Cleantech

Global trends and Indian scenario

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Contents

Acronyms and abbreviations

ATF	Aviation Turbine Fuel
BEE	Bureau of Energy Efficiency
bcm	billion cubic meters
BWE	Bureau of Water Efficiency
BNEF	Bloomberg New Energy Finance
CAGR	Compounded Annual Growth Rate
CAFE	corporate average fuel economy
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CfD	Contracts for Difference
CMP	Comprehensive Mobility Plan
CNG	Compressed Natural Gas
CPCB	Central Pollution Control Board
CFA	Central Financial Assistance
DC	Designated Consumers
DSM	demand-side management
ECBC	Energy Conservation Building Code
EE	energy efficiency
ESCerts	Energy Savings Certificates
EPC	Engineering, Procurement and Construction
EPCM	Engineering, Procurement and Construction Management
FDI	foreign direct investment
FEEED	Framework for Energy Efficient Economic Development
FICCI	Federation of Indian Chambers of Commerce and Industry
GBI	generation-based incentives
GDP	gross domestic product
GHG	greenhouse gas
GoI	Government of India
GW	gigawatt
IEX	Indian Energy Exchange
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
JNNSM	Jawaharlal Nehru National Solar Mission
MNRE	Ministry of New and Renewable energy

MoWR	Ministry of Water Resources
NWM	National Water Policy
NMP	National Water Mission
NEMMP	National Electric Mobility Mission Plan
NMEM	National Mission for Electric Mobility NMEM
NCEF	National Clean Energy Fund
NZEB	Net-Zero Emission Buildings
RPO	Renewable Purchase Obligations
SREC	State Electricity Regulatory Commission
SEZ	Special Economic Zone
UMTA	Unified Mass Transit Authority

Foreword

India is at the crossroads of economic development and environmental sustainability. The transition to an environment friendly growth paradigm necessitates the shift to a resource efficient economy. Clean technology will be the underpinning of inclusive growth in India, besides its impact on energy security, climate change, and environment. It has the potential to bring about social innovation and have a positive impact on education, health and livelihoods. Every sector of the economy, be it industry, agriculture, the service sector, infrastructure, has potential for clean technology interventions that will help in the transition to a sustainable growth path in the long term. Clean technology interventions will not only impact the urban landscape but will create a transformational shift in the rural economy of India. We are at the juncture where we must take a leap of faith towards our future, a future that will be sustainable and more equitable. We need to create an ecosystem that will incentivize and nurture clean technology innovation and diffusion, and drive development and widespread adoption.

This strong case for building a clean technology ecosystem has given us the motivation to launch a platform that will facilitate the discussion in this direction. Therefore we are proud to launch the India International Cleantech Summit this year as an annual point of convergence on the Cleantech ecosystem.

The India International Cleantech Summit 2013 aims at enabling such an ecosystem in the country and focusing on clean technology applications that would provide scale, be replicable and have significant material impact in a country like India. The Summit will also focus on building consensus on an enabling policy environment that would catalyze investment in clean technology, and address barriers to and solutions for Cleantech development, deployment and diffusion. It will also highlight the opportunities for global Cleantech companies and investors to engage in the Indian market.

The numerous stories of clean technology interventions from industry and urban growth centres to rural hinterlands that will also be shared at this forum are not only inspiring but will also help in bringing to light the many challenges that exist in making these widespread.

The FICCI-EY Knowledge Paper titled **Cleantech – Global trends and Indian scenario** captures the current trends and emerging scenario of clean technology around the globe, an overview of the Cleantech scenario in India and the corporate agenda for Cleantech. I am sure the Knowledge Paper will be an important reference point for Cleantech stakeholders and will help in providing the context for deliberations at this maiden Summit.

A Didar Singh

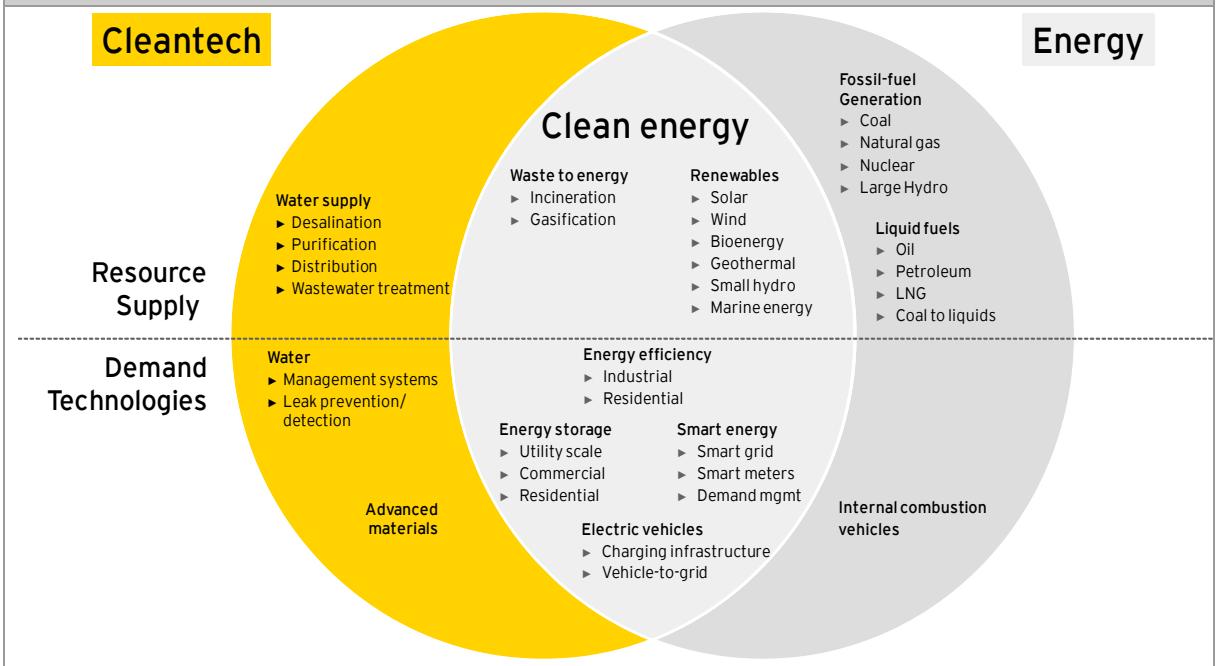
Secretary General, Federation of Indian Chambers of Commerce and Industry

Executive summary

A global transformation to a low carbon economy is under way, fundamentally changing the way in which natural resources – including energy and water – are produced, distributed, stored, managed and consumed. The growing world population, increasing power consumption of the middle class in emerging markets and growing scarcity of natural resources around the world are driving this transformation. Energy security-related concerns, rising energy and commodity prices, and the business response to climate change are also important drivers of change.

Cleantech is the technology and business model innovation that is enabling a transformation to a more resource-efficient, and a low carbon model - a shift that could signal a new industrial and technological revolution. From start-ups to large corporations and national governments, organizations across the globe are embracing cleantech as a means of growth, efficiency, sustainability and competitive advantage worldwide. Since cleantech enables a variety of industries, old and new, to transform themselves and become a part of this new journey. This has led to innovation in technology, business models, financing mechanisms, cross-industry partnerships and its adoption by corporate organizations.

Figure 1: The clean energy transformation

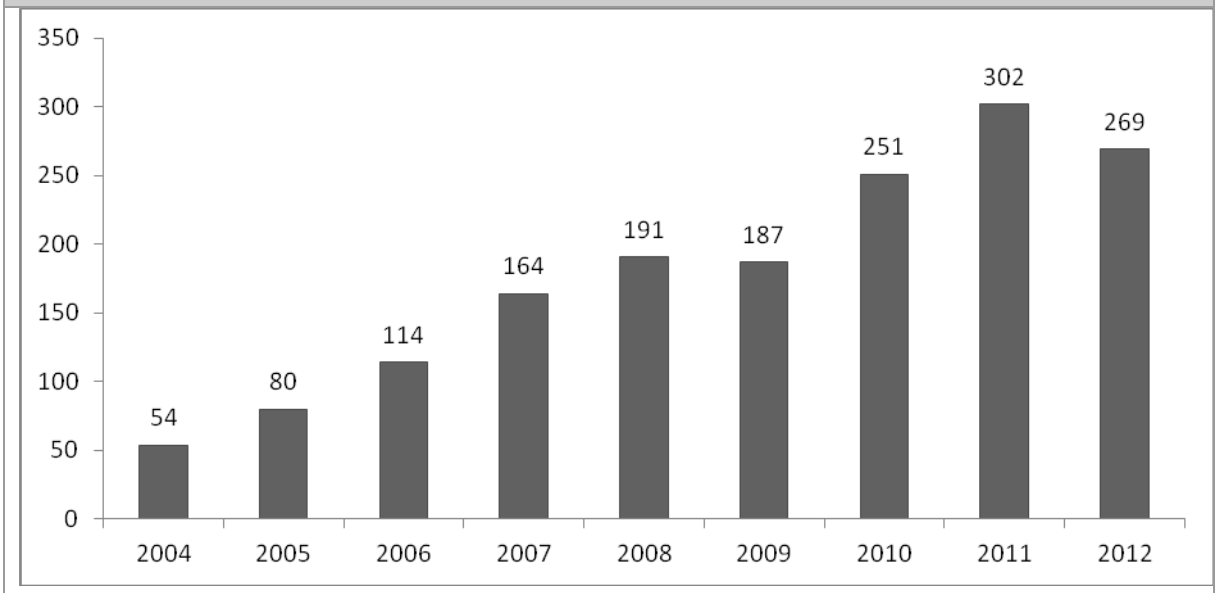


Recent developments

- **Investment trends and the capital flows:** Global investment in clean energy grew at a CAGR of 22% from 2004–2012 and approximately US$1.6 trillion have been invested in clean energy since 2004. Global investments in clean energy declined in 2012, but renewable energy capacity continued to grow due to increasing use of technology and falling prices of technologies adopted. The economic austerity of developed markets in 2012 is also one of the reasons for the decline in investments. Private developers are increasing their investment in the cleantech market and governments are moving away from revenue-based support mechanisms such as feed-in tariffs and green certificate regimes toward concession-based regimes, including capacity auctions.

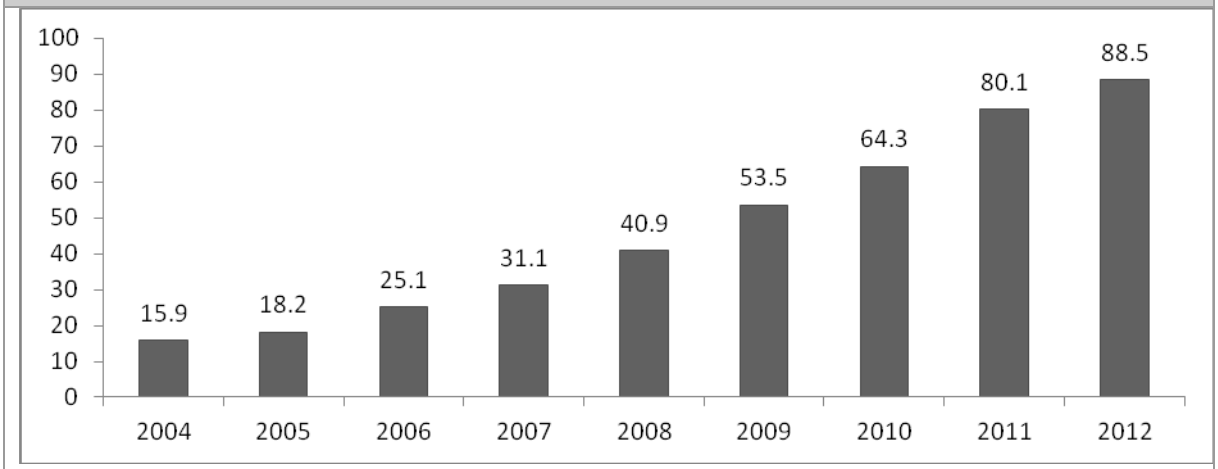
Unlike traditional capital flows, 2012 saw the cross-border funding from East to West (particularly in the case of emerging economies such as China, Japan and South Korea) in clean tech markets and technologies. These countries are driving clean energy transactions in the Americas and Europe. Furthermore, governments of emerging economies such as China are developing investment strategies to help developers and manufacturers grow their business outside China, since they face challenges relating to consolidation of supply chains, domestic grid capacity-related constraints and protectionist measures in the West.

Figure 2: Global clean energy investments (US$ billion)



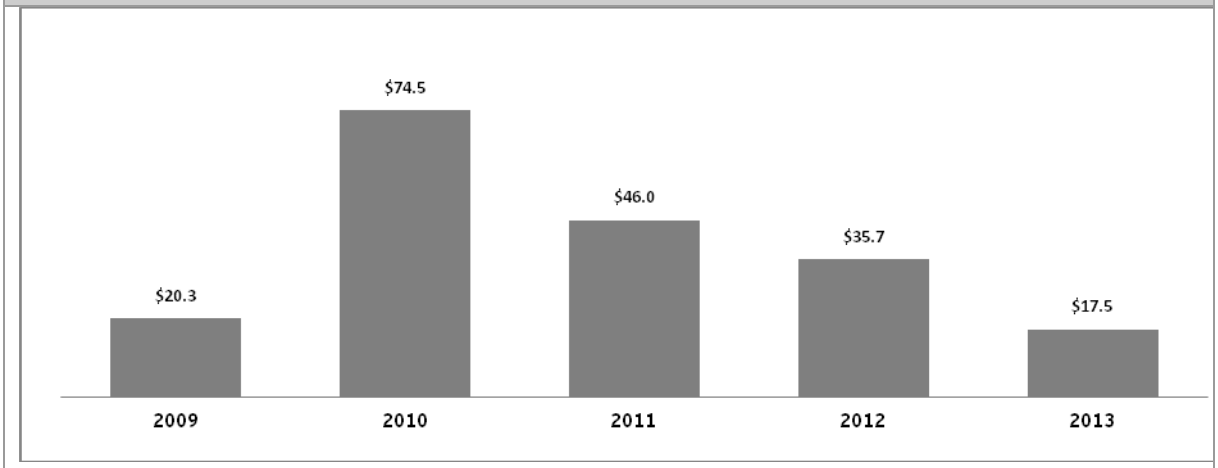
Source: BNEF – Global Trends in Clean Energy Investment, Clean Energy Ministerial, 17 April 2013

Figure 3: Annual new renewable energy generation capacity (GW)



Source: Bloomberg New Energy Finance

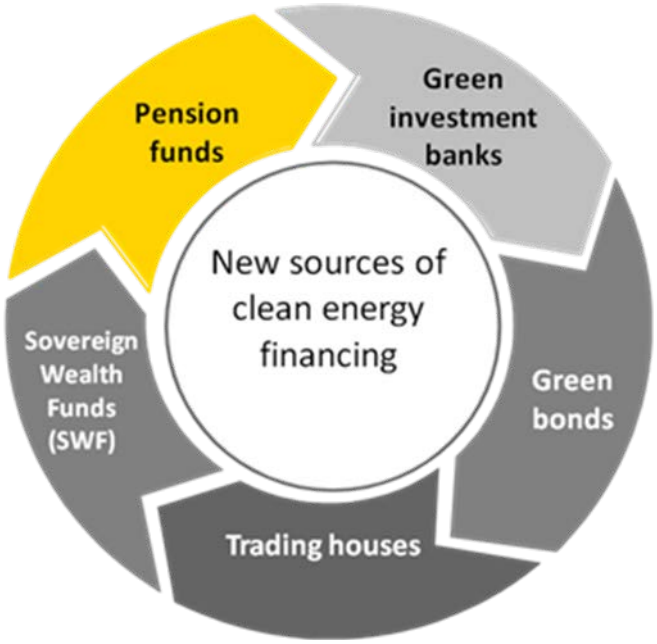
Figure 4: Diminishing impact of global stimulus for clean energy (US$ billion)



Source: Bloomberg New Energy Finance

- **New finance-related mechanisms:** Today, state-owned banks, multilateral financial institutions and trading houses are becoming more active players in cleantech, spurred by governmental policy objectives. Chinese state-owned banks have stepped up their loans to renewable energy companies. The European Investment Bank and the European Bank for Reconstruction and Development are focused on stimulating clean energy markets and are actively lending funds to the sector. The emergence of these new sources of capital is giving a boost to the global cleantech market.

Figure 5: New Finance Mechanisms for cleantech



- **Maturing clean energy technologies and falling prices:** Several clean energy technology segments have grown robustly in recent years, driven by private innovation and entrepreneurship as well as critical public sector support in the form of tax credits, grants and loan guarantees. Many of the clean technologies adopted, such as biomass, solar thermal and onshore wind farms, are already commercialized. The prices of such technologies have fallen due to their increased production and innovation witnessed in the segment. Their costs are expected to decline further, particularly due to effective policy support, with increased adoption of clean technologies.
- **Cleantech a key driver for corporate organizations:** Strategic management of energy by corporations is rapidly evolving in response to financial, energy security, brand equity, regulatory, competitive risks, etc. Global enterprises are increasingly realizing that they must understand the impact of cleantech on their industries and develop strategic action plans on whether to improve their internal operations, implement a more efficient energy and other resource mix or pursue new cleantech-enabled revenue opportunities. This report discusses the corporate agenda, key business risks and energy mix options that can be implemented by corporate organizations, keeping in view their long-term sustainability strategies.

Recent Developments in India

India, one of the world's fastest growing economies, is looking at diversifying and growing its energy portfolio in a manner that it reduces its carbon emissions and yet caters to the growing energy demand. India released the National Action Plan on Climate Change (NAPCC) on 30 June 2008 to outline its strategy to meet the challenge of climate change. Eight national missions form the core of the NAPCC, representing multi-pronged, long-term and integrated strategies for achieving key goals in the context of sustainability and climate change. In December 2009, the Indian Government announced that it plans to reduce the intensity of emissions in its GDP by 20%–25%from levels in 2005 by 2020. This further articulated the Government's voluntary domestic commitment. India's draft Twelfth Five Year Plan (2012-2017), launched in 2012, looks at reducing low-carbon inclusive growth and aims to install 18.5 GW of renewable energy. In context of these commitments, the demand for clean technologies is rising exponentially in the country, and development of renewable energy resources and environmental technologies is a high priority for the Government of India. From the policy perspective, there is a genuine push toward clean energy. Grid-connected renewable energy in India stood at 28.9 GW, comprising 12% of the total installed capacity in India. This report covers the policy scenario and developments in the different sectors in which cleantech plays a vital role.

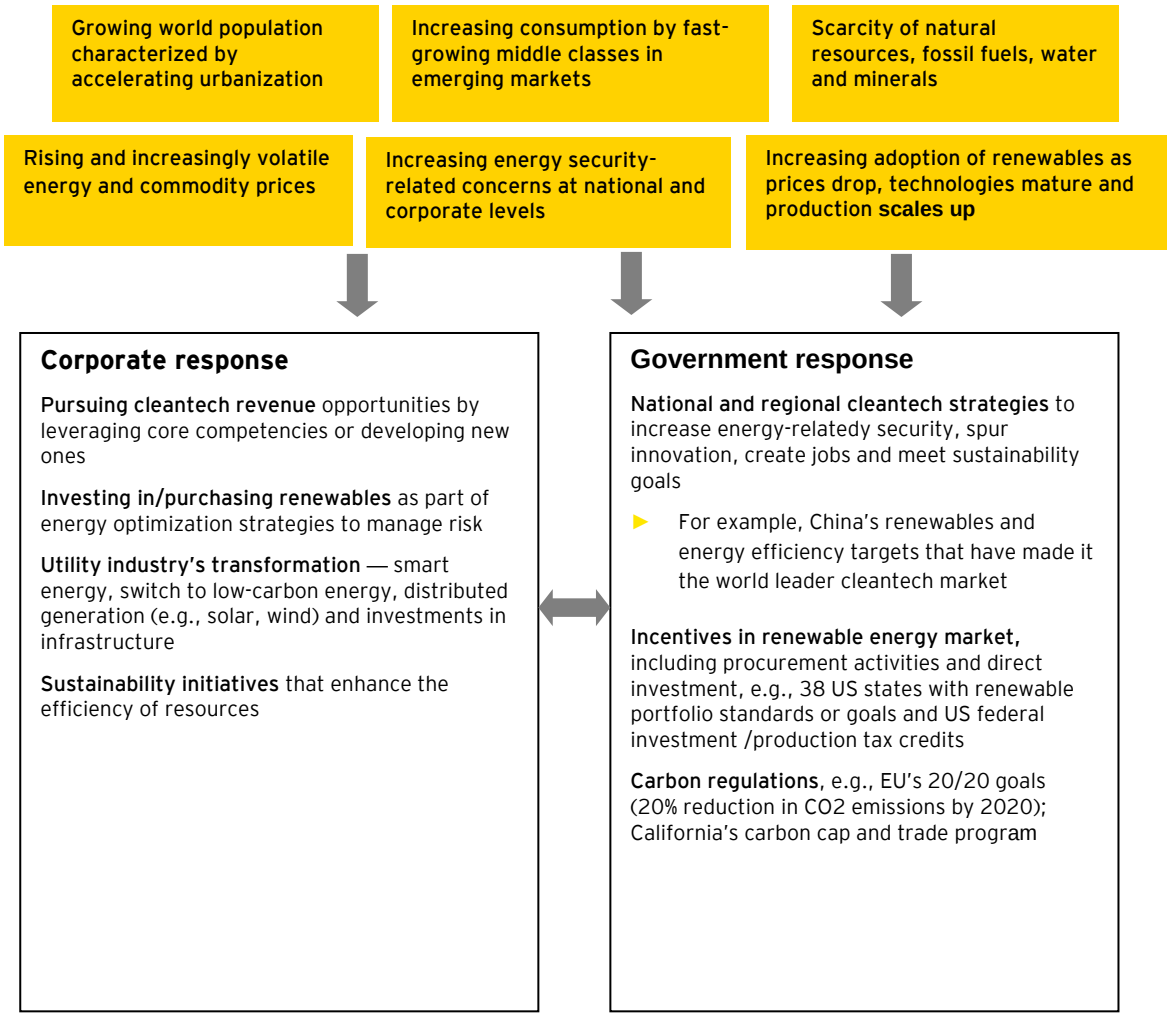
Market drivers and global cleantech trends

Key drivers for global cleantech:

1. Growing world population, characterized by accelerating urbanization
2. Increasing consumption witnessed among fast-growing middle classes in emerging markets
3. Scarcity of natural resources, fossil fuels, water and minerals
4. Rising and increasingly volatile energy and commodity prices
5. Increasing energy security concerns at national and corporate levels

These market drivers are leading to various government and corporate initiatives and responses. The link between the market drivers and the responses are depicted below:

Figure 6: Global market drivers of cleantech



How countries are responding to Cleantech – global trends

- The momentum is shifting to new markets, where development of cleantech technologies offers multiple benefits including economic growth and jobs, diversification of the national energy mix and an improved environment.
- US and Europe remain key markets, but the uncertainty on current energy policies uncertainty and fiscal austerity are having an adverse effect on them.
- Renewables are becoming more cost-competitive as clean technologies mature and the prices of wind and solar equipment falls.
- The solar sector is becoming very competitive and consolidation is under way in it, with the emergence of winners and losers due to overcapacity.
- The deal landscape is being transformed by divestment, market restructuring and the entry of new investors in the sector.
- East-to-West capital flows and transactions are on the rise through investments and acquisitions.
- Global corporations are emerging as important drivers of the demand for renewable energy as they seek to manage their energy-related risks.
- The Asia-Pacific region, driven by China, is projected to be the leading market for renewables, electric vehicles and waste-to-energy as well as a growing source of biofuels.

The Renewable Energy Attractiveness Index (RECAI) developed by EY provides the scores for national renewable energy markets, renewable energy infrastructure and their suitability for individual technologies. The indices provide scores out of 100 and are updated on a quarterly basis. According to the recent index, the US, China and the UK dominate the cleantech market, but indices suggest that India plays a crucial role in the global renewable energy sector. According to RECAI, India ranks sixth on the wind energy index, third on the solar energy index and ninth on the overall renewable energy attractiveness index.

Table 1: Ernst & Young RECAI as on Aug 2013

Country	All Renewable		Wind		Solar	
	Score	Rank	Score	Rank	Score	Rank
US	75.4	1	68.8	2	78	2
China	71.9	2	76.7	1	79.6	1
Germany	69.6	3	58.4	4	59.6	4
UK	62.1	4	58.8	3	38.9	24
Japan	61.8	5	43.7	12	56.8	6
Australia	61.3	6	46.2	9	57.2	5
Canada	59.3	7	52.5	5	46.1	14
France	56.9	8	47.3	8	48.3	10
India	**56.2**	**9**	**50.5**	**6**	**60.6**	**3**
Italy	54.4	10	37.3	24	50.3	8

Key developments in the renewable energy sectors in some leading/pioneering countries

China standing by solar energy: The Chinese Government has stepped up its efforts to support its flagging solar sector by urging lenders to ease financing constraints and give tax breaks to companies, using M&A to reorganize their operations. It has also increased its 2015 domestic solar target by 67% to 35GW and is promoting competition in the market through consolidation and overseas investment. June 2013 saw the launch of an ETS in Shenzhen — the first of seven pilot schemes in anticipation of a national rollout in 2015.

UK details disclosed: The UK Government ended months of speculation by releasing the proposed strike prices for its new Contracts for Difference (CfD) mechanism. It also received 18GW of applications under its "final investment decision" program, which will qualify some large-scale projects for CfDs ahead of the electricity market reform (EMR) becoming law, in order to avoid a major project gap. Late June 2013 also saw the Green Investment Bank (GIB) receive an additional £800m (US$766m) and increased borrowing powers.

US' green agenda: Measures set out in Obama's Climate Action Plan include an additional 10GW of renewable energy projects on public lands by 2020 and an increase in the renewable share of federal power procurement to 20% by 2020 from 7.5% at present. It also reaffirmed the need to increase the FY14 budget for clean energy R&D by 30% to US$7.9b. In other news items, the first two offshore lease auctions (representing 5.5GW of capacity) were scheduled for 31 July 2013 and 4 September 2013.

Australia's carbon conundrum: Prime Minister Kevin Rudd wants to scrap the fixed carbon price a year early to reduce energy prices. But this will cost A$3.8b (US$3.5b) and take the price of carbon from A$25 (US$23) to A$6 (US$5), potentially delaying investments. Bloomberg New Energy Finance (BNEF) predicts that oversupply could result in carbon units being sold at 40% below the EU price. May 2013's budget saw A$370m (US$339m) set aside for renewables deferred until after 2020 and the loss of A$260m (US$239m) of funding to enhance energy efficiency and large solar programs.

Germany destabilizing itself: Despite strong public support for a green economy, rising political tensions prior to elections in September 2013 are paralyzing investment in the sector. Calls to reform the FIT scheme ignore the relatively small impact of new renewable plants on the consumer surcharge, while rhetoric about the "affordability" of Germany's energy supply has not translated into policy statements. In related news, the European Commission is examining whether the exemption of energy-intensive industries from the renewables surcharge constitutes state aid.

India's REC wreck: India's REC market is facing collapse due to insufficient enforcement and falling renewable costs, leaving developers with 2.1 million RECs and no buyers, and funders shunning projects that are heavily reliant on REC revenues. In the meanwhile, Gujarat's electricity regulator is seeking permission to cut its solar tariff retroactively by 28% to prevent developers from witnessing windfall gains, and potentially affecting 970MW of solar capacity. In Rajasthan, a court filing has stalled the country's first wind power auction, which would have added 1.2GW of capacity in the state.

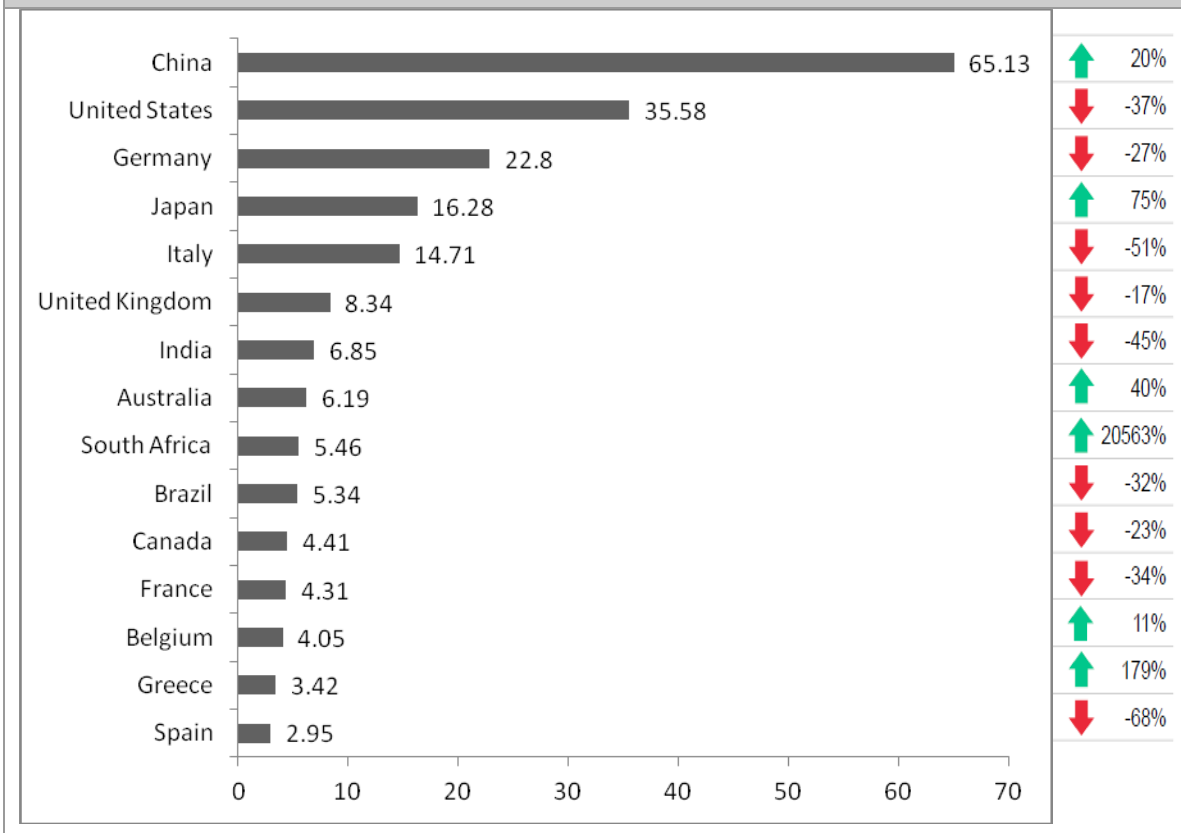
Global investments trends in cleantech

US$1.6 trillion has been invested in clean energy since 2004 and the global clean energy investments grew at a CAGR of 22% from 2004 to 2012. Global investments in renewable power and fuels stood at US$269 billion in 2012 as compared to US$302 billion in 2011, reflecting rapidly falling solar and wind equipment prices since less capital was required to complete renewable energy projects. Furthermore, economic austerity measures began to be felt in developed markets in 2012, contributing to the decline in 2012.

The year 2012 saw the most dramatic shift yet in the balance of investment activity between developed and developing economies as emerging markets (developing economies), e.g., China, Brazil and South Africa, became drivers of growth. This shift was driven by reductions in subsidies for solar and wind power development in Europe and the US, increased investor interest in emerging markets due to the rising demand

for power and attractive renewable energy resources and the falling technology costs of wind and solar photovoltaic (PV)[1].

Figure 7: Top 15 countries that invested in clean energy in 2012



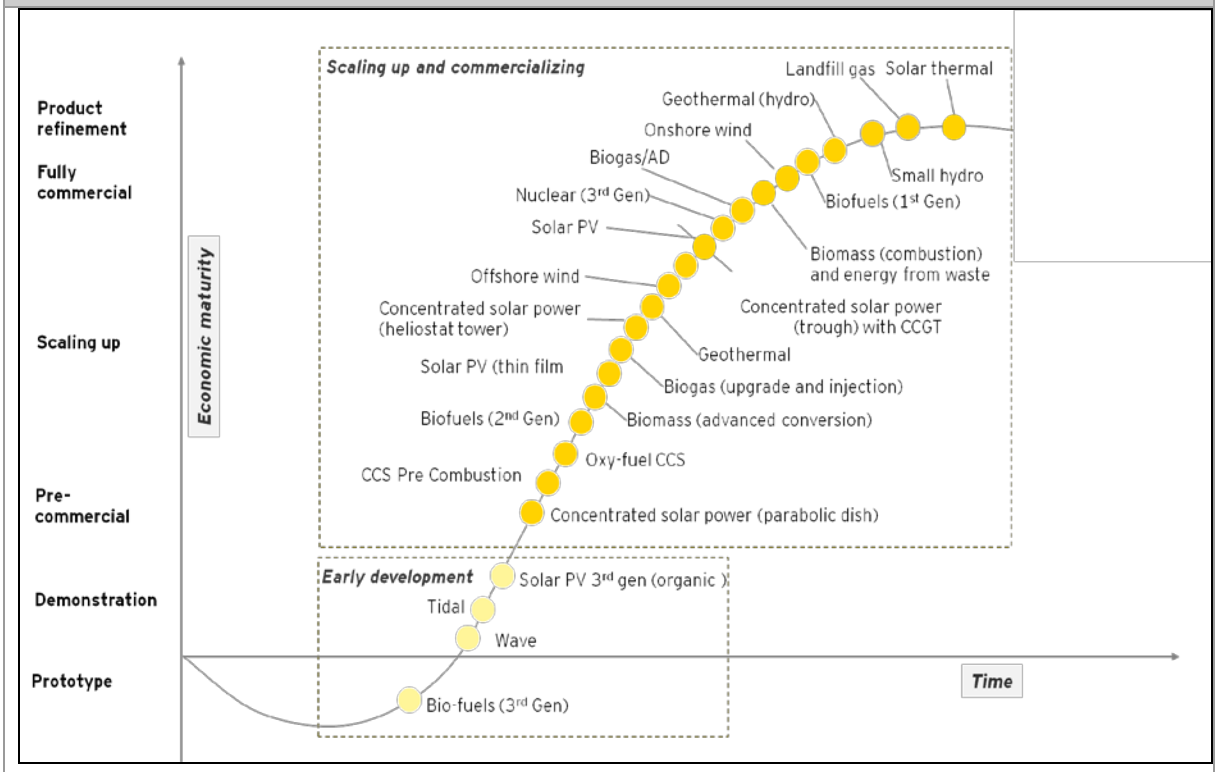
Source: Bloomberg New Energy Finance

Rapid maturity in cleantech

A strong pipeline of clean technologies is moving to economic maturity. However, many clean technologies are already fully commercialized, e.g., onshore wind, solar thermal and biomass. Many others are scaling up and are at their evolving stages. The prices of renewable energy equipment have fallen dramatically due to technological innovation, increasing scale of manufacturing and experience curve gains, e.g., solar module prices have fallen by 80% and wind turbine prices by 29% since 2008. As renewable energy scales up, costs are expected to decline further, particularly with provision of effective policy support.

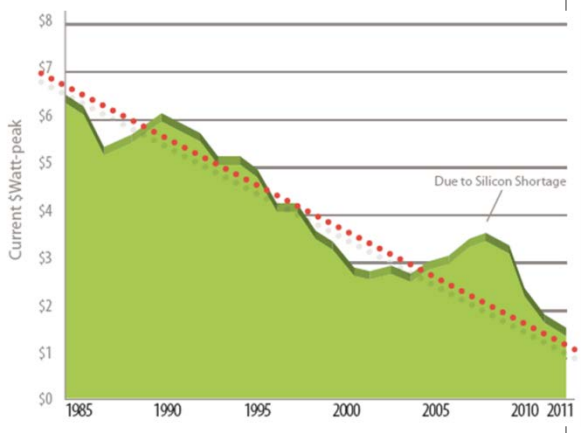
[1] Renewables 2013, Global Status Report

Figure 8: Cleantech maturity cycle



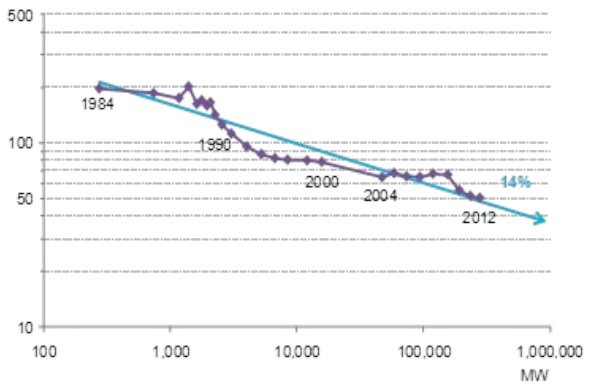
Source: Ernst & Young Analysis

Figure 9: Cost of solar energy modules



Source: Power Forward: Why the World's Largest Companies Are Investing In Renewable Energy, 2012, David Gardiner & Associates, LLC.

Figure 10: Average levelized cost of onshore wind



Source: Bloomberg New Energy Finance, ExTool

Solar module prices have fallen 80% since 2008

Wind turbine prices have fallen 29% since 2008

Shaping up

The global shift toward a more resource-efficient and low-carbon economy is inevitable. In the near and medium term, cleantech will play a critical role with the following drivers:

- Capital innovation, through new financing structures, players, financing vehicles and roles, will complement technology.
- Renewables will play a growing role in the energy mix of countries and corporations.
- Sub-national entities, whether cities, states or provinces, will become increasingly important as markets, funding sources and test-beds for innovation as they turn to cleantech in response to their sustainability-related imperatives.
- Global development of clean energy will speed up in response to the surging demand for energy in emerging markets and increasingly favourable economics for solar and wind energy.
- Consolidation will continue among cleantech pure-plays[2], but so will the development of new business models and cleantech applications.
- Investments from developing economies will rise.

[2] Cleantech companies defined as "pure-play" are those that are classified as "A1 Main Drivers" by Bloomberg New Energy Finance (BNEF), or those companies that derive 50% to 100% of their total value from cleantech.

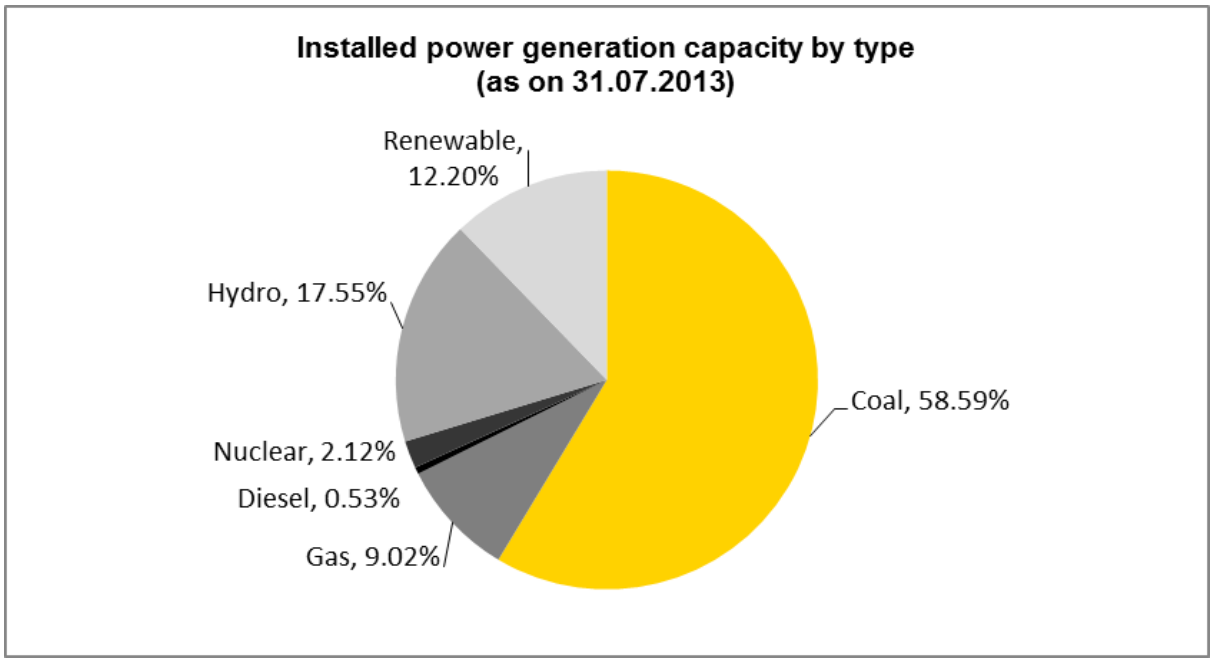
India: overview of cleantech and policy scenario for various sectors

Power sector

Energy is of strategic importance for India, particularly because of its fast-growing economy, rising population and commitments for inclusive socio-economic development. India needs to sustain an economic growth rate of 9% sustained over the next 20 years to meet its human development goals and objective of eradicating poverty.[3] Therefore, the country is faced with the challenge of meeting its energy requirements to sustain high economic growth, while adopting a sustainable low-carbon development path.

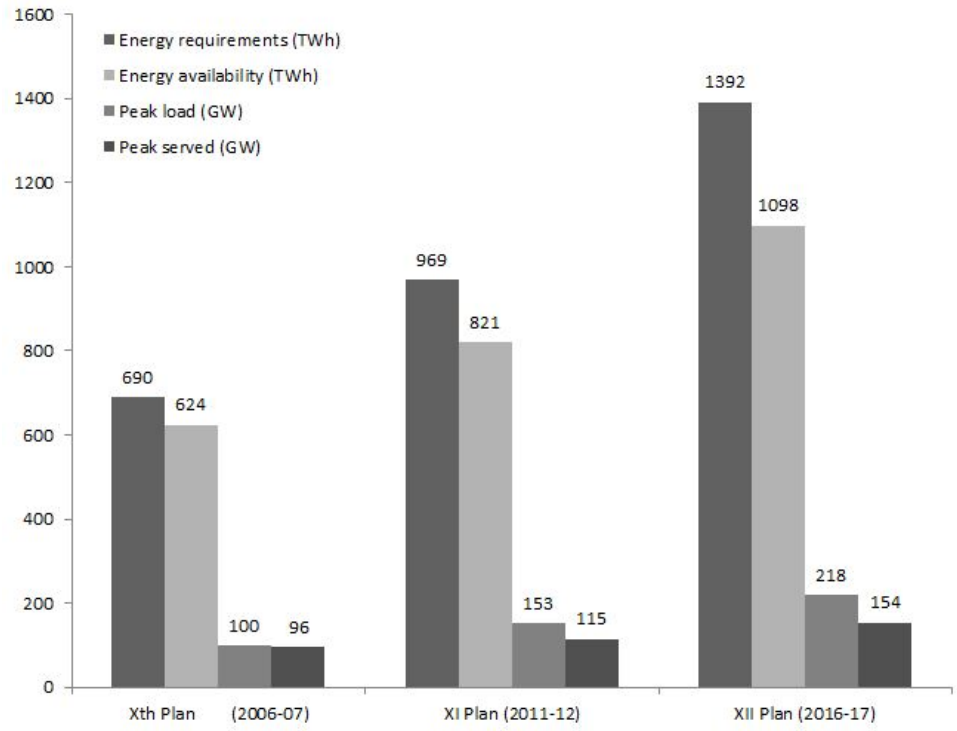
India's total usage of energy has grown by more than 25% over the last two decades and the use of fossil fuel has contributed predominantly to this growth.[4] Over the last 10 years, the shortage in energy and peak demand averaged around 8% and 12%[5], respectively. A variety of initiatives are in process to boost additional capacity from public and private players, including UMPPs, MPPs and group captive generation. However, despite these ambitious targets, the demand for power is likely to outstrip its supply well into the Twelfth Plan period[6]

India's total power generation capacity was around 225 GW as of July 2013. Around 58% of its power generation capacity comprises coal-based power plants, with natural gas-based power generation contributing another 10%.



[3] "Low Carbon Strategies for Inclusive Growth," Planning Commission of India, Govt. of India, 2011
[4] "Low Carbon Strategies for Inclusive Growth," Planning Commission of India, Govt. of India, 2011
[5] Central Electricity Authority
[6] Source: India Energy Handbook 2011

Figure 12: India: energy demand/supply forecasts

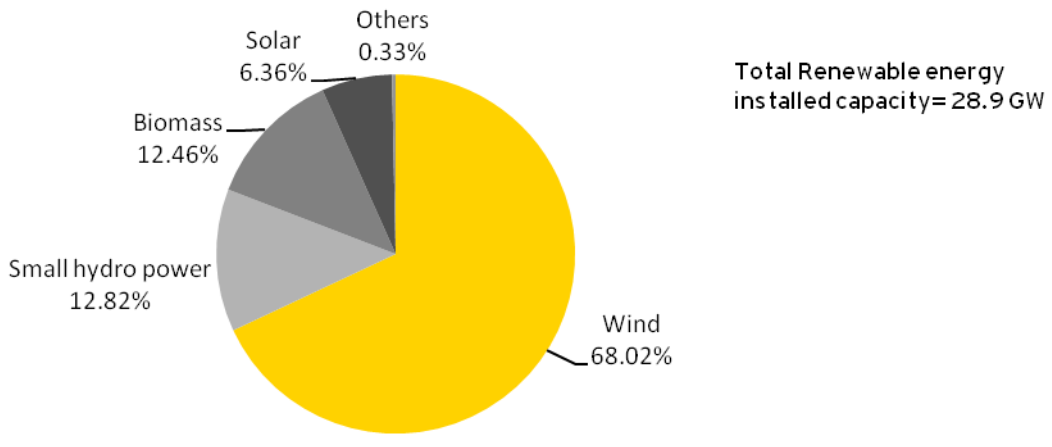


Source: Harnessing the potential, he India renewable energy potential, Ernst & Young, 2012

Renewable energy scenario in India

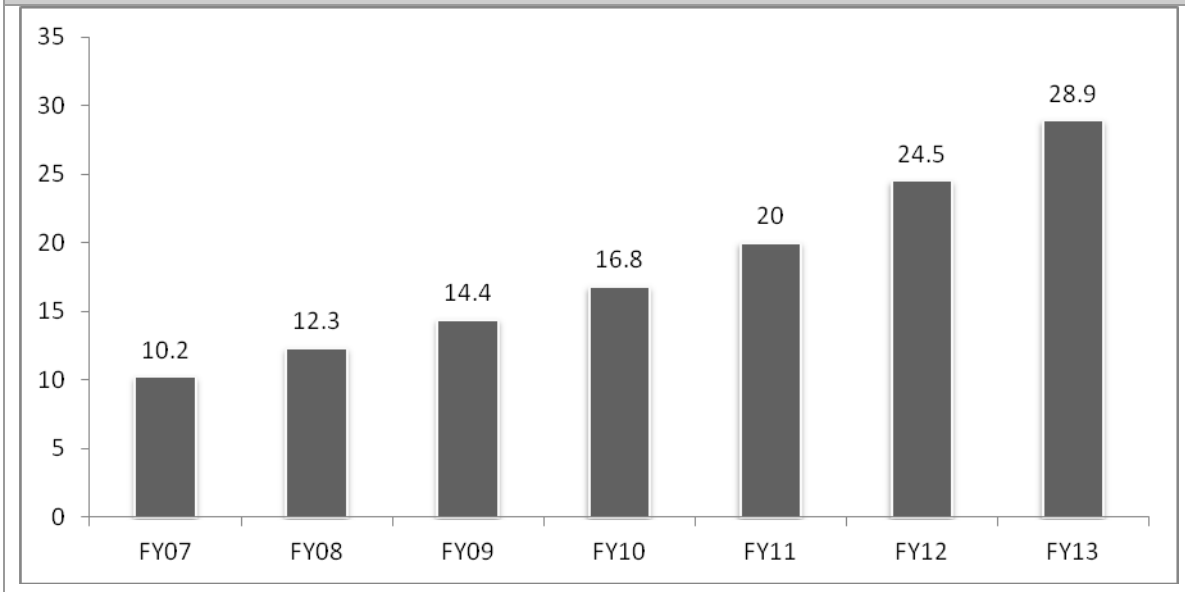
Renewable capacity comprises about 12% of the total installed energy capacity in India. Amongst this, wind energy dominates India's renewable energy industry, and accounts for 68% of its installed capacity for renewable energy-based power generation. Small hydro, biomass and solar power contribute 12.8%, 12.46% and 6.36%, respectively, to the country's installed capacity. The National Action Plan for Climate Change places particular emphasis on the role renewable energy needs to play in ensuring low-carbon development in the country. NAPCC targets 15% energy generation through renewable energy sources by 2020, but at present, only 4% of energy generation in India is from renewable energy sources. It is therefore clear that renewable energy needs to be promoted aggressively to meet the country's goal of achieving sustainable low-carbon development and inclusive growth.

FIgure 13: Installed renewable power generation capacity by type
Source :MNRE as on 31.07.2013



Apart from the sources mentioned above, there is also potential for tidal, geo-thermal and wave energy. The installed capacity of renewable power in India has witnessed a CAGR of 19% over the past few years.

Figure 14: Growth of installed capacity of renewable energy in India (GW)



Source: MNRE as on 31 July 2013

Key drivers of renewable energy in India

Vast untapped potential: India has abundant untapped renewable energy resources. The country's large land mass witnesses one of the highest levels of solar irradiation in the world. Furthermore, it has an extensive coastline and sees high wind velocity in many areas. This provides ample opportunities for establishment of land-based renewable energy generation and offshore wind farms. In addition, India's numerous rivers and waterways have the strong potential to generate hydropower. The country also has significant potential to produce energy from biomass from agricultural and forest residues.

Table 2: Renewable energy: potential and installed capacity in India

Resource	Estimated potential (GW)	Installed capacity (GW)
Wind	100*	19.66
Small hydro	20	3.7
Biomass	22	3.6
Solar	30-50 MW/sq. km	1.83

* At an 80m height

Source: MNRE as on 31 July 2013

Energy security concerns: India's primary energy consumption between 2006 and 2010 increased at a CAGR of 8.3%, from 381.4 million tons of oil equivalent (MTOE) to 524.2 MTOE. The country imported 73% of its oil requirements in FY11 due to the increasing demand for energy in the country and stagnant domestic production. Its total import bill of petroleum products for FY11 was INR7,170.8 billion. Furthermore, prices of petroleum products have been rising continuously and have seen significant volatility in recent years due to

increased competition in procurement of fossil fuels. Increased use of the country's indigenous renewable resources is expected to reduce its dependence on expensive imported fossil fuels.[7]

National Action Plan on Climate Change (NAPCC): India needs to develop a low-carbon growth strategy to successfully address the global threat of climate change and sustain its rapid economic growth in the long run. The Government of India implemented the NAPCC in 2008 to tackle this situation. The NAPCC comprises eight national missions that collectively focus on promoting understanding, adaptation and mitigation of climate change as well as energy efficiency and conservation of resources. The National Solar Mission (NSM) is driving the growth and development of the solar energy sector in India as part of the NAPCC.

Government support: The Government is playing an active role in promoting renewable energy resources in India by attracting private sector investment and mandating the use of renewable resources in the country's total energy mix. It is also offering various incentives to encourage development and use of renewable energy sources such as generation-based incentives (GBIs) and tax holidays.

Foreign investment policy: The Government has created a liberal environment for foreign investment in renewable energy projects. In addition to allowing 100% foreign direct investment (FDI) in the renewable energy sector, it is also encouraging foreign investors to set up renewable energy-based power generation projects on a build-own-operate (BOO) basis in the country.

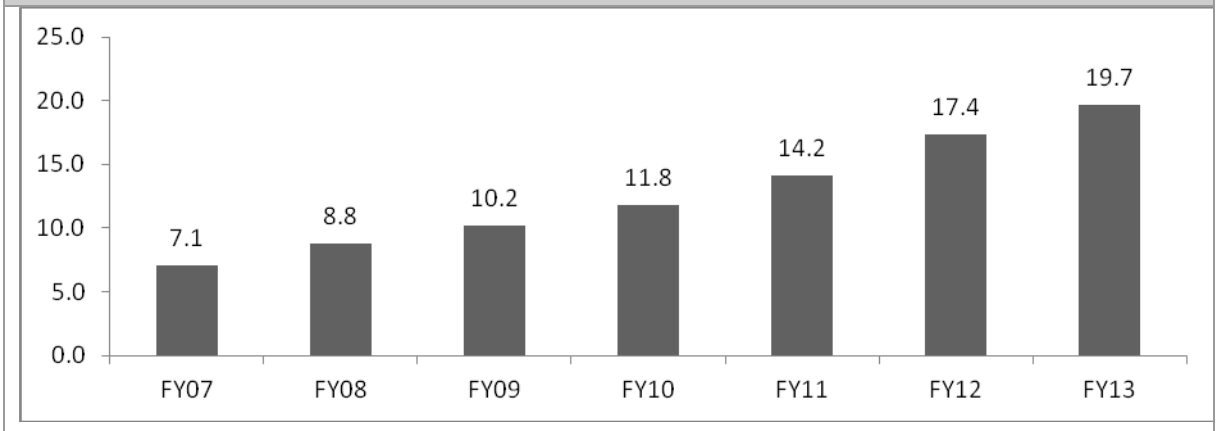
Unmet demand in rural areas: As a distributed and scalable resource, renewable energy technologies are well-suited to meet the need for power in remote areas, which lack grid and road infrastructure. Distributed renewable sources of power are expected to play a key role in improving access to energy in India, where nearly 25% of the population lacks access to electricity.

Sector overview

Wind

Wind is by far the largest renewable energy segment in India, contributing 68% percent of its total renewable energy-based installed capacity. The Center for Wind Energy Technology (C-WET) has revised the estimated on-shore wind energy potential of the country from 48.5 GW (at a 50-meter hub height) to 102 GW (at a 80-meter hub height). India's installed wind power capacity has grown at a healthy CAGR of 20% over the last few years to reach 19 GW[8] at the end of July 2013. While Karnataka, Gujarat and Andhra Pradesh have the highest estimated potential, Tamil Nadu, Gujarat and Maharashtra are the leaders in installed wind capacity. Incentives such as preferential tariffs, accelerated depreciation and Generation Based Incentives (GBI), along with renewable purchase obligations (RPOs), continue to support this segment. Some states (such as Gujarat and Rajasthan) have even announced wind-specific RPOs. Therefore, wind is likely to play crucial role in increasing the share of renewable energy sources in India.

Figure 15: Installed Capacity of Wind Power (GW) in India, 2013



Source: MNRE as on 31 July 2013

[7] India's energy security on fragile ground (FICCI- E&Y Report), Business Digest, Jan 2012
[8] MNRE

Potential of off-shore wind development

Off-shore wind energy has immense potential to generate renewable energy. It has certain advantages as compared to onshore wind energy:

- Higher wind speeds
- Possibility of setting up large-scale plants
- High capacity utilization factors (CUFs)
- Less intermittent than on-shore wind energy
- Possibility of avoiding land acquisition issues

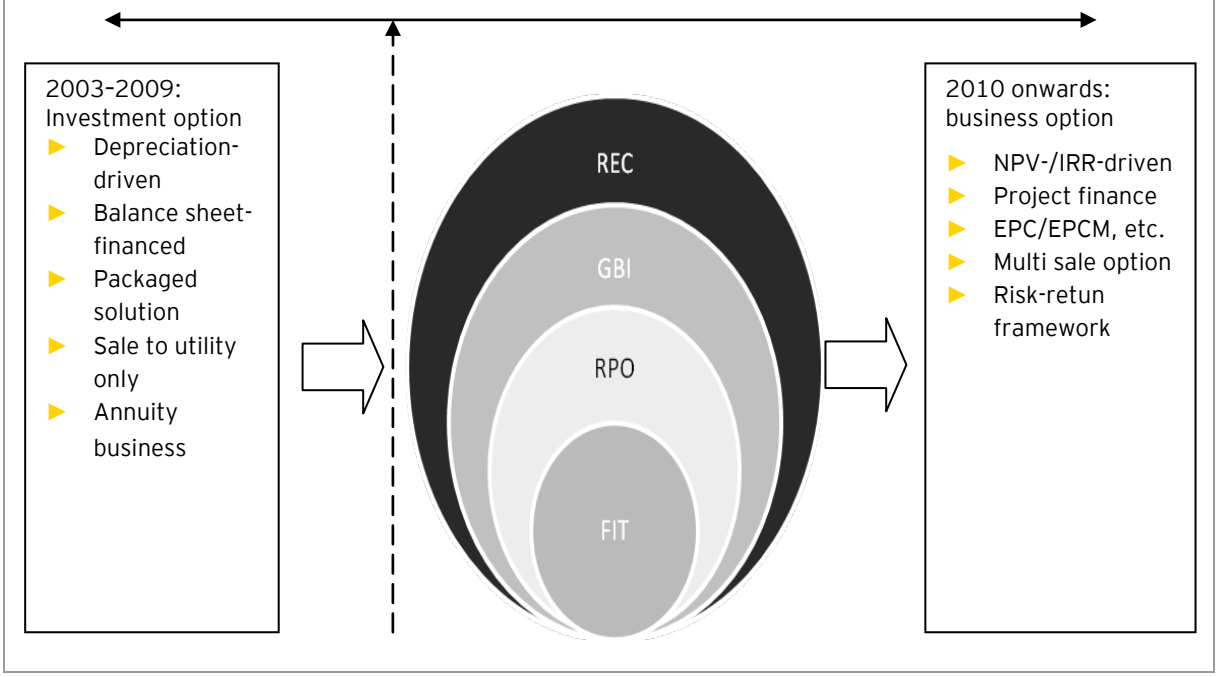
However, generation of off-shore wind energy is still at an evolving stage, with the main factors hindering it being high capital costs as compared to those of on-shore wind farms. These costs can be mainly attributed to the complex civil constructions required in the sea, high electrical connection costs and costly materials required to prevent corrosion in the maritime environment. Furthermore, the seas around India are much deeper than those surrounding Europe, which makes construction difficult and expensive. However, these costs are likely to come down as more experience is gained in generation of off-shore wind energy over time.

Countries such as Denmark, the UK and Germany have taken the lead in developing off-shore wind farms, with offshore wind energy accounting for more than 8% of total wind energy capacity addition in Europe in 2011. The Offshore Wind Energy Steering Committee (OWESC) has been recently constituted in India to develop the sector in a focused manner.

Incentives and benefits

- Concession on import duties on specific wind turbine components
- Ten-year Income Tax holiday for wind power generation projects
- Almost full exemption from Excise duty on certain wind turbine components
- Wheeling, banking, third-party sales, buy-back facility for states
- Guaranteed market through specified renewable portfolio standards in some states, which are decided by the states' electricity regulators
- Reduced wheeling charges as compared to those for conventional energy
- FDI investment amounting to 100% allowed in the case of renewable energy generation projects
- Special incentives provided to promote exports from India for various renewable energy technologies under renewable sector-specific Special Economic Zones (SEZs)

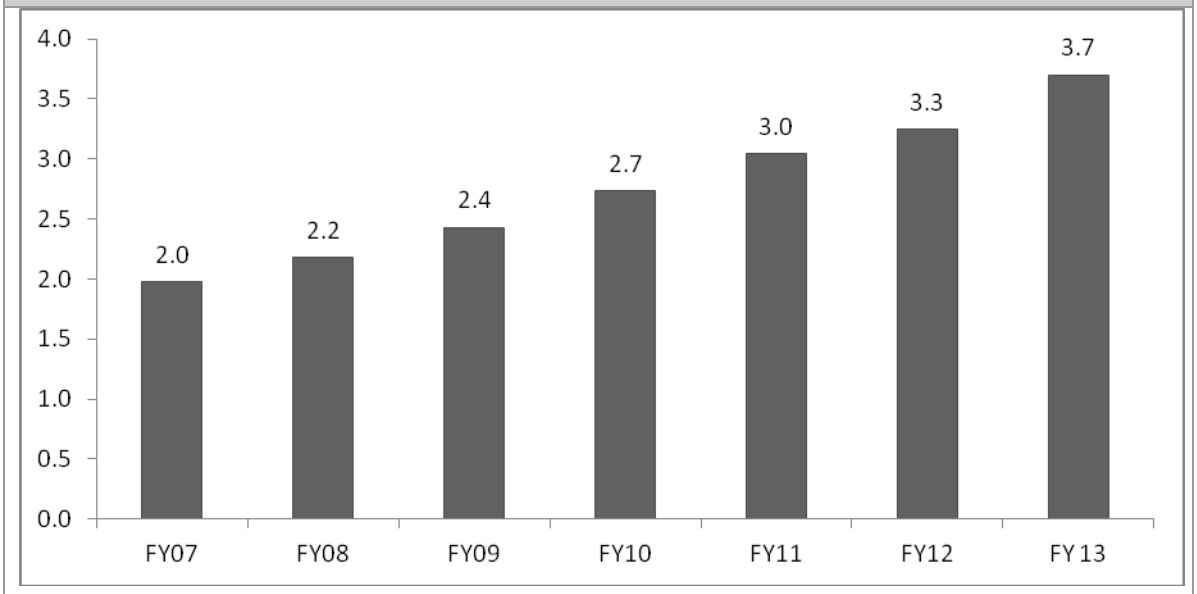
Figure 16: Changing paradigm of wind power



Small hydro power

Small hydro power (SHP) projects play a critical role in improving the overall energy scenario in the country, particularly in remote and inaccessible areas. Hydro projects up to a capacity of 25 MW are classified as small hydro power projects in India. MNRE has created a database of potential sites of small hydro, and 5,415 potential sites with an aggregate capacity of 14,305.47 MW for projects up to 25 MW capacity have been identified. Around 50% of the total potential for SHP is in the states of Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Uttarakhand and Chattisgarh. MNRE aims to install around 7000 MW of SHP by the end of the Twelfth Plan. The focus of the SHP program is to reduce the cost of equipment, increase its reliability and set up projects in areas that provide the maximum benefits in terms of capacity utilization.

Figure 17: Installed Capacity – Small hydro power (MW)



Source: MNRE as on 31 July 2013

Small hydro is a well-established technology that offers investors projects with low technology risk and potentially high returns. It currently has on average the lowest generation costs among all renewable energy technologies in India[9].

SHP projects are expected to play a crucial role in improving the overall energy scenario in India, particularly in remote and inaccessible areas, but it continues to be a resource that has not been tapped to its full potential. Moreover, implementation of SHP projects is governed by state policies and potential sites are allotted by state governments to private developers. Although the Central Electricity Regulatory Commission (CERC) has prescribed a set of tariffs for SHP projects, depending on the capacity and location of a project, lack of consistency in different SHP tariffs across the states hinder investment in the sector. Some states have fixed / "levelized" tariffs, while others have incorporated escalation factors. Moreover, feed-in tariffs do not adequately compensate for high resource and other operational risks investors are likely to face over the 35-year investment time period. Individual states therefore need to align their respective renewable energy tariffs with the latest CERC tariffs to increase the attractiveness of SHP-based power development and facilitate further investments by private developers in the country.

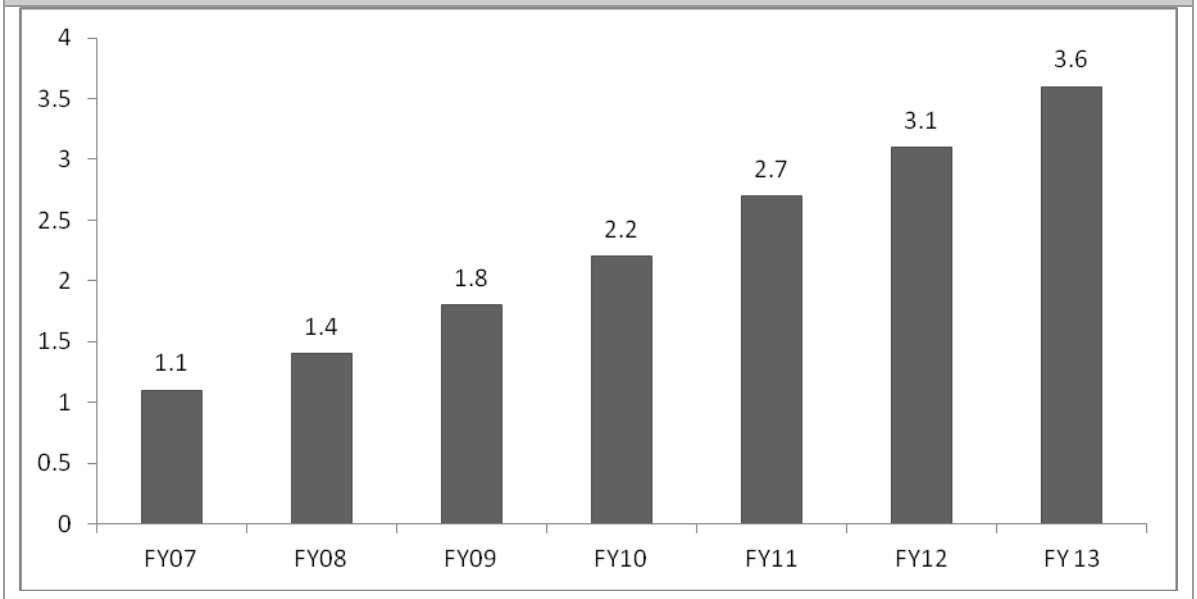
Biomass

Biomass resources in India are used to generate power through three general applications: grid-connected biomass power plants, off-grid distributed biomass power applications, and cogeneration in sugar mills and other industries. According to current estimates, around 120–150 million tons of usable additional biomass is available per year for power generation in India. This translates to a potential of around 18,000 MW. In

[9] Indian Renewable Energy Status Report

addition, capacity of around 5,000 MW could be set up through bagasse-based cogeneration plants. This additional potential of 5,000 MW of power can be realized from 550 sugar mills in India, if these mills adopt technically and economically optimal levels of cogeneration to extract power from the bagasse produced by them[10]. India's total grid interactive installed biomass capacity was around 3.6 GW as of July 2013. The key advantage of biomass power is its scheduling flexibility and high plant load factor (PLF). However, challenges relating to biomass supply chain management, due to the unorganized nature of the market, need to be overcome to scale up investment in the sector.[11]

Figure 18: Installed Capacity (MW) – Biomass based projects



Source: MNRE as on 31 July 2013

The MNRE plans to initiate the National Bioenergy Mission in association with state governments, the public and private sectors and other key stakeholders to promote ecologically sustainable development of bio-energy. In addition, it is looking at setting up a company to generate biomass-based power and promote it in a bid to encourage renewable energy sources of power generation in India. Moreover, it has set up 13 biogas development and training centers (BDTCs) in the country to provide training support and technical back-up. The MNRE is also exploring possibilities of setting up a fund for generation of renewable energy, including bioenergy.

[10] MNRE
[11] MNRE

Recent technological advancement

- The MNRE has undertaken new initiative to set up medium-sized mixed feed biogas-fertilizer plants (BGFPs) for generation, purification or enrichment, bottling and piped distribution of biogas. Installation of such plants is aimed at meeting stationary power and electricity needs in addition to cooking and heating requirements. So far, a total of 21 BGFP projects (with an aggregate capacity of 37,016 m3/day) have been sanctioned by the MNRE.
- The MNRE is also developing upgraded systems for converting biogas into natural gas quality fuel. In addition, it is setting up a facility to produce around 8 tonnes of compressed natural gas (CNG) per day at Warnanagar in Kolhapur.
- It is initiating research projects on integrated technology development for production of biodiesel. In all, 18 biogas research and development (R&D) projects have been sanctioned by the MNRE so far under its Research, Design, Development and Demonstration (RDD&D) framework.
- In addition, it has developed a state-of-the-art research facility for research in different areas of bio-energy at the Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE).

Solar

Solar energy is an important, yet currently under-utilized resource in India. The country has nearly 300 sunny days a year and receives average hourly radiation of 200 MW/sq. km, which translates to a potential of more than 100 GW of solar energy. India's current installed solar capacity of 1,044 MW accounts for only 0.5% of its total power generation capacity. The Government plans an extensive program as part of the Jawaharlal Nehru National Solar Mission (JNNSM). India's solar energy market has been given a boost with the launch of JNNSM. The mission is focused on achieving grid parity for solar energy and increasing grid- connected solar power projects, and envisages an ambitious target of 20 GW of installed solar generation capacity by 2021–22[12]. It is worth noting that JNNSM is not just an announcement of intent, but a well-drafted operational plan. The mission document comprehensively covers various aspects such as allocation of projects, manufacturing, R&D and skill enhancement.

Out of the country's current total installed solar energy capacity of 1,839 MW, nearly 900 MW was added in 2011–12. Grid-connected solar PV projects of 130 MW have already been commissioned under Phase-I, Batch-I of the JNNSM. A further 310 MW of solar PV projects have been commissioned under Phase-I, Batch-II of the program. Under the JNNSM, the National Tariff Policy for Power Sector was modified to include a mandate for SERCs to source a certain percentage of the total energy they purchase from solar energy sources. The percentage has been fixed at 0.25% for 2013 and is expected to increase to 3% by 2022. The JNNSM also aims to boost India's domestic manufacturing capability with respect to the components and equipment required by solar power plants. It targets manufacturing capacity of 4–5 GW equivalent by 2020, including capacities for polysilicon, a resource for which India currently relies on imports. In addition, it has mandated requirements pertaining to locally manufactured content required in solar projects. The Government is providing subsidies and tax incentives, and is also putting in place efficient approval mechanisms to further stimulate manufacturing in the country. The main barrier in the path of increased uptake of solar energy is that it is more expensive than power obtained from conventional sources. However, with technological developments and increased deployment of solar energy projects, module costs have come down significantly over the years.

Globally, the price of polysilicon fell by more than 50% last year. The industry has benefitted from this price decline, since India imports most of the raw material required to manufacture solar cells and modules.

Other incentives offered by the Government to develop the solar energy sector:

- Exemption from Excise duties and concessions on import duties on components and equipment required to set up solar plants
- Ten-year tax holiday for solar power projects
- Generation-based incentive (GBI) scheme for small solar projects connected to grids of below 33 kV

[12] MNRE

- Guaranteed market through solar power purchase obligation for states
- Wheeling, banking and third-party sales, and buy-back facility provided by states
- Reduced wheeling charges as compared to those for conventional energy
- Special incentives provided to promote exports from India for various renewable energy technologies developed in renewable sector-specific SEZs
- Payment Security Mechanism (PSM) to cover the risk of defaults by state utilities or discoms.
- FDI investment of 100% allowed in renewable energy projects
- Subsidy of 30% of project cost for off-grid PV and solar thermal projects
- Loans at concessional rates for off-grid applications

Apart from the Central Government, several state governments are also taking initiatives to promote the renewable energy sector in India. These initiatives include segment-specific and investor-friendly policies to attract investment, financing of R&D and pilot projects based on new technologies, and financing of renewable technologies to increase access to energy.

Key government initiatives for generation of renewable energy

The Electricity Act 2003 provided the framework for generation of renewable power in India by enabling the following provisions:

- Optimal utilization of resources
- A national policy for standalone systems for rural areas
- Promotion of electricity from renewables
- Suitable measures for grid connectivity and notification of Renewable Purchase Obligations (RPOs) by State Electricity Regulatory Commissions (SERCs)

The National Electricity Policy further provides for:

- SERCs to set progressive RPOs
- SERCs to set differential tariffs for renewable energy

The Integrated Energy Policy's long-term vision for renewable energy includes:

- Special support for renewables for a well-defined period
- Linking incentives to generation and not capacity addition
- SERCs mandating feed-in laws

Table 3: Key policy initiatives

2008	2008-09	2009-11	2011 onwards
▶ Launch of the NAPCC ▶ State-specific feed-in-tariffs (FITs) for wind energy ▶ Notification of renewable purchase obligations (RPOs) ▶ Generation-based incentives (GBI) scheme for solar power	▶ GBI scheme for wind energy ▶ Solar policies/tariffs announced by several states/ SERCs	▶ Notification of solar-specific RPOs ▶ Formulation of National Clean Energy Fund (NCEF) ▶ Launch of Renewable Energy Certificates (RECs) ▶ Launch of JNNSM ▶ Launch of smart-grid task force	▶ Launch of National Water Mission (NWM) ▶ Imminent launch of National Electric Mobility Mission Plan 2020 ▶ Release of Guidelines for Green Large Area Development by the MNRE ▶ Establishment of the Central Financial Assistance (CFA) to set up small/micro hydro power projects ▶ Constitution of offshore Wind Energy Steering Committee (OWESC) by MNRE

Energy efficiency

Energy efficiency in industries

Industry is one of the most important sectors in India, since it contributes substantially to the country's GDP (27% in 2007[13]). On the other hand, the sector has the second-largest share of final energy usage after the residential sector. Industry has made significant advances in conservation of energy in the last decade. Government policies, campaigns by industry associations and strategic decisions made by corporate organizations have all contributed to significant improvement in the intensity of energy use in industries. The major energy-consuming sectors include the steel, cement, caustic soda, brick, aluminum and electric power generation industries. Measures to improve energy efficiency in industries include promotion of fuel-efficient practices and equipment, replacement of old and inefficient boilers and other oil-operated equipment, fuel switching and technology upgrades.

The Government has launched the National Mission on Enhanced Energy Efficiency (NMEEE), with an outlay of INR2.35 billion, in June 2010. The NMEEE is one of the eight key missions under the NAPCC. By 2015, the mission is expected to bring about savings of nearly 23 million tons oil-equivalent of fuel in coal, gas and petroleum products.

The NMEEE targets four initiatives to significantly scale up implementation of energy-efficiency efforts undertaken in India. This is in addition to the policies and programs for energy efficiency being implemented by the Bureau of Energy Efficiency (BEE). These new initiatives include:

- **Perform, Achieve and Trade (PAT)**, a market-based mechanism to make improvements in energy efficiency in energy-intensive large industries and make facilities more cost-effective by certification of energy savings that can be traded
- **Market Transformation for Energy Efficiency (MTEE)** by accelerating the shift to energy-efficient appliances in designated sectors through innovative measures that make such products more affordable
- **Energy Efficiency Financing Platform (EEFP),** a mechanism to finance DSM programs in all sectors by capturing future energy savings
- **Framework for Energy Efficient Economic Development (FEEED)** to develop fiscal instruments to promote energy efficiency

PAT, the flagship program of the mission, seeks to utilize a market-based mechanism to facilitate energy efficiency improvements in large energy-intensive industries in a cost-effective manner. Not only does the mechanism establish a framework of legal obligations under the Energy Conservation Act, 2001, but it also provides innovative market-based incentives to trade-related savings beyond prescribed targets. The PAT framework has been developed considering legal requirements mandated by the Energy Conservation Act, an analysis of the situation of designated consumers, the national energy-saving goals to be achieved by 2013–14 and the sustainability of the entire scheme. A key premise of the scheme is to incentivize the industry to achieve improved energy-efficiency, as compared to defined SEC improvement targets, in a cost-effective manner. To facilitate this, the scheme provides the option to trade any additional certified energy savings with other designated consumers in order to comply with SEC reduction targets. The Energy Savings Certificates (ESCerts) issued are tradable on special trading platforms created in two power exchanges —the Indian Energy Exchange (IEX) and Power Exchange India Ltd. (PXIL). Eight industry sectors are currently covered under the PAT scheme (thermal power plants, and the cement, iron and steel, fertilizer, aluminum, textile, pulp and paper, and chlor-alkali industries).

The Ministry of Power, through its Gazette Notification dated 30 March 2012, has released a list of 478 industrial designated consumers (DCs), along with the specific energy reduction targets assigned to each of these. This historic announcement marks the start of India's "Cap and Trade Scheme" relating to energy

[13] Ministry of Environment & Forest, GoI, Indian Network for Climate Change Assessment INCAA, Report 2010

efficiency. Estimated at around US$15 billion, the scheme fosters market-driven incentives to promote energy efficiency in Indian industry. [14]

The industrial sector has also seen a significant increase in the share of renewable energy consumption, which has been mainly due to policy interventions, in addition to other energy security issues. The NAPCC lays emphasis on industries increasing their renewable energy consumption and using non-conventional sources of energy for sustainable growth. The REC mechanism has considered industries with captive generation facilities and other third-party consumer-obligated entities. The obligated entities have been given incremental targets to increase their share of renewable energy consumption till 2020.

The Government has taken overarching initiatives to finance energy efficiency and renewable energy implementation schemes and improve product designs.

The National Manufacturing Competitiveness Programme (NMCP) is the Government's nodal program to develop global competitiveness among micro, small and medium enterprises (MSMEs) in india.[15] One of the components of the NMCP focuses on providing support on technology and quality upgrades to sensitize MSMEs to the benefits that can accrue from the use of renewable energy, energy-efficient technologies and reduction in GHG emissions. The major activities planned under this program include initiatives such as "Capacity Building of MSME Clusters for Energy Efficiency/Clean Development Interventions", "Implementation of Energy-efficient Technologies in MSME Sector" and setting up of carbon credit aggregation centers. The National Manufacturing Policy of India stresses on three strategic paths —mainstreaming and promoting green business, protecting natural resources and addressing technology-funding issues. Immediate focus on these strategies is required to achieve environmental sustainability in the manufacturing industry.

Smart grids

India's rate of electricity loss in transmission and distribution (T&D), at about 25% is one of the highest in the world. Being one of the fastest growing global electricity markets, the country needs to modernize its grid infrastructure to be able to handle its current and future energy demands. Smart grids use information and communication technology to bring reliability and efficiency in electrical grid systems. Smart grid systems provide real-time information to consumers and enable them to manage their consumption better and electricity boards to improve their detection of electricity theft.

The key developments areas of smart grids:

- The Central Ministry of Power is launching a pilot smart grid project for industrial consumers in Kerala. It has sanctioned INR280 million for the project, out of which 40% will be provided as grants.
- In March 2012, Maharashtra announced its US$25 million smart grid program, which covers electricity distribution in eight cities including Mumbai.
- The Puducherry Electricity Department has signed an MoU with the Power Grid Corporation of India for a pilot project on smart grid. The project aims to install smart meters in 87,000 houses in the town, with an investment of INR770 million.
- Bangalore has also launched a program, which aims to install one million smart meters in the city in one year.

As the country strives to rapidly increase its generation of intermittent renewable sources such as solar and wind energy, a smart grid network will enable efficient integration of these with the grid. Therefore, expanding the country's smart grid network is crucial.

The Central Ministry of Power has launched the India Smart Grid Task Force, an inter-ministerial group that will serve as the Government's focal point for smart grid-related activities. The Ministry has also launched the India Smart Grid Forum, a not-for-profit and voluntary consortium constituting multiple stakeholders, to accelerate development and deployment of smart grid technologies in the country.

[14] Ministry of Power, GoI, Details on the energy conservation initiatives of the Ministry of Power, Government of India.

[15] Ministry of Micro, Small & Medium Enterprises, GoI, Annual Report 2011-12

Energy efficiency in buildings

Rising energy costs, concerns over energy security, growing accountability for CO_2 emissions and environmental concerns are driving the market for energy-efficient products and services. Buildings, commercial and residential, account for around 40% of overall energy consumption and more than 70% of electricity sales, both of which are on an upward trend. Urbanization and the rise of emerging markets, particularly in the Asia-Pacific region, are leading to a significant increase in the number of buildings worldwide.

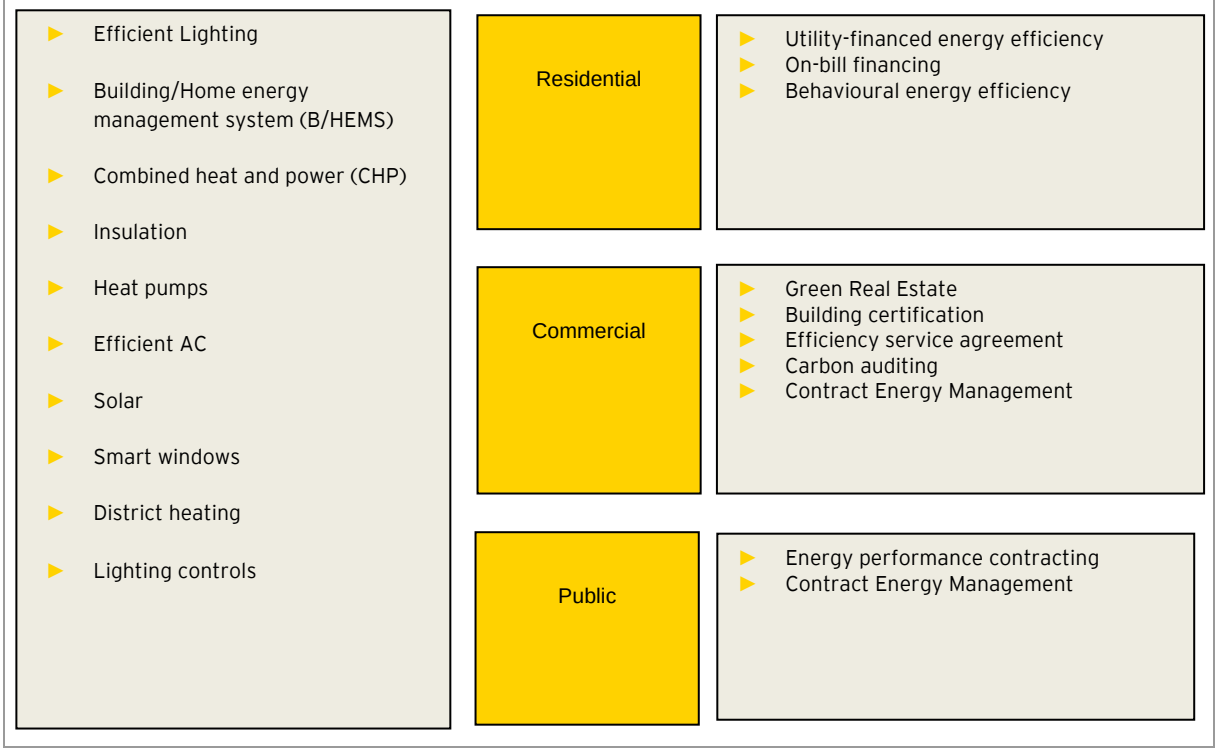
The capital expenditure involved in construction of energy-efficient buildings and retrofitting material and technology still prevents industry players from turning towards greener buildings. However, there is greater recognition of short to mid-term cost benefits. Governments have realized the socio-economic benefits of constructing energy-efficient buildings and have put in place various policies to drive growth in this segment.

With the growth of the Indian economy and the development of infrastructure in the country, there is expected to be an increasing demand for new commercial and industrial building spaces. In addition to this, the increasing population in urban and emerging cities is likely to create a demand for new residential buildings. In this scenario, this sector will play an important role in low-carbon transformation initiatives.

Government of India has launched National Mission on Sustainable Habitat under NAPCC. The mission promotes energy efficiency and renewable energy technologies in the residential and commercial sectors.

It is estimated that, on an average, implementation of energy-efficiency measures will help to achieve energy savings of around 30% in new residential buildings and of 40% in new commercial ones. In the case of existing buildings, these estimates are around 20% and 30%, respectively[16]. Indian Green Building Council estimates that there is a potential to save 142MT of CO_2 per year and 296MT of CO_2 per year by 2030, in residential and commercial buildings, respectively.

Figure 19: Illustrative overview of energy efficiency in buildings



Overview of India's policies on sustainable buildings

[16] Ministry of Environment & Forest, GoI,India's Second National Communication to the United Nations Framework Convention on Climate Change

The Ministry of Power has initiated the Energy Conservation Building Code (ECBC), which will issue mandates for all upcoming buildings in India, going forward. The ECBC sets minimum efficiency standards for energy-efficient designing, construction of buildings and major renovations if the connected load exceeds 110kVA or the peak demand is greater than 100kW. It is estimated that ECBC-compliant buildings use 40%–60% less energy than conventional buildings in India. The implementation of the ECBC can therefore promote sustainable development in the segment by reducing energy usage and environmental impact, cutting costs and improving services. It can help struggling states/cities meet their growing demand for energy. Although compliance with the code is currently voluntary, the Ministry of Urban Development and BEE are working toward making it mandatory.

In 2006, BEE introduced the Standards and Labeling Programme to improve the efficiency standards of various appliances used in the buildings. The scheme includes four kinds of equipment/appliances under the mandatory minimum energy performance scheme. These include frost-free refrigerators, tubular fluorescent lamps, room air-conditioners, distribution transformers and 11 other appliances[17].

The MNRE has taken many initiatives, such as giving a rebate on solar water heaters and promoting SPV technology. The Government of India and the USAID have initiated the Net Zero Emission Buildings (NZEB) program, under which one-third of all new buildings should comply with NZEB norms by 2020, two-third by 2025 and all new ones by 2030[18].

[17] Ministry of Power, GoI, Super Efficient Equipment and Appliance Deployment.
[18] Bilateral Project Agreement was signed between the Government of India (GOI) and the United States in January 2000 , Energy Conservation and Commercial Programme, Net Zero Emission Building, Roundtable on Technologies for NZEB 25 May 2011

Transport sector

The transport sector is projected to grow robustly over coming decades. Unless there is a major shift in the current patterns of energy use, projections indicate a continued growth in usage in the global transport sector at 2% per year. According to IPCC (2007), energy usage and CO2 emissions are forecasted to grow by 80% over 2002 levels by 2030. The transport industry is the fastest growing source of GHG emissions. Urban areas are expected to continue being responsible for the highest proportion of GHG emissions. Furthermore, in addition to increasing GHG emissions, motorization of transport using fossil fuels has created congestion and air pollution in large cities around the world. Pursuit of low-carbon and resource-efficient technologies to reduce fossil fuel usage in transportation is one of the most intensive areas of investment, research and development in cleantech today.

Mitigation-related decisions in the transport sector are complex and characterized by peculiarities such as large and long-term investments, major infrastructural changes, dependence on a single fuel source, the involvement of a large number of stakeholders, the potential for large co-benefits and non-GHG factors playing a major role. Furthermore, the sector is unique as compared to other energy-consuming segments due to its reliance on a single fossil fuel — petroleum — and the immediate alternative of biofuel being a arguable option, with questionable net GHG reduction potential as well as multiple environmental risks such as loss of biodiversity, land degradation and conflict with food production.

The transport sector is the second-largest contributor of energy-related GHG emissions in India, and its share in national GHG emissions has increased from 6.4% to 7.5% between 1994 and 2007[19]. Out of the total emissions, 87% (123.55MT CO2e) is from road transport, 7% from civil aviation and 5% from the railways. Moreover, India imports around 80% of its petroleum requirements, a significant part of which is used for transport. The quantity of oil imported, the unit cost of oil and the share of transport fuels (petrol, diesel and aviation turbine fuel) in the petroleum basket are all steadily increasing. Given the likelihood of an oil-constrained future, there is a real need to reduce the transport sector's dependence on petroleum to increase India's energy security and decrease its carbon footprint.

Overview of India's policies for sustainable transportation

In the last decade, the Government has taken various measures, including implementation fuel-related regulations, upgrading of public transport systems, development of energy-efficient vehicles and alternate modes of transportation, etc., which have had a significant impact on reducing the sector's carbon footprint. Some of the major initiatives taken by the Government include its framing of the National Urban Transport Policy (NUTP) and stipulation of fuel-efficiency norms for automobiles.

National Urban Transport Policy

National Urban Transport Policy (NUTP), which was implemented in 2006, defines policies in the transport sector at the Centre. The policy aims caters to the transportation needs of India's rapidly growing urban population. The objectives of this policy are to promote clean technologies in transportation, alternative fuels, mass rapid transportation and traffic management systems, and non-motorized vehicles. The policy provides a regulatory and enforcement mechanism to enhance coordination among key agencies and enforce its implementation. The Government has also undertaken pilot projects to promote best practices under a sustainable transportation system under this initiative.

Fuel efficiency norms for automobiles in India

The Prime Minister's Office (PMO) has approved a new set of standards for the automobile industry and car manufacturers, to ensure that vehicles comply with mandated fuel-efficiency standards.

India is set to introduce new fuel-efficiency standards to force auto-manufacturing companies to produce cars that provide increased mileage. The standard, called "Corporate Average Fuel Economy (CAFE)" will give auto manufacturers time till 2015 to improve and raise the fuel efficiency of cars by around 18%, up from the

[19] National Communication on Climate Change, Government of India, 2007

average of 14.1km/liter of petrol to 17.3km/liter. Cars will have star labels (ranging from one to five), depending on their fuel efficiency. The CAFE standard is intended to ensure that the average annual fuel efficiency of a manufacturer's vehicles and is measured in terms of CO_2 emissions. The draft fuel-efficiency standard, based on CAFE, will mandate 135g/kmCO_2 emissions for the entire fleet of cars in 2015. In 2010, the average CO_2 emission was 165g/km.

Other initiatives

The National Policy on Biofuels emphasizes the importance of increased use of clean energy fuel, especially biofuels. The policy proposes mandatory blending of petrol and diesel with 20% biofuel by 2017. The policy aims to accelerate cultivation, production and use of biofuels as a substitute for petrol or diesel to run vehicles, and thereby, reduce GHG emissions caused by the use of carbon-intensive vehicle fuels.

Star labeling of cars defines their fuel-efficiency standards, based on their fuel consumption in liters/100km. It was formally proposed by the Bureau of Energy Efficiency (BEE), Ministry of Power, in a consultation paper in October 2011. A star rating (based on a five star scale, with five being the most efficient and one the least) would help in a comparison of the fuel efficiency of different car models within the same weight class.

The National Auto Fuel Policy, 2010, has introduced the Bharat Stage IV norms in 13 cities including the National Capital Region, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur, Agra, Solapur and Lucknow, while Bharat Stage III norms were implemented across the country.

Jawaharlal Nehru National Urban Renewal Mission: The Sub-Mission for Urban Infrastructure and Governance, administered by the Ministry of Urban Development, focuses on water supply and sanitation, solid waste management, road networks, urban transport and redevelopment of old city areas. The sub-mission implements reforms for enhanced planning and management of urban transport, e.g., the Comprehensive Mobility Plan (CMP), setting up of the Unified Mass Transit Authority (UMTA), the Dedicated Urban Transport Fund at state and city levels, the Transit Oriented Development Policy and the Parking Policy. In addition, it is responsible for setting up of city-specific Special Purpose Vehicles to manage public transport, Traffic Information and Management Control Centres, intelligent transport systems and integration of multi-modal systems, prioritization of buses at intersections, dedicated/demarcated lanes for buses, a nodal department for urban transport and a mechanism for periodic revision of public transport fares.

National Electric Mobility Mission Plan: Launched in 2013, the principal end objectives of the National Mission for Electric Mobility (NMEM) include national energy security, mitigation of the adverse impact of vehicles on the environment and growth of domestic manufacturing capabilities. The NEMMP 2020, the mission document of the NMEM, sets the vision, lays targets and provides joint government-industry vision to realize the huge potential for a full range of efficient and environmentally friendly electric vehicle (including hybrid) technologies by 2020. According to the projections of the mission document, the sale of six to seven million units of the full range of electric new vehicles, along with resultant liquid fuel savings of 2.2–2.5 million tonnes can be achieved in 2020. This will also result in reduction of vehicular and carbon di-oxide emissions by 1.3% to 1.5% in 2020, as compared to the current status quo scenario. NMEM is among the most significant interventions of the Government, which promises to transform the automotive paradigm of the future by reducing dependence on fossil fuels, increasing the energy efficiency of vehicles and providing the means to achieve the ultimate objective of clean transportation that is compatible with sustainable renewable energy generation. This intervention will also encourage the Indian automotive industry to move to new and clean technologies and builds its future competitive advantage around environmentally sustainable products, high-end technologies, innovation and knowledge.

Cleantech and water

The water sector is increasingly at the center of many industrial, geopolitical and social agendas. Water is a fundamental requirement for human life, but the quality and security of its supply is also fundamental to economic activity, including power generation, as well as in the mining and many industrial and consumer goods sectors.

In many developed markets, water-related issues center on purification of water and treatment of wastewater, and there is significant demand for advanced water infrastructure. In the emerging world, water-related issues are dominated by shortage of fresh water, its poor quality and the need for investments in infrastructure. Dry regions such as the Middle East, the Mediterranean and Australia are increasingly implementing new desalination or water-reclamation technologies to overcome water shortages. Other responses to water-related issues focus on technologies in the field of filtration, wastewater treatment and recycling, reuse and reclamation of water. In many countries, municipal water rates are often too low to justify investment in sophisticated water filtering, recycling or desalination technologies. The reason is often political, since policy-makers prefer to low water prices.

The water sector must respond to the supply-demand imbalance (created by the combined effect of demographic and climate change) through regulatory reforms to better protect water resources and encourage management of demand by investments in infrastructure to secure supply of drinking water and implement improved treatment of wastewater.

Outlook of the water market

China, the US, Mexico and India have the highest potential for water and wastewater-related services, with dissimilar drivers and demands in different business segments.

Indian scenario

The Central Water Commission of the Government of India indicates that the total annual utilizable water available in India is 1,123 billion cubic meters (bcm)[20]. The Standing Sub-Committee of the Ministry of Water Resources (MoWR) has indicated that the total demand for water in India is expected to cross 1400 bcm for drinking water and there is likely to be a 400% rise in the demand for water for industrial use[21]. At this point of time, demand has already outstripped supply and the country's continued growth is not sustainable without implementation of effective measures to cut down usage of water and augment its supply. According to the CPCB[22], in many parts of the country, water has high levels of organic and bacterial contaminants in surface water, and there are pollutants such as fluoride, nitrate, and arsenic in ground water. The main reasons for contamination of surface water include inadequate sewage treatment capacities in urban areas (resulting in untreated discharge) and that of ground water include increased application of fertilizers and pesticides in agriculturally intensive regions.

India's water policies

There have been two major policy responses from the Government to address the issues faced in the current water-consumption scenario and for effective management of the country's water resources. These include the following:

- National Water Policy (1987, 2002, 2012 – draft)
- National Water Mission (2009)

The National Water Policy (NWP) is the primary guiding framework for management of water resources in India and the National Water Mission (NWM) was formulated as one of the eight missions of India's National Action Plan on Climate Change (NAPCC). The NWM takes into account the provisions of the NWP and emphasizes on a framework for increasing the efficiency of water usage in the country by 20%, including the formation of a

[20] Water and Related Statistics, Central Water Commission ISO Data Bank, December 2010.
[21] Report of the Working Group on Water Resources for XI Five Year Plan, Ministry of Water Resources, Government of India.
[22] The Central Pollution Control Board

Bureau of Water Efficiency (BWE) on the lines of the Bureau of Energy Efficiency (BEE), to oversee achievement of this goal.

Challenges in the sector

- Lack of uniformity in distribution of surface water resources
- Ground water extraction versus recharge
- Non-utilizable water
- Lack of uniformity in Institutional frameworks and tariff structures governing the sector
- Increasing demand for water for industries
- Unreliable water supply networks

Table 4: Water Market - Key drivers and cleantech opportunities

Drivers	Characteristics	Opportunity
Energy costs	▶ Waste water treatment is energy-intensive (involving pumping, filtering, etc.). ▶ Waste water treatment facilities spend b/w 7% and 25% as operating costs on energy (excl. sludge mgmt. processes)	▶ Energy-efficient technologies
Water scarcity	▶ This is driven by the increasing population, middle-class lifestyles and industrial growth. ▶ Global warming increases the volatility of weather patterns and evaporation.	▶ Water conservation and reuse ▶ Off grid water systems
Sludge handling/ recovery of nutrients	▶ Sludge treatment and disposal account for up to 31% of the operating costs of waste water plants. ▶ Currently, only 60% of sludge is used in the US. ▶ There are limited landfill sites in Europe. ▶ Increased phosphorous and nitrogen in water bodies cause "eutrofication".	▶ Minimization of sludge ▶ Energy recovery from sludge – net energy yield despite energy required for drying ▶ Nutrient (phosphorous and nitrate)-recovery technologies
Ageing infrastructure	▶ Replacement of infrastructure is needed in mature markets. Around 25% to 35% of water infrastructure is older than 45 years. Between 30% and 60% of treated potable water is lost due to leakage. ▶ There is increased need for new infrastructure in emerging markets.	▶ Decentralized systems
Emerging contaminants	▶ These include endocrine, pharmaceutical and personal care compounds.	▶ Advanced oxidation technologies ▶ Improved water-testing applications

Corporate agenda

Environmental, natural resource and water-related issues are among the top 50 risks identified in the World Economic Forum's *Global Risks 2013* report. The energy landscape for corporate consumers is shifting and there are concerns regarding energy security, and rising and volatile energy prices. Moreover, the shift to a resource-efficient and low-carbon economy is creating new risks and opportunities that no business can afford to ignore. As a result, optimization of energy and resources is now high on the agenda of corporate management bodies as executives and directors seek to:

- Increase energy efficiency, improve predictability of energy prices and switch to low-carbon energy sources
- Improve energy security through access to a portfolio of alternative energy sources
- Enhance reputation and brand by meeting the sustainability expectations of customers, investors and other stakeholders
- Gain a competitive edge through innovative energy-efficient, low-carbon and low-resource footprint, products and processes
- Avoid long-term carbon- and environment-related penalties by complying with current and future regulatory requirements

Key business risks driving corporate energy optimization

The energy mix has become a strategic issue for corporations, since energy accounts for a significant share of operating costs. While reducing energy costs through energy-efficient measures is often the foremost objective of energy-related strategies, a number of other subsidiary goals are also driving strategies, e.g., energy security, carbon reduction and stability of prices. Compliance with regulations, together with reputational and brand-related aspects, also plays a part. Companies' self-generation of energy and integration of renewables into energy supply have been fixed at significant rates to enable them to meet these ends, and these practices are set to accelerate over the next five years. The main barriers to self-generation and use of renewables are mainly related to risk and financial returns, which indicates that adoption could be even faster with financing innovations and increasing cost-competitiveness of renewables. In summary, only those corporations that have comprehensive and diverse energy strategies will be able to create a competitive advantage in the new world of a more resource-efficient and low-carbon economy.

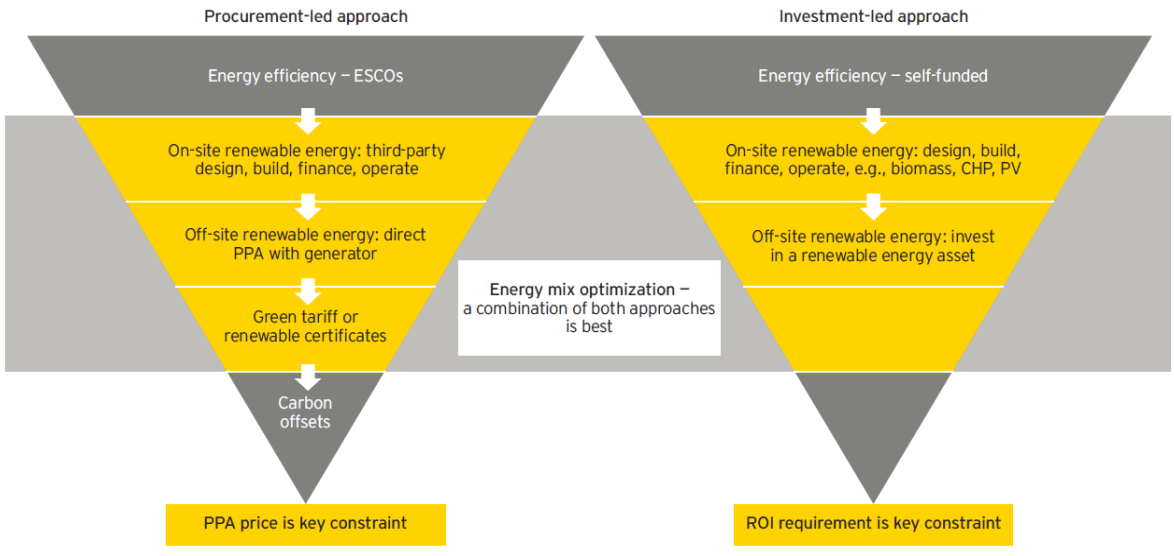
There are various benefits associated with optimization of energy mix:

- Operational security
- Return on investment
- Reduced carbon
- Decreased costs
- Diminished uncertainty
- Improved brand

Table 5: Key business risks and energy mix dimensions

Business Risks	Financial	Energy	Brand equity	Regulatory	Competitive
Dimension of energy mix	Fossil fuel-based energy prices increasing as global demographics and economic growth boost demand	Fukushima disaster in Japan and political turmoil in the Middle East highlighting energy-availability risks	Increasing consumer focus on sustainability	Long-term carbon penalties in major markets	New reality of resource-constrained, low-carbon economy changing the basis of competitive advantage
	Price fluctuations in traditional energy sources impacting the bottom line	Production in high-growth emerging markets facing energy quality- and reliability – related issues	Industry leadership defined outside traditional metrics	License-to-operate issues as governments focus on energy efficiency and environmental objectives	Operational efficiency becoming a key differentiat-or in the economic downturn
	Energy spend accounting for growing share of operational costs	Flexibility of energy-portfolio needed to ensure operational consistency	Inaction becoming untenable in light of smart energy developments and growing availability of renewables	Focus on credibility of renewable energy certificates as markets become more sophisticated	Cleantech adoption enabling long-term market leadership

Figure 20: Energy mix: implementation options



Conclusion

Cleantech has witnessed growing interest of technologists, business and government leaders, and investors in the last decade; which has in turn resulted in growing number of innovations, reduced prices and development of new financial and policies frameworks. Clean technologies can eliminate the problem of environmental pollution caused by non-renewable sources of energy; moreover it can also address the dire need of energy for all. These developments have ultimately led to an increased size of the clean-tech market.

Cleantech investment in India was US$6.9 billion for the year 2012 and was largely driven by sizeable energy demand-supply gap due to rapid industrial growth, population growth and urbanization, abundance of untapped renewable energy resources, environmental and social issues related to conventional sources of energy. This makes India as one of the most active player in the cleantech market. However this opportunity comes with its own set of challenges such as shortage of skilled manpower, easy adoption of new clean technologies, grid integration and high capital expenditure.

Present scenario of the country, demands greater utilization of available clean-tech resources along with scaling up of the present capacities. Pricing models have to be reworked to exhibit greater adoption of these new technologies at a large scale. Government policies, incentives, tax-credit schemes, subsidies, models around phasing out of conventional sources of energy and replacing them with the newer non-conventional ones are bound to play a large role under the given conditions.

For Government, there are clear take-aways in form of increased energy supply and creation of livelihoods; for businesses, there is a clear advantage to the first movers as they would enter an otherwise unchallenged market. However, many players in the industry are choosing to tread the path cautiously and are playing the waiting game.

Through the detailed analysis, it can be concluded that given India's diversity there is no "one size fits all" for its cleantech needs. Customized solutions can fit in like a jig-saw puzzle to create an energy sufficient India. This would include further development of cleaner and alternative sources of energy and an infrastructural framework to support the same. With a clearly defined destination of cleaner, affordable and sustainable sources of energy for all, the focus is now required to shift to ways to reach this objective.

About Federation of Indian Chambers of Commerce and Industry (FICCI)

FICCI, the apex industry organisation in India, is the leader in policy thinking and change and is in the vanguard of nation building. Established in 1927 and with a nationwide membership of over 1500 corporates and over 500 chambers of commerce and business associations, FICCI espouses the shared vision of Indian businesses and speaks directly and indirectly for over 2,50,000 business units. It has an expanding direct membership of enterprises drawn from large, medium, small and tiny segments of manufacturing, distributive trade and services. FICCI maintains the lead as the proactive business solution provider through research, interactions at the highest political level and global networking. It is constantly involved in bringing about integration of the Indian economy with the global mainstream. FICCI facilitates business-to-business linkages, promotes trade and investment linkages, creates awareness on key issues for the economy, provides inputs for policymaking, acts as a conduit for government-industry exchange and promotes bilateral ties.

FICCI's Expert Committees and Task Forces, headed by leading Industrialists, regularly meet to discuss the current issues. Joint Business Councils (JBCs), FICCI's track two business diplomacy with India's trading partners, open up new business opportunities to Indian businessmen with overseas investors, technology suppliers, multilateral and bilateral funding agencies.

FICCI's Committees and Task Forces on Environment, Climate Change and Renewable Energy serve as platforms for policy deliberations and interface with the government on key policy and regulatory developments. FICCI is actively involved in creating awareness, outreach, capacity building, business linkages, international partnerships, thought leadership, and policy change on key environmental issues, climate change and carbon market, corporate sustainability, and alternate energy sources in the solar, wind and bio-energy spaces. The Climate Change Task Force serves as the voice of Indian industry on domestic and international policy and regulatory issues pertaining to climate change and carbon market. FICCI has been promoting Indian business interests in the global carbon market. FICCI is also an accredited observer organization under the United Nations Framework Convention on Climate Change (UNFCCC). On environmental issues, the FICCI Environment Committee represented by 28 industry members has actively engaged with the government on policy issues pertaining to environment & forest clearances, waste management, biodiversity, and electronic waste regulations. The FICCI Solar Energy Task Force was launched in February 2010 to provide a platform for the solar energy sector to deliberate on policy and regulatory issues and advance interests of the sector at domestic and global platforms. The Task Force is represented by 32 members from the entire value chain of the solar industry including manufacturers, project developers, system integrators, EPC companies, raw material suppliers as well as the certification agencies. In July 2013, FICCI also launched the Wind Energy Task Force and the Bio-Energy Task Force comprising diverse industry members to extend its work in a focused manner in the renewable energy segment.

FICCI's Annual Flagship Events that provide the platforms for policy advocacy and business linkages in the above areas include:

- India Sustainability Conclave
- India Climate Policy and Business Conclave
- India International Cleantech Summit

For more details, please visit www.ficci.com

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EY's Climate Change and Sustainability Services

Sustainability strategy

EY understands the sustainability drivers of our clients' businesses while putting in place a strategy that is designed following a well-accepted methodology. The process of developing a sustainable strategy is founded on an understanding on internal "as is" situation through the assessment of baseline and compliance and external benchmarking.

Low carbon transformation (LCT) / energy strategy

Our services in LCT and energy strategy are geared to address all regulatory and compliance requirements to optimize energy costs, earn energy certificates (Ecerts) or renewable energy certificates (RECs). In light of these regulations there is a strong case for revisiting or developing an organization's energy strategy. Our carbon service offerings also include life cycle based carbon footprint for organizations, products and processes. We also offer services for green building and green factory that have several concomitant sustainability benefits beyond carbon and energy.

Water strategy

We assist clients in evaluation of the baselines scenario including regulatory requirements and existing socio-economic conditions, conducting water balance studies, identifying opportunities for reduction including technocommercial feasibility analysis, identification of barriers to implementation of strategic recommendations, and assurance of water footprint reports.

Waste management

We assist clients in creating waste inventories, conducting "as-is" analysis, developing waste management programs as per regulation in identifying recycler/technology provider and in reviewing downstream value chain for compliance. We also assist with Environmental Product declarations based on a standardized life cycle methodology based on ISO 14040 and ISO 14020 series.

Sustainability reporting

We assist organizations in reporting starting with policy development, strategy and institutional framework, gap analysis, identification of sustainability or CSR programs, development of SD/CSR and Business Responsibility (BR) Reporting roadmap and development of SD metrics. Once internal capacity is built and the report is independently prepared by the organization, we provide sustainability assurance services in line with ISAE 3000, AA1000 or other recognized assurance standards. We also assist organizations with their sustainability management systems such as ISO 14001, OHSAS 18001 and environmental and social management system for banks and financial institutions.

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