustainable future. Still, much remains to be done. This report provides a perspective on the changes required for India to achieve an affordable, secure, inclusive and environmentally friendly energy system. Apart from the rising electricity demand, India has started to witness very rapid energy demand growth for heating, cooling and transport.

India's socio-economic characteristics make it unique among the world's major energy-consuming economies. Per capita income is low, but is expected to grow quickly as India becomes the world's most populous country towards the end of this decade. Population and economic growth, combined with accelerating urbanization, will increase the number of people living in cities and towns from approximately 435 million in 2015 to 600 million by 2030. Urban populations consume more energy and – importantly in India's case – significantly more electricity.



India's total demand for energy will more than double by 2030, while electricity demand will almost triple. Ensuring that India's growing population has access to energy, and meeting the country's ambitious economic growth targets, will require massive investments in the power, transport, buildings and industry sectors. Despite rapidly growing demand and significant renewable energy potential, India is set to install less renewable power-generation capacity than China, Germany or the United States. India's electricity demand has grown by 10% a year over the past decade. Rapid growth is expected to continue, requiring massive investments in power-generation capacity and related infrastructure. This creates an important opportunity for renewable energy deployment, assuming the right policies are in place and policymakers start planning for it now.

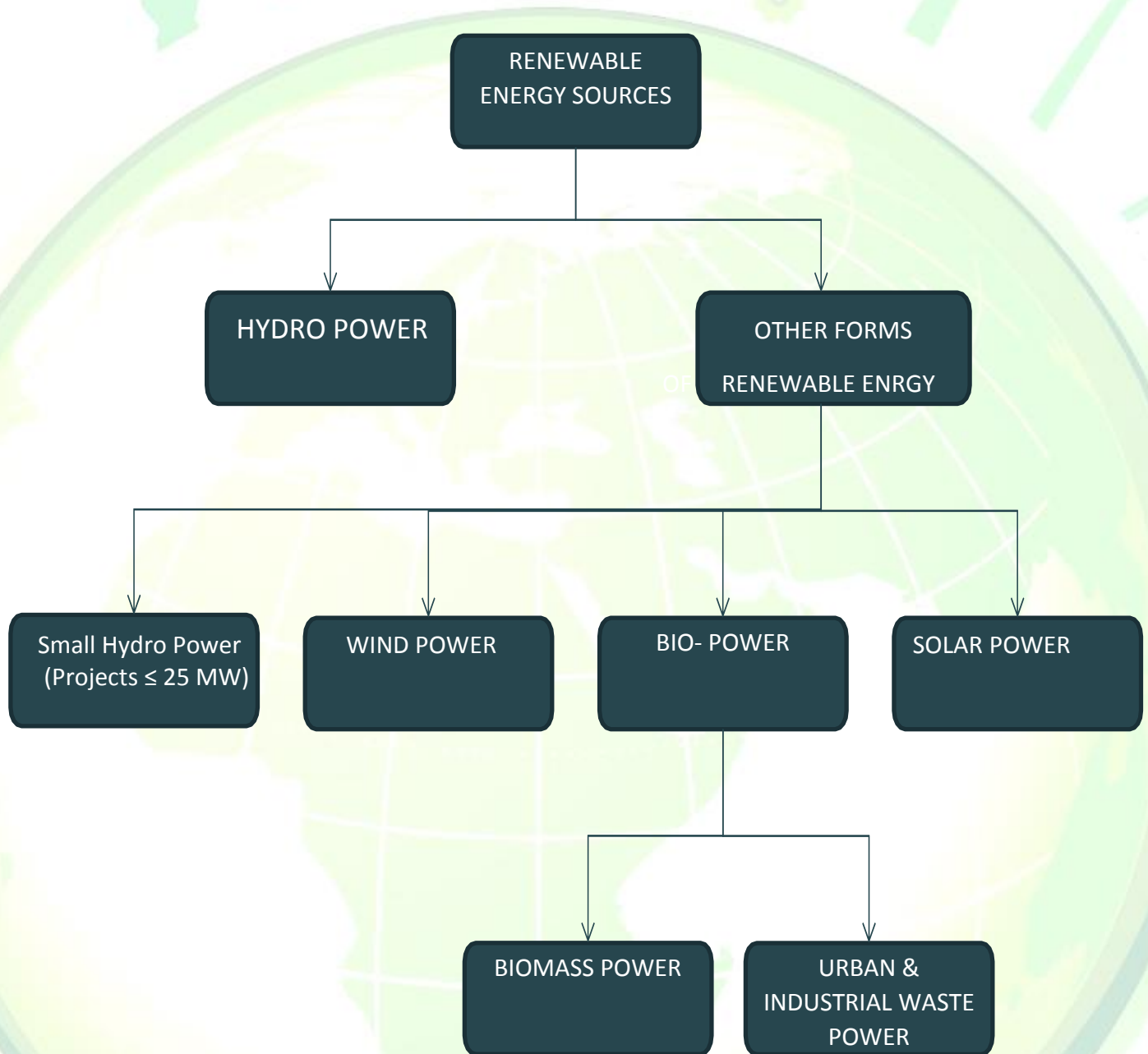
The country has already devoted considerable attention to renewables in its energy policy, becoming the first in the world to set up a ministry dedicated exclusively to new and renewable energy sources as long ago as 1992. Wind and solar policy and targets have, however, only achieved mixed success over the past two and a half decades. India has set a target to install 175 GW of renewable energy capacity by 2022, showing an awareness of how the marketplace for renewable energy technologies is changing.

Wind, bioenergy, small hydropower and solar photovoltaics (PV) have all become increasingly competitive with fossil-fuel-based power generation. But increasingly competitive production costs are not the only reason to promote renewable energy. Other motivations include reducing exposure to fossil-fuel price volatility, improving a heavily burdened grid infrastructure, further expanding access to modern energy services, curbing air pollution and meeting the country's sustainability targets.

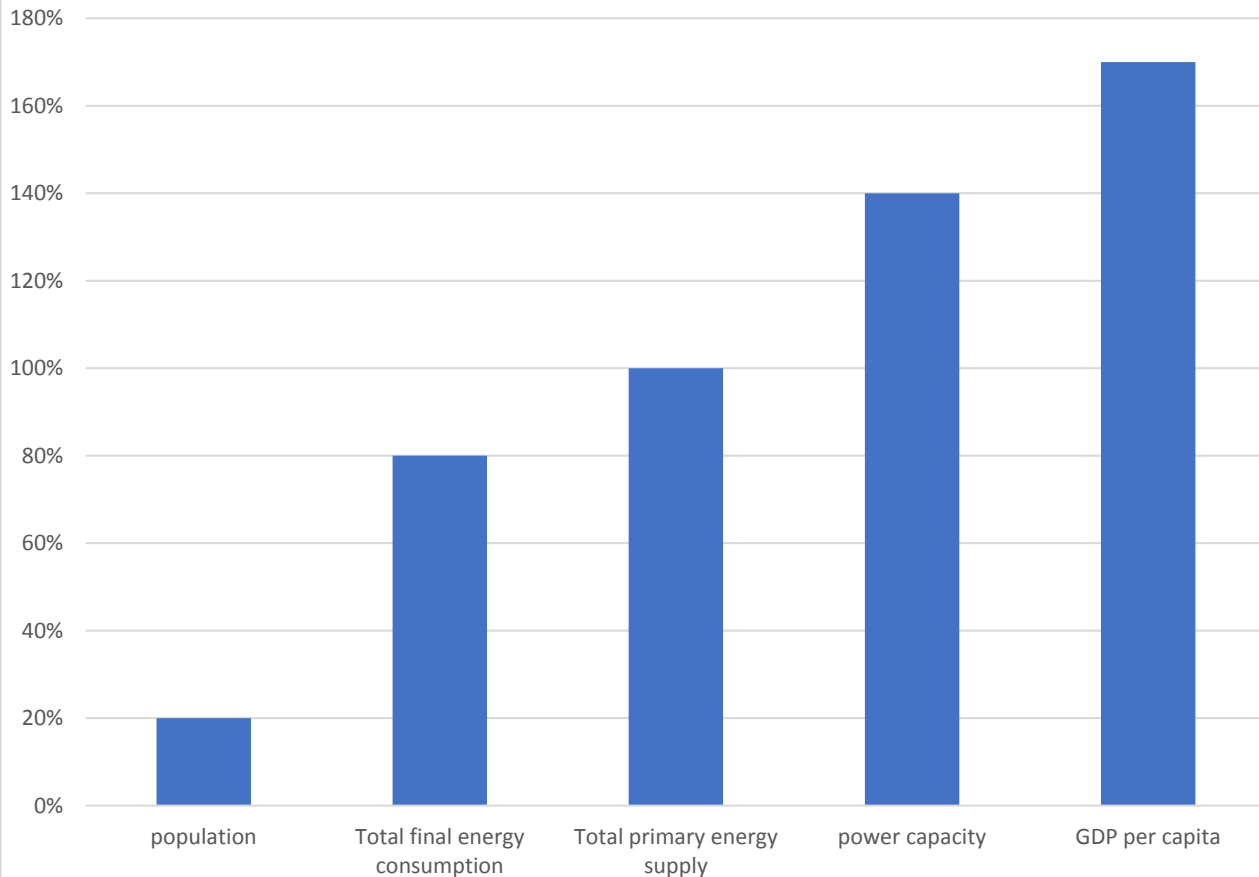




# Renewable Energy Sources



## Growth in key economic and energy indicators for India, 2014 to 2030



Source: IRENA analysis

Despite rapidly growing demand and significant renewable energy potential, India is set to install less renewable power-generation capacity than China, Germany or the United States. India's electricity demand has grown by 10% a year over the past decade. Rapid growth is expected to continue, requiring massive investments in power-generation capacity and related infrastructure. This creates an important opportunity for renewable energy deployment, assuming the right policies are in place and policy makers start planning for it now. Despite rapid strides in adding power capacity, India continues to be plagued by widespread energy poverty. Much of the population lacks access to clean and affordable energy.

# India Energy Consumption & Energy Security

**Being the second largest populated country, India's energy consumption is drastically rising & there is still much of population lacks to the access of clean & affordable energy.**

Estimates suggest that 80 million households, or more than 300 million people, have limited or no access to electricity. While the electricity grid now covers much of the country, reaching rural or remote areas with the necessary transmission and distribution infrastructure often remains a challenge. Supply constraints, therefore, persist. In economic terms, the health impact of outdoor air pollution costs about 3% of India's annual gross domestic product, and indoor air pollution adds significantly to this total. The World Health Organization estimates that the number of deaths from ambient air pollution reached 700 000 in 2010. Besides, 400 million Indians (90% of them women) are exposed to respiratory, pulmonary and vision hazards associated with indoor air pollution from burning traditional biofuels. Both outdoor and indoor air pollution must be addressed through clean and sustainable rural and urban energy supplies.

If business continues as usual and present energy and environmental policies persist, fossil fuels will still dominate India's total energy mix in 2030 and beyond. Such a pathway, known as the *Reference Case* in this report, relies heavily on fossil fuels along with unsustainable and inefficient uses of bioenergy to meet most of the country's rising energy demand. While the growth of renewable power generation will accelerate, even faster increases are expected in the use of coal for industry, natural gas in residential and commercial buildings, and oil in transport. India's demand for coal is set to triple by 2030. As a result, the share of modern renewables could decrease from around 17% to only 12% of India's total energy mix by 2030. A large share of energy demand will need to be supplied by imports, increasing energy security risks. Growing reliance on coal imports will add to India's existing import dependency for oil and gas.

India's total gross power capacity will more than double from 284 gigawatts (GW) in 2015 to an estimated 670 GW by 2030, while electricity generation more than triples from 1 100 terawatt-hours (TWh) per year to over 3 450 TWh per year. More than three-quarters of this new production is to be met by new coal-based capacity, according to current plans and policies (the Reference Case in this study). The planned growth in renewable power capacity, while significant, is low by comparison. India has set a target of 175 GW of renewable energy in power generation by 2022, but developments after that date are uncertain.

Policy makers have thus far overlooked the potential of renewable energy in heating, cooling and transport. Apart from the rising electricity demand, India has started to witness very rapid energy demand growth for heating, cooling and transport. National plans currently envisage the vast majority of this being met with fossil fuels. The significant renewable potential in these end-use sectors could also be harnessed to address India's energy supply challenges.



## **An affordable, secure and sustainable energy mix**

With one of the world's largest and most ambitious renewable energy programs, India can take a leading role in a renewable energy transformation both regionally and globally. Renewable power will maintain its strong growth in the Indian market reaching 35% share of generation, and 60% share of power generation capacity. The REmap Options – outlined in this report represent accelerated uptake of renewable energy beyond the country's current plans to 2030. Accordingly, total wind power capacity would reach 185 GW by 2030, almost eight times its level at the end of 2015. Solar PV capacity would increase even more than wind, a total installed capacity of almost 200 GW by 2030, with additional capacity in off-grid. Renewable power's share of total power generation capacity would increase to 60% in REmap, compared to 39% with expected developments (the Reference Case). Thus, India's INDC pledge of reaching a renewable energy share of 40% by 2030 is possible – and much more can be achieved. Similarly, the country can achieve a 35% share for renewables in power generation.

## **Security of affordable energy supply**

Despite the competitive direct costs of fossil fuels, broad motivations for promoting renewable energy in India are provided by such factors as exclusion for the poor (who either do not have access to the energy markets or are unable to pay for energy services), the instability caused in the energy market by fluctuations in energy prices, and other real and potential market failures. Renewables are also increasingly emerging as the least-cost option for meeting the country's rising energy needs.

Ensuring access to energy is central to India's policy, which aims to address the underlying demand for energy services. The household sector consumes nearly 39% of the total energy supplied in the country: a significant proportion of this (around three-quarters) is provided by traditional biomass-based fuels – like firewood, dung cakes, and charcoal – which are not accounted for in official statistics. This indicates the pressing need for increasing access to modern energy sources for millions of Indians.

The energy policy also aims to cater for India's growing energy demand and domestic supply gaps. Even under an aggressive scenario of global climate stabilisation, India would consume at least 60% more energy in 2035 than today. Varying output from domestic fuel sources, volatile prices of imports and uncertainty in geopolitical conditions, all lead to concerns about the predictability and stability of fuel supplies. The pursuit of energy access and energy security enjoys considerable political support, and is recognised in the Integrated Energy Policy (IEP), which considers energy security as providing all Indians with an energy lifeline, regardless of their ability to pay for it. This is supported by a history of policies and programmes aimed at enhancing rural electrification going as far back as 1969 when the Rural Electrification Corporation was established. The Corporation promotes and finances a wide range of rural energy projects, including grid-connected, off-grid, renewables or conventional fuel driven power generation, power conservation and power distribution network initiatives.

India has limited sources of fossil fuels and is not geographically adjacent to any major sources of supplies, making it vulnerable to geopolitical and geo-economic shocks. The country's energy security policy, therefore, needs to be viewed through a wide lens, considering supply and demand issues from a planning and financial perspective at both the micro and macro scale (TERI, 2015). Renewable energy should be considered as a viable alternative that can mitigate this risk, at least in part, and offer the double advantage of allowing energy access to the poor and aiding energy security by diversifying the sources of supply.



# Challenges of Coal and Oil & Gas

The high dependence of India's energy system on fossil fuel is unsustainable not only because of the high share of carbon footprint in the total ecological footprint and the various other adverse environmental effects, but also because of the economic unsustainability of such dependence due to heavy financial requirement for imports arising from the growing scarcity of the fossil fuel resources. The factors underlying the financial unsustainability of such an energy supply are outlined in this column.



## Issues with coal

Among the fossil fuels, coal, being relatively cheaper and perceived to be an abundant energy resource as compared with hydrocarbons in India, has remained the focus of attention for energy planners ever since the oil shock of the early 1970s to meet the ever-increasing energy demand in

the country. The total estimated reserve of coal in India as of 31 March 2010 was around 277 billion tonnes, according to the Energy Statistics of India in 2012.

However, the minability and extractability of Indian coal are significantly affected by the geological, technical and other surface constraints

such as township, riverbed, high environmental fragility due to the location of deposits underneath deep pristine forests, and so on, resulting in high economic cost for at least some part of the resource, which cannot be as a result categorised as economically viable reserves. Some errors in measurement due to methodological



reasons have further compounded the problem of estimation of reserves for energy planning. The high ash quality problem of Indian coal also tends to offset part of the apparent benefit of the low cost of coal from the geo-technically friendly coal fields and basins. All these factors have resulted in the growing import of both coking and non-coking coal over time due to demand exceeding domestic supply and also of washing both coking and also non-coking coal. The share of import of coal in total apparent consumption has in fact grown from 2.2% in 1989-90 to 11.1% in 2010-2011. The unit prices of imports of coal by India also rose during the period 1989-90 to 2010-11 in both nominal dollars and rupees, particularly since 2000, at respective annual

rates of 10.8% and 11.4%. The rise in the import price of coal in its turn eroded the relative cost benefit of imports of such coal.



#### **Issues with oil and natural gas**

India is highly dependent on the import of crude oil to meet its energy demand and imports have been steadily rising over the years. Although India has set up some refinery

capacity under a private initiative that is used only to produce for export of petroleum products, the net imports of total oil (that is, aggregate of all imports of crude and petroleum products less all exports of petroleum products) have increased from around 25 million tonnes during 1989-1990 to around 120 million tonnes in 2010-2011—a growth rate of over 7% each year over the past two decades. While the average price of India's net import of oil has gone up in nominal rupees by around 14% each year and in nominal dollars by around 6% each year, the share of import in the total apparent consumption of oil (that is, crude oil production plus net petroleum import) grew from 43% in 1989-90 to a high of 76% in 2010-11.

The natural gas market, on the other hand, is only an emerging market in India. The International Energy Agency (IEA) estimates the Indian market of natural gas to be one of the fastest growing in the world in the next 20 years and projects the growth to be around 5.4% per year over 2007-30 (IEA, 2009). It is being preferred mainly due to its inherent environmentally benign nature, greater efficiency and cost-effectiveness as a fuel.

The production of natural gas picked up very recently in 2009 with the start of the product at the deep-water KG-D6 field in the Bay of Bengal after remaining stagnant for almost a decade. The enactment of the new exploration licensing policy by the government has played a key role in ensuring greater participation of private and foreign companies in natural gas discovery and extraction. India has already started importing natural gas in spite of such growth in production, the share of import reaching 19% of apparent consumption in 2010-11. The unit price of natural gas in nominal dollar has also been growing at an annual average rate of 3.85% per year since 2004-05.

### **Aggregate fossil fuel energy**

As now India is importing all kinds of fossil fuels, the percentage share of total import in the total apparent consumption of such fuels (in units of oil equivalent tonne) had been increasing throughout the past two decades and touched 35% in 2010-2011. Meanwhile, the unit price of total fossil fuel (in oil equivalent units) has increased in nominal rupees and dollar terms at the rates of 10% per year and 6% per year respectively.

As a result of the price rise and the growing imports of all the fossil fuels as indicated above, India's total bill of net import of energy has grown at an alarming rate of close to 20% per year, leading to an increase of almost 55 times over the past two decades. As a consequence, the share of total energy import bill as a percentage of India's total export earnings has also been growing over time, and has now reached almost 38% in 2010-2011 which is a source of concern for economic sustainability of such pattern of growth of energy use in India. In view of the sharp decline in the rate of growth of IT-related service export earnings to 10% per year, the slowing down of inflow of foreign direct investment (FDI) into India and the footloose erratic character of inflow of foreign portfolio investment, the current pattern of fossil fuel use is likely to create economic stress on the front of the balance of payments and the stability of India's currency value. Thus, replacement of fossil fuel by renewables is not only important for the environmental sustainability or greenness of our development process, but also in the interest of the macroeconomic sustainability of our growth process.



# Infrastructure efficiency of Power Sector and Lowering Power Losses – The Smart Grid

## Need for smart grids in India

According to the Ministry of Power, India's transmission and distribution losses are amongst the highest in the world, averaging 26 per cent of total electricity production, and as high as 62 per cent in some states. These losses do not include non-technical losses like theft etc.; if such losses are included, the average losses are as high as 50 per cent. India loses money for every unit of electricity sold, since India has one of the weakest electric grids in the world. Some of the technical flaws in the Indian power grid are - it is a poorly planned distribution network, there is overloading of the system components, there is lack of reactive power support and regulation services, there is low metering efficiency and bill collection, etc. India is venturing very fast into renewable energy (RE) resources like wind and solar. Solar has great potential in India with its average of 300 solar days per year. The government is also giving incentives for solar power generation in the form of subsidies for various solar applications; and has set a goal that solar should contribute 7 per cent of India's total power production by 2022. With such high targets, solar is going to play a key role in shaping the future of India's power sector. A lacuna of renewable resources is that their supply can be intermittent i.e. the supply can only be harnessed during a particular part of the day, like day time for solar energy and windy conditions for harnessing wind energy, also these conditions cannot be controlled. With such unpredictable energy sources feeding the grid, it is necessary to have a grid that is highly adaptive (in terms of supply and demand). Hence, the opportunities for building smart grids in India are immense, as a good electric supply is one of the key infrastructure requirements to support overall development.

## Smart grid technologies

Smart metering/demand side management: Smart meters are microprocessor-based devices that provide a two-way communication capability. They help homeowners and the suppliers to manage the respective electricity usage and supply in a more efficient and cost-effective manner. With the help of the information provided by such smart meters the power companies will have the capability to set up real time pricing systems for electricity.

## Virtual power plants

The goal of virtual power plants (VPPs) (Fig 2) is to allow discrete energy resources (DERs) to access the energy market i.e. to feed the electricity grid constantly and reliably.



### Micro grids

A micro grid (Fig 3) is a cluster of local DERs and loads in such a way that an operation is possible within the grid or in independent mode. Usually it is connected at the low voltage level but sometimes also at the medium voltage level. All these technologies can be used in India in different forms depending on the applications. Different algorithms can be used for the control of smart grids, VPPs etc.

# Recommendation towards Sustainable Development

**Move from Fossil-Fuel to Clean Energy** - the biggest disadvantage to burning fossil fuels for energy is the fact that it is badly damaging the environment & environment is the main sources of renewable energy such as(wind, solar, hydro, sun ).

**Population Control** - Rapid population growth, has increased the number of poor people in developing countries, thus contributing to the degradation of the environment and the renewable resources of land, water, and nonhuman species on which humans depend .

**Practising the Tax benefits for Renewable energy user** - Appropriate government incentives can be an important tool to speed deployment and reduce costs for clean energy technologies. We need a fair and stable federal tax policy for renewable energy that will attract new investments and maintain the strong growth that renewables have experienced in recent years.

**Smart Electrical Grid** -To move toward a cleaner energy economy, we must improve our nation's electrical grid, as well as construct the transmission infrastructure needed to connect renewable energy facilities to cities and regions with high power demand.

**Renewable Electricity Standard** - RES also called a Renewable Portfolio Standard—requires utility companies to obtain a certain percentage of their electricity from renewable sources. Which **reduces dependence on fossil fuels and lower fossil fuel prices.**

**Develop responsible and consistent siting regulations for renewable energy projects** -State and local governments should coordinate their plans to develop harmonious, transparent, and science-based siting regulations for renewable energy projects.

**Invest in new transmission capacity for renewable energy** -Federal, regional, and state authorities should identify transmission projects that provide the greatest economic benefits in delivering renewable electricity from where it can be most effectively generated to where it is most needed.





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Our strength lies in our outstanding team, sector expertise, superior execution capabilities and a strong professional network. We have served clients across key industry sectors including Infrastructure & Energy, Consumer Products & Services, Real Estate, Metals & Industrial Products, Healthcare & Pharmaceuticals, Telecom, Media and Technology.

In the short period since our inception, we have grown to a 100 people team with a pan-India presence through our offices in New Delhi, Kolkata, Mumbai, and Bangalore. Resurgent is part of the Golden Group, which includes GINESYS (an emerging software solutions company specializing in the retail industry) and Saraf & Chandra (a full service accounting firm, specializing in taxation, auditing, management consultancy and outsourcing).

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ASSOCHAM initiated its endeavour of value creation for Indian industry in 1920. Having in its fold more than 400 Chambers and Trade Associations, and serving more than 4,00,000 members from all over India. It has witnessed upswings as well as upheavals of Indian Economy, and contributed significantly by playing a catalytic role in shaping up the Trade, Commerce and Industrial environment of the country. Today, ASSOCHAM has emerged as the fountainhead of Knowledge for Indian industry, which is all set to redefine the dynamics of growth and development in the technology driven cyber age of 'Knowledge Based Economy'. ASSOCHAM is seen as a forceful, proactive, forward looking institution equipping itself to meet the aspirations of corporate India in the new world of business. ASSOCHAM is working towards creating a conducive environment of India business to compete globally. ASSOCHAM derives its strength from its Promoter Chambers and other Industry/Regional Chambers/Associations spread all over the country.

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As a representative organ of Corporate India, ASSOCHAM articulates the genuine, legitimate needs and interests of its members. Its mission is to impact the policy and legislative environment so as to foster balanced economic, industrial and social development. We believe education, IT, BT, Health, Corporate Social responsibility and environment to be the critical success factors.

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### **Insight Into 'new Business Models'**

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ASSOCHAM derives its strengths from the following Promoter Chambers: Bombay Chamber of Commerce & Industry, Mumbai; Cochin Chambers of Commerce & Industry, Cochin; Indian Merchant's Chamber, Mumbai; The Madras Chamber of Commerce and Industry, Chennai; PHD Chamber of Commerce and Industry, New Delhi and has over 4 Lakh Direct / Indirect members.

Together, we can make a significant difference to the burden that our nation carries and bring in a bright, new tomorrow for our nation.

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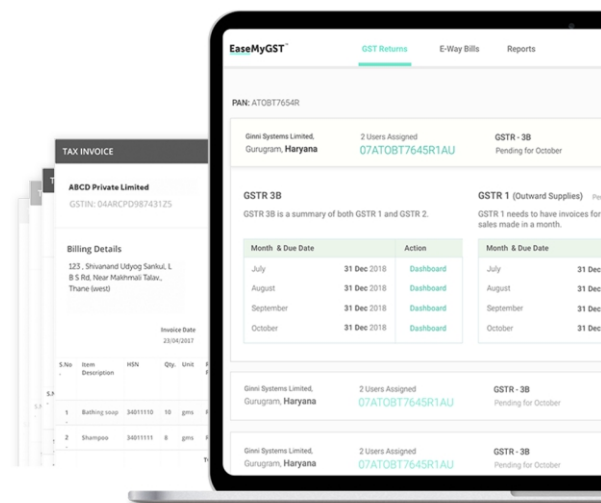




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