Energy Transition in India?

Exploring the German Energiewende

Take-aways from the Energiewende Roundtable Discussions held in Kolkata, Bangalore, Pune, Ahmedabad and Delhi in February/March 2014

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Project Director: Kartikeya V. Sarabhai
Project Co-ordinator: Rixa Schwarz
Authors: Rixa Schwarz, Reema Parikh
Design: Hardik Raval
Production: Shailesh Bhalani
Photograph: Katrin Enting

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Introduction

With its Energiewende ('energy transition'), Germany explores one of many possible pathways for a national low-carbon transition. Heinrich Boell Foundation Delhi and Centre for Environment Education India seek to introduce the Energiewende concept in India for a discussion on possible useful insights from the German approach for utilising the large renewable energy potential in India and enhancing energy efficiency.

While the German energy policy currently is amongst the most ambitious ones worldwide, the trend towards increased renewable energy use and enhanced energy efficiency is globally evident. China, for example, designs far-reaching low-carbon zones and South Africa tests innovative international funding structures in pilot projects for renewable energy support.

As India currently prepares its low-carbon strategy its main motivation lies in fostering utilization of renewables and promoting energy efficiency as energy security measures, which in this context is defined as national-wide access to reliable, affordable and environment-friendly energy. In order to meet this challenging objective, India has initiated on implementing national missions on solar, energy efficiency and is moving ahead with plans on sectoral missions for wind and biogas energy as well.

Experience sharing from the German energy policy toolkit and operation experience could provide insights and eventually assist India to successfully implement these missions and help the tropical subcontinent use its large renewables potential. India could apply conclusions from the Energiewende for leapfrogging the fossil-fuel systems by accelerating the renewable pathway.

This paper briefly introduces the Energiewende and the Indian energy landscape as well as it presents the result in terms of take-aways of five Roundtable Discussions held in Kolkata, Bangalore, Pune, Ahmedabad and Delhi in February and March 2014.

1. The German Energiewende

'Energiewende' ('energy transition') is the newest German term making its way into the English dictionary. Surprisingly even to Germans, this language phenomena explains the scale of international attention which the energy policy of Germany currently attracts. Observers frequently raise the question how Germany intends to fundamentally restructure its energy system by phasing-out fossil and nuclear power simultaneously and gradually shifting to renewable energies supported by enhanced energy efficiency.

For reasons like energy security, Germany decided to scale-up its renewable energy generation and phasing-out nuclear and fossil fuels (the latter due to the national climate targets). With this twin phase-out of nuclear and fossil energy, Germany tries to build the case of an industrialised country run on renewable energy. Due to the ambition to generate 80% of the electricity by renewables by 2050, the scope of the Energiewende goes far beyond the technological installation of solar and wind systems, and reaches onto investment and financing structures, public participation and sustainable development plans. The package of objectives for the fossil fuel phase-out and renewable phase-in, the according renewables and energy efficiency targets and respective policy instruments such as feed-in tariffs as well as the citizen involvement in the implementation process are commonly known as the Energiewende concept.

The concept Energiewende was firstly mentioned by the Institute for Applied Ecology in 1980, when the need for decoupling of economic growth and rising energy consumption was realised due to environmental impacts from energy generation as well as the risen oil prices. The Energiewende roots moreover in a decades-long anti-nuclear social movement in Germany. Renewables and energy savings are thus since decades seen as the best alternatives to polluting fossil fuels and unsafe nuclear energy generation.

As a first policy tool to foster renewable energy, feed-in tariffs (FIT) for renewables were introduced as early as in 1991, a year before the UN Summit in Rio. FIT guarantee sufficient compensation for renewable energy that is fed into the national grid. Finally in 2000,

the Renewable Energy Act (EEG) was formally introduced, which prioritises renewable energy in the national grid and triggered massive investment in renewable energies.

As a comprehensive energy policy concept, the term Energiewende was mainstreamed in 2011 when the German public after the nuclear disaster of Fukushima, Japan, raised its call for a final nuclear phase-out while sticking to the integrated energy and climate programme of 2008 with its climate protection objectives (basically starting a coal phase-out). Since then, the up-scaling of renewables and energy efficiency was given highest political attention.

This twin phase-out and the renewable phase-in imply complete restructuring of the energy sector with challenges for both technological innovation and policy creativity. Germany is under international observation even in regard to the social effects of temporarily rising (or so perceived) electricity costs due to the Energiewende, the development of the economic system and even lifestyle shifts. Will Germany lead the world along a pathway towards smart and modern renewable energy generation and use? Or will the industrialised economy fail to provide a renewable-run prosperity model? These questions are yet to be answered as the Energiewende is still under progress. Certainly, it offers inspiration already today.

However, decision makers in Germany are aware that a truly comprehensive shift towards a socially just, eco-friendly and economically wise society, the so-called Great Transformation, calls for more than an Energiewende alone. The energy transition must be accompanied by a transportation shift, an agriculture shift and a shift in buildings and infrastructure construction. Lifestyle and behaviour change like energy saving, more vegetarian diets or car pooling must be at the core of any of these transformations in order to meet not only efficiency but also saving requirements.

1.1. The Energiewende roadmap: From planning to implementation

Germany's reasons for the Energiewende range from energy security, climate change, stimulation of new technologies, and avoiding risks from nuclear power to strengthening local communities and citizens' self-interest. With this list of identified reasons for the Energiewende, the German concept builds upon four different groups of targets:

1. *Climate protection:* reduction of GHG emissions by 40% by 2020 compared to 1990 levels
2. *Nuclear phase-out:* 8 nuclear plants were closed in 2011 and the 9 remaining will be shut down gradually until 2022
3. *Renewable energy generation:* a share of 35% of electricity by 2020 and 80% by 2050
4. *Energy efficiency:* 20% primary energy efficiency improvements until 2020.

The Energiewende would not be of transformational nature with these targets alone. Their surfacing side effects largely contribute to further primarily social-economic shifts. Temporarily rising energy costs and their equity implications triggering protest against rising prices, the attached question mark to the existing prosperity model and discussions about alternatives and the adoption of new lifestyle patterns especially in urban areas, which might themselves require new urban infrastructure development, are only a few to mention. Keeping this in mind, the Energiewende becomes even more interesting to observe - not only for India.

Without doubt, the industrialised Germany origins from a very different energy (policy) background than India. As argued above, India's foremost priority in the current energy policy development is energy security in terms of national access to sustainable energy. The pure magnitude of this challenge should be reason enough to explore the German Energiewende concept. Even other of the above rationales apply to the Indian context as for example the reduction of energy imports or the creation of green jobs.

The attributes of the Energiewende characteristic for the German energy transition are mainly the chosen technologies, the policies designed for successfully implementing the Energiewende and the citizen participation.

Technical solutions and innovations

Most naturally, innovative technical solutions shape the core of the Energiewende attributes. Renewable energy systems, energy efficiency means, energy storage technology and grid improvements are the crucial fields for innovation.

Since the long-term target of 100% renewable energy supply becomes more feasible with a reduction in total demand, energy efficiency and

energy savings play a central role in the Energiewende. Thus, the mentioned target on energy efficiency was decided by the German parliament in 2011 for primary energy as 20% until 2020 and 50% by 2050, currently supported by the European Union target of 20% until 2020. It needs to be mentioned though that Germany so far has not achieved much on energy efficiency. The objective, nevertheless, is the same as in India and elsewhere: to produce more GDP with less energy.

As commonly associated with the concept, the key element of the Energiewende is less, respectively zero, electricity generation from fossil and nuclear and consequently the enormous up-scaling of renewable energy generation. The currently cheapest and for that reason main renewable energy sources in Germany are solar and wind power. By 2022, about 70 % of the renewable energy is expected to be generated from solar (photovoltaic, PV) and wind. Biomass is conflicting with food production and therefore not expected to be amongst the game changers of the energy system, even if its share may rise. The same is true for hydropower, as the geography of Germany limits its potential. Geothermal energy for heating purposes on the other hand still has potential to grow, but is unlikely to exceed the solar and wind sectors. Figure 1 explains the interplay of renewable and energy efficiency targets until 2050.

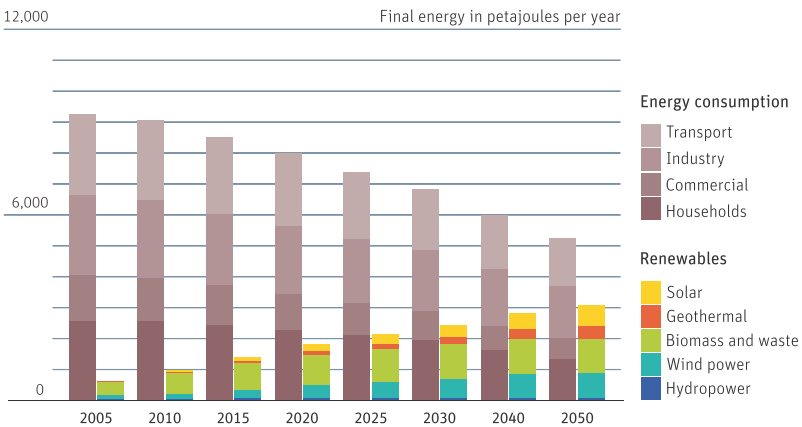

Figure 1: Scaling up renewables, lowering energy consumption, Source: HBF, 2012

The installed renewable capacity in Germany was 142.418 GWh in 2012 and during 2013, as much as 23.4% of Germany's electricity was produced from renewable sources. In 2015, renewables are expected

to produce electricity at a cost of 7-10 €ct/kWh in combination with gas turbines as backup technology. Thereby, renewables are in the same cost range as *new* gas and coal fired power plants and, most importantly to notice, cheaper than nuclear power plants (7-11 €ct/kWh) or even coal power plants with carbon capture and storage (CCS). Still, especially solar and wind have further high potential. Especially the heat generation by solar systems has so far been neglected in Germany and holds unexplored potential.

The main difference in renewable energy generation compared to fossil or nuclear energy regarding supply and demand management is the required flexibility, because solar and wind energy are not generated at any given time during the day or the year. In the transition phase the generation of renewables and fossil and nuclear energy must be coordinated. In fact, Germany is on the pathway from a fossil base load to a flexible back-up. Natural gas is the most flexible energy source and thus most sufficient for the back-up.

Additionally, transmission grids must be extended and transformed into smart grids. Demand-side management can ease these challenges by for example technology innovation of automatically run appliances at peak times of energy generation. An example would be washing machines that start operating when the electricity in the grid is most and therefore cheapest. Another unresolved issue for enhancing the flexibility of the future energy regime is the lack of storage technology. Effective storage of renewable energy generated at peak generation times must enable use at peak demand times. Pump storage currently is the most promising technology in this regard.

Policy Tools

A whole set of incorporative policy instruments have been introduced in Germany over the past years to implement the Energiewende objectives. The most prominent ones are the Renewable Energy Act of 2000 and tax schemes. These policies undergo steady revision with the coalition contract of 2013 between the Christian and Social Democrats being the most recent and perhaps most comprehensive policy adjustment.

Renewable Energy Act and Feed-In Tariffs

The German Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG) (2000) expanded the 1991 Electricity Feed-In Act and was designed to reduce renewables costs based on improved renewable

systems over time. The EEG became the most successful renewable policy tool (Figure 2) and inspired about 50 countries to implement similar policies, including India. It accelerated the trend of private investment in renewables via the feed-in tariff (FIT, guaranteed renewable tariff at fixed rate) and the priority given to renewables on the grid. In this way, the act ensured investment without burdening the citizens and triggered technical innovation.

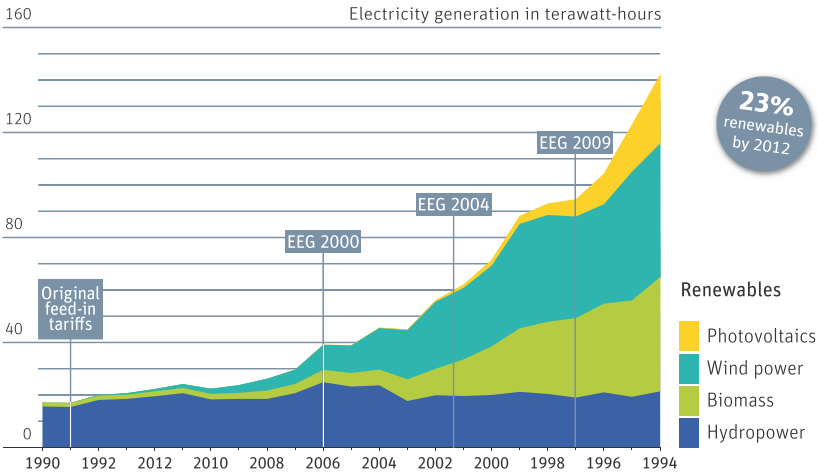

Figure 2: Feed-in tariffs stimulate renewable installation in Germany 1990-2011, Source: HBF, 2012

Environment taxation reform

Environmental taxation increases taxes on environmentally unfriendly activities such as fossil fuel consumption, especially on petroleum use which is taxed in Germany since 1951. The policy was very successfully implemented in Germany and has even created some 250,000 jobs even as it reduced fuel consumption and made German workers more competitive internationally.

Energy Conservation Ordinance (EnEV):

A policy act, introduced to foster energy savings from the housing sector, is the Energy Conservation Ordinance (EnEV). It acts on a basis of building standard structural requirements for efficient operation, required energy needs of the building or construction project. It applies to residential buildings, office buildings, and certain premises.

Other important tools are the Renewable Energy Heating Act and Market Incentive Program (MAP), the Cogeneration Act, the Act on Accelerating Grid Expansion, the Ecodesign/ErP Directive, the Efficiency Fund and Climate Initiative and the emissions trading (see HBF, 2012 for further information). These policies were supported by various other initiatives covering knowledge and awareness rising, building of competences and new networks of cooperation as well as the development of infrastructure.

The latest changes in Germany's energy policy were decided between the currently governing parties (Christian and Social Democrats) in agreeing on their coalition contract. Key elements of the revised Renewable Energy Sources Act are meant to keep the energy prices low, ensure energy security and develop the electricity market (BMWI, 2014). Additionally, the Energiewende was moved from the Ministry of Environment to the Ministry for Economic Affairs and Energy. The former Minister of Environment, Sigmar Gabriel (SPD), is now Minister of Economic Affairs in charge of the Energiewende.

Ownership and public inclusion and social backup

Public participation is clearly one of the main characteristics of the Energiewende. German citizens are involved by own investment and ownership of renewable systems and even grid infrastructure. Private individuals, often organised in rural communities, in 2010 held 51% of the installed renewable capacity; as much as 11% within this group are farmers. On the other hand, only 6.5 % of the installed renewable capacity was in the hands of the big four German energy suppliers. Private persons typically install solar systems on their rooftops while rural communities jointly invest in larger installations and farmers use their land for wind mills or solar plants as well as large stable roofs for photovoltaic systems. Energy cooperatives have grown in number from 101 in 2007 to more than 850 today and eco-villages go energy self-sustaining (HBF, 2012). The feed-in tariffs certainly have encouraged this trend and made the investors to 'prosumers' who produce and consume their own electricity.

In India, the Solar City programme aims at minimum 10% reduction in projected demand of conventional energy at the end of five years, through a combination of enhancing supply from renewable energy sources in the city and energy efficiency measures. **31 cities** which have received in-principle approvals and pilot cities like Gandhinagar,

Gujarat, and Chandigarh test public-private partnership models for introducing solar energy on rooftops, looking for inspiration from Germany in terms of solar and grid technology and the involvement of small and medium enterprises and private investment. So far the citizens only provide their rooftops for solar installations, but don't benefit financially from the solar energy generated on their roofs.

Status Quo / Barriers

On a positive note, experience shows that the renewable energy benefits outweigh the costs. Consequently, renewables are becoming more competitive. This trend is expected to continue due to the huge renewable potential that Germany still can explore given the experienced and expected innovation rate. Nevertheless, a first stocktaking of the Energiewende realisation process suggests that energy efficiency is an area where the Energiewende was least successful so far. Low-hanging fruits might have already been harvested before the Energiewende began, but policies with comparable power of impact as the FIT are clearly missing for the efficiency area. Crucial for the way forward are the challenges that Germany faces. Policies in the near future will have to address:

- avoiding the rise of electricity costs,
- technical improvement of grid infrastructure and storage technology in order to secure system reliability and thus supply,
- a market design to ensure: continuous investments in renewable, synchronising supply and demand, safeguarding system stability, driving flexible power generation,
- improved cooperation on the European energy market and grid structure as well as on European climate and energy policy
- mainstreaming demand-side management and fostering behaviour change up to introducing change in lifestyle.

The recent revision of the EEG seeks to tackle some of these challenges.

In summary, the German Energiewende still has a long way to go and its success is challenged in many ways. However, the decisions taken for maximising renewable energy use are proven right and already today the Energiewende has provided inspiration to other nations.

2. An Indian energy transition?

India's immense past and planned economic growth, mainly powered by the fossil energy sector, implies massive stress on amongst others the country's energy resources, its national household and public health. Moreover, today about 300 million people in India still lack energy access. Hence, energy security remains one of the top challenges to overcome for the Indian economy to grow inclusively and to foster development. Nationwide access to sustainable energy in the sense of reliable, affordable and eco-friendly electricity and clean cooking fuels evidently should be India's first priority in energy policy. Renewable sources are in most energy scenarios seen as a welcome add-on to meeting the demand, but need to be taken out of this niche as otherwise expected economic growth, increasing unsustainable consumption and fast urbanization as well as spread of energy access will substantially increase the total demand for electricity further. However, the energy supply-demand imbalance is expected to grow even larger as even a more sustainable low-carbon path would initially imply increasing energy demand in India. It was estimated according to the 12th FYP that on 31 March 2012 the peak deficit gap was 11.1 %. *In this context it is important to address energy challenge and deficit in electricity and strengthen role of renewable energies*.

As per International Energy Agency (IEA) 2011 India's projected electricity generation is between 3700 TWh to 6600 TWh in 2050 compared to its 912 TWh in 2013. In such a scenario, the technologies and fuel sources India adopts to add to its electricity generation capacity, may make significant impact to global resource usage and environmental issues. Further up-scaling of renewables for electricity generation thus is key to the Indian energy policy.

India's current electricity mix is mainly coal based (Figure 3). The relatively low quality of the Indian coal necessitates the import of high quality coal to meet the nation's demand. Import of coal has steadily increased from 20.93 MTs during 2000-01 to 102.85 MTs during 2011-12 (CSO 2013). According to the Twelfth Five Year Plan the import dependence will continue at a high level until 2017. Namely, import

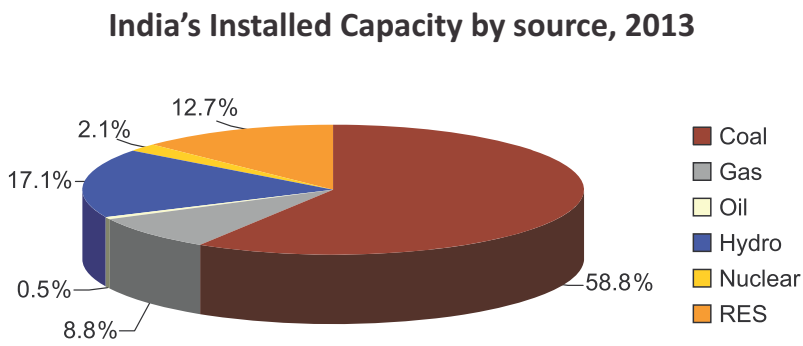

Figure 3: India's installed capacity by Source
Renewable Energy Sources (RES) include wind, solar, small hydro, waste and biogas.
Source: CEA (http://www.cea.nic.in/reports/monthly/executive_rep/nov13.pdf)

dependence for coal is also estimated to increase from 18.8% in 201112 to 22.4% by the end of the Twelfth Plan and 25.9 % by the end of the Thirteenth Plan. The main area of energy import will be non-electricity relevant crude oil, where nearly 78 % of the demand will have to be met from imports by the end of the Twelfth Plan. It is estimated that the import dependence for coal, LNG and crude oil taken together in 2017 is likely to remain at the Eleventh Plan level of 36%. However, this assumes that the projected domestic production levels of coal, petroleum and natural gas will be realised.

With the objective of meeting the demand, a capacity addition of 118,536 MW has been planned during the Twelfth Plan (2012-2017) out of which hydro is 9%, thermal is 61%, nuclear is 4.5% and renewable is 25.5%. The Twelfth Plan also gives the projected change in the mix of generation by fuel supply by the end of 2030. The share of renewables in electricity generated is expected to rise from around 6 % in 2012 to 9 % in 2017 and 16 % in 2030. However, the share of hydro electricity is expected to fall from 15 % in 2012 to 11 % in 2030. The share of nuclear power which is considered a “clean source” by the Government is expected to rise from 3 % in 2012 to 5 % in 2017 and to 12 % in 2030. Thus the Twelfth Plan expects the share of clean energy sources to rise from 23 % in 2012 to 39 % by 2030, however of that 12 % is nuclear which is highly debatable.

Table 1: Changing structure of electricity sources between 2012, 2017 and 2030

Source: 12th Five Year Plan, Planning Commission, Government of India

	Capacity (%)			Generation (%)		
	2012	2017	2030	2012	2017	2030
Coal	56	57	42	70	69	58
Oil	1	1	0	0	0	0
Gas	9	6	3	7	5	3
Hydro	20	15	13	14	12	11
Nuclear	2	4	9	3	5	12
Renewables	12	17	33	6	9	16

The Eleventh Plan had targeted creation of 78.7 GW of additional capacity for grid power out of which 54.9 GW was achieved which proves that ensured energy access remains a challenge. As mentioned before the planned capacity addition for the Twelfth Plan is 118.5 GW. The plan projections reflect increasing contribution of energy imports in total supply of primary commercial energy over 2001-02 to 2021-22; increasing from 20 % to 30 %.

From a long-term perspective and to balance emissions with growth as well as the need to diversify energy sources, limit energy imports, and provide access, the importance of renewables grows in India's energy sector. In regard to the common definition of renewable generation by wind or solar parks, there has been an extraordinary growth in recent years in the grid-connected renewable power generation in India especially since 2010. Starting with a very low base of renewables in 2000, the installed capacity of renewables has reached 30.52 GW in October 2013 of which 29.5 GW i.e. about 97% is grid connected. The drive of this development largely comes from the National Action Plan on Climate Change (NAPCC) of 2008 that promises to deliver 15% of the total electricity energy from renewable sources by 2020.

Although wind dominates the share of renewable presently, solar power is catching up at a fast rate as a result of the National Solar Mission target of 20 GW by 2020 compared to 3 GW in 2013. The National Solar Mission i.e., the 20,000 GW solar target, is applied

uniformly across all states without any differentiation in solar tariff across the states. The tariff as of February 2012 was 8.75 Rs/kWh for Solar PV and 11.90 Rs/kWh for Solar Thermal.

The share of new renewable energy in total commercial energy use at this juncture is around 12 % with conventional hydro-electricity accounting for another 17 %. As per the projections of the Twelfth Five Year Plan the share of new and renewable energy could go up to 16 % by 2030. With improved capacity utilisation, this may result in a higher share of clean energy in the overall energy basket. While these figures appear small, one should keep in mind the gigantic 'direct' use of renewable energy in India today, where sunlight is used to dry clothes and food items or as pure source of light. The distributed nature of renewables can provide much socio-economic benefit, especially when the 'direct' renewable use can be adopted in so-called modern or post-modern lifestyles thereby reducing dependence on electronic appliances and lighting. The current mechanism of accounting renewable energy use overlooks the traditional practice of 'direct' or 'natural' as it accounts only renewable use with technology use and in most cases also grid connectivity. Leapfrogging the fossil fuel pathway would imply to modernise this 'natural' renewables use and make it efficient and suitable to the modern lifestyles.

With a large land mass that receives one of the highest levels of solar irradiations and an extensive coastline and high window velocity in many areas, India has ample opportunities for establishment of land based renewable energy generation. Ernst &Young in 2013 estimates the potential of wind power and solar power in India at 103 GW and 6000 GW respectively. With the numerous waterways in the country the small hydropower potential is estimated to be 19.7 GW and biomass (including bagasse) has an estimated potential is 22.5 GW. India ranks ninth overall on Ernst & Young LLP's most recent renewable attractiveness index. According to the report, the macroeconomic outlook for India remains strong, however lack of enforcement of incentive regimes and oversupply is having a negative impact.

3. Conclusions from the Energiewende for India

Against this background, it becomes interesting for India to explore the still under progress Energiewende experience of Germany. Insights in existing and under-development technology options and in currently tested policy tools for increased reliable access would be useful for India's own energy policy efforts, the various missions on solar, wind, biomass and energy efficiency that resulted from India's Energy Conservation Act 2001, National Action Plan on Climate Change and the Integrated Energy policy 2008. Affordable energy initiatives for the national economy and the yearly national household budget plan in terms of e.g. reduced energy imports on one hand, and on the other hand financial mechanisms for affordable electricity for private households and industries are of enormous value for India. Additionally, technology for environmentally friendly energy generation at low cost or creating national markets for these technologies is in the interest of India. Involvement of stakeholders including small and medium size enterprises and citizens seems one of the immediate take-aways.

Further, experiences on the more far reaching implications for society and development of such a comprehensive transition in terms of rising cost implications, innovation needs in all involved sectors, required administrative systems, matching urban and rural infrastructure and lifestyle structures are useful for the future design of the Indian energy scheme and society development.

Possibly most importantly, India's trust in renewable energies and energy efficiency to power a larger share of the country should rise by observing the temperately climated Germany increasingly run on renewable energies. India should feel encouraged to explore possibilities to utilise its vast renewable potential. This insight might help India also to shape its vision for leapfrogging into a comprehensive low-carbon and access-for-all future.

Participants of the five Energiewende Roundtable Discussion identified the below lists of eight possible aspects worth exploring for India. The recommendations are:

1. **Recognizing India's enormous solar and wind potential and renewable energy as a serious source of energy for India** and rethinking the role renewables can play for India's energy security. Breaking the myth that only fossil fuels can power development and recognizing renewables not as a niche but the major role they can play in India's energy mix.
2. **Framing an ambitious long-term national vision** on different integrated renewable energy sources in different states. Gathering the relevant stakeholders behind that vision with the required political will generated for implementation of a clear roadmap with 2020/30/40/50 targets, regulations and implementation mechanisms. In so doing, shaping a leapfrogging strategy by identifying a sustainable energy mix for India, the most appropriate use of renewables in India's different geographical and urban vs. rural regions as well as the utilities and infrastructures of the future.
3. **Implementing policies for the entrepreneur route to renewable energy use with the means of promoting citizen involvement by financial incentives** to change the energy landscape of the country. Deciding a suitable, for the Indian circumstances redesigned FIT or other subsidy scheme like auctioning for investor planning security (including good governance) to create prosumers. As part of this, exploring the role of renewables in bringing the community closer and fostering newer innovations creating co-operatives, finding local solutions to local problems. Thereby, reducing costs of renewables such that it becomes viable without subsidies in the long run.
4. **Improving policy processes with regard to vertical planning processes** between local, regional and national level and improving cooperation between governments (national and local), businesses and NGOs during the planning and implementation period. For example, engaging the private sector with government for financial and infrastructure support. Enforcement of existing cooperation and policies supporting renewables.
5. **Identifying the right mix of grid connection, off-grid solutions and direct renewable use for India.** Enhancing technological capacity of grid and connectivity for improved access (and proximity to transmission and distribution networks for feeding in) to electricity where meaningful, as a renewable energy transition

is more feasible the more households are efficiently connected to the grid. At the same time fostering off-grid solutions for immediate energy supply. The required technology for these different options must be developed and/or made available. Most importantly, planning processes for infrastructure, mainly buildings, to allow direct use of renewables in order to avoid overconsumption of electricity. Innovating, developing and deploying technologies that addresses on-site storage and variability in production and supply thus providing quality power to the grid, will enhance offtake of the concept at prosumer level.

6. **Considering whole cycle assessment and whole price scheme providing holistic costs of energy generation** from nuclear, coal (including import costs) and renewable sources. In propagating the economic viability, the cost of environmental damage through conventional sources should be presented for true cost comparison as holistic costs need to be compared and subsidies designed for the transition towards renewables. Moreover, considering the social and environmental impacts of different energy generation technologies.
7. **Promoting green jobs** by creating a market and manufacturing in India and developing a plan to capture the job loss in the fossil fuel sector like coal mining sector as green jobs might be of different quality and require higher education. Development of courses for this required higher education will enable further employment generation and capacity building. One the means for this could be enforcing utilities and industries, especially manufacturers, by policy to invest in R&D for energy efficiency and renewable power.
8. **Extending the energy transition beyond electricity to the sectors of transportation, buildings and agriculture**. In order to make the energy transition part of a greater transition towards a socially just and eco-friendly economy more sectors than only electricity generation is required.

Other relevant needs for an Indian energy transition were mentioned in the Roundtable Discussions and are not less crucial:

- It was widely suggested that off-grid solutions should be considered/provided for a) providing access where it is difficult to extend the grid, and b) directly leapfrogging beyond the grid to

decentralized renewable energy solutions. Existing and future decentralised solution and mini/micro grids should be grid interactive and should be integrated with the national grid gradually over time.

- There is a very high need for awareness raising and training about renewables. A mechanism to access information regarding renewable to increase the understanding of consumers is required. State utilities could be mandated to have a certain percentage of demo project creation using renewable. As proper documentation of renewable energy projects across the country is not available at the moment, these demo projects and other successful examples should be well documented and shared for awareness raising and showing the true benefits of such projects. Clarity (contractual and otherwise) is essential in making renewable energy bankable for the community.
- Owing to large energy efficiency scope in India, accelerating and up scaling current demand side management efforts in terms of reduction in electricity transmission loss, reduction of energy demand by green buildings, reducing the need to cool / heat and making best use of direct solar and wind energy to reduce electricity use and associated life style change. Enhancing energy efficiency by integrating renewable should also be explored.
- The Government needs to establish credible renewable energy related planning and executing institutions that can create visions, translate them into targets and implement them. There should be a mechanism to increase the coordination/ connectivity between the government bodies at state level and Centre. At the same time, steps towards improving the financial conditions of utilities are also required.
- Land acquisition has been identified as a major barrier for renewable projects across India similarly to other conventional energy projects. With more renewable projects the competition for suitable land will become tougher and drives up capital cost. Faster land acquisition and clearances for renewable energy could be created as incentives by the government to promote such projects
- Scaling up of renewables in urban areas, beyond street lights through schemes like rooftop solar in solar rooftop pilot cities or other such schemes should be taken up by the (local) governments as a priority

- Germany has successfully proven that a country can have a steady upward growth along with declining emissions. This decoupling of economic growth and environmental impacts needs to be understood by Indian decision makers and economists.
- There is a need to increase technology development and innovation for renewables through enhanced R&D to back up policy decisions on energy transition

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CEE

Centre for Environment Education

Thaltej Tekra, Ahmedabad-380 054, Gujarat, INDIA
Phone : 91-79-26858002 to 09 Fax : 91-79-26858010
Website : **www.ceeindia.org**