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About The International Journal On Green Growth And Development

The International Journal on Green Growth and Development is an effort to stir a debate around emerging 'green' concepts and development. The publication aims at building knowledge through stakeholder engagement on policy-relevant issues to understand the many facets of green growth and development. It is a step towards a forward-looking knowledge process for new opportunities linked with growth and sustainable development. The journal showcases new research through peer reviewed articles, opinions, and innovative practices. The new journal builds on the previously published *Green Growth and Development Quarterly*.

The publication will cover the following topics:

- Sustainable energy
- Options in natural resource management
- International cooperation and development
- Climate change
- Best practices in innovation policy
- Public–private cooperation
- Financing
- Theoretical paradigms around green economy
- Resource efficiency
- Natural capital and ecosystem services
- Assessment and communication of green growth benefits
- Integrated strategies for poverty reduction and green development
- Green infrastructure
- Harmonizing economic, environmental, and social development policies
- Green innovation
- Water management
- Food–energy–water interlinkages
- Sustainable consumption and production
- Lifestyles

Editorial

We are pleased to introduce the Second Issue of *The International Journal on Green Growth and Development*. The journal is an effort to stir a debate around emerging 'green' concepts in context of sustainable development. A key aspect of this publication is the process followed. Through stakeholder engagement, the journal aims at building knowledge on policy-relevant issues to understand the many facets of green growth and development.

On the scholarly contributions, the current issue features an article on energy efficiency prospects in Bhutan and a commentary on growth in Africa. The two policy contributions are on the topic of green budgeting in the state of Punjab and green growth planning in Khyber Pakhtunkhwa Province of Pakistan. The knowledge showcase features the flagship annual report of REN21 which is the Renewables Global Status Report. The grassroots section showcases contributions on wildlife conservation and sustainable energy initiatives. The section on business sustainability narrates initiatives by Mahindra Sanyo Special Steel Private Limited in an energy intensive industrial unit. Finally, the book review includes a review of the '*Golden Rules for a Golden Age of Gas*' published by the International Energy Agency.

We hope that the journal facilitates in building a body of knowledge for practitioners and researchers by identifying innovative opportunities around growth and sustainable development. The hope is to engage with stakeholders across the globe for creating the nucleus for a debate on the subject by receiving ideas and experiences which would enrich the understanding of the multi-faceted concept of green growth.

We do hope you enjoy reading the contents of the current issue, and we would welcome comments and ideas which would help us improve on this modest effort in subsequent issues of the journal.

Editorial Team
The International Journal on Green Growth and Development

ARTICLE

Sustainable Energy in Bhutan: Opportunities for Energy Efficiency

SHERAB JAMTSHO[1]

Abstract: *In terms of Bhutan's energy trade, while the country exports clean energy, the country imports fossil fuels. On the demand side, transport and industry sectors are the major consumers of energy in Bhutan constituting together more than 80 per cent of the total energy consumed in the country. On a seasonal basis, power generation in the summer months is more than four times the winter generation, whereas the power demanded is the maximum during the winter. There is also a gradual increase in annual domestic power demand in the recent years, necessitating import of power from India during the lean season. The paper first presents the gaps in the energy situation of Bhutan and then identifies the energy efficiency saving potentials in the transport, industry, and buildings sector. The objective is to identify areas and suggests measures where energy savings can be achieved through regulatory, financial, and technical approaches.*

Introduction

Bhutan's climate is distinguished by warm and wet summers, and dry and cold winters. Most of the precipitation in Bhutan is received during the summer months. With no peaking power plants or reservoirs, power generation in Bhutan is mostly dependent on the seasonality of the river flow. Although Bhutan's electricity generation capacity is to the tune of 1,500 MW, the generation in winter drops down to as low as 300 MW due to low flow in all of the rivers (DGPC 2013). Winter is also the time during which most parts of Bhutan need more power for heating purposes. While the country boasts of tremendous hydropower potential and generation capacity, there is shortage of electricity in the winter months. This is a serious energy security concern for the country. As of now, most of the plans and programmes in the energy sector in Bhutan are aimed at increasing generation capacity, power banking, and importing energy from India (Kuensel 2013; Kuensel 2012).

The country is also facing a challenging situation of energy sufficiency in winter when the hydropower generation is at its minimum and the domestic energy demand is at its maximum. The irony of Bhutan's energy trade is that while Bhutan

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exports green energy, the country imports fossil fuels. This import of fossil fuel greatly impacts the net energy trade. Besides emitting Greenhouse Gas (GHG), the import of fossil fuel is one of the main causes of foreign reserve shortage. These fossil fuels pose a challenge to the carbon neutrality of Bhutan.

There are few alternative solutions to address the issue of seasonal energy. Energy Conservation (EC) and Energy Efficiency (EE) improvement are considered as cost-effective ways to enhance energy security, reduce the effect of climate change as well as ensure sustainable economic growth. Energy efficiency refers to reduction of energy consumption for the same service. EE uses energy more effectively by reducing wastage.

As part of the UN Secretary General's Initiative on 'Sustainable Energy for All', a rapid assessment and gap analysis had been carried out in 2012 and it stated that Bhutan was at an early stage of economic development and its energy intensity is likely to be closely linked to its GDP growth for the next several years. It also stated that the energy intensity of the Bhutanese economy was very high, roughly over 36,000 BTUs/$ of GDP[2], which was higher than the energy intensity in most Asian countries, and about four times that of the US and about seven times the energy intensity in Japan. This indicates that Bhutan is not efficient in terms of energy usage and need to significantly improve its EE.

This paper presents a holistic understanding of the energy situation in Bhutan focusing on the transport, industry, and buildings sectors. It highlights the need of energy efficiency to address the gaps and challenges in attaining energy sustainability and recommends ways to improve energy efficiency. The challenges faced by EE in Bhutan is based on the review of energy efficiency situation observed in Bhutan Energy Efficiency Baseline Study (BEEBS 2012), Energy Efficiency for Building Sector (PWC 2014) and Sustainable Energy for All (SE4All 2012) conducted for Bhutan. The paper draws on the authors' experience as a project manager for the BEEBS. The paper seeks to contribute to the growing body of green growth literature. It seeks to develop benchmarks for gauging and improving the current performance in energy efficiency for Bhutan.

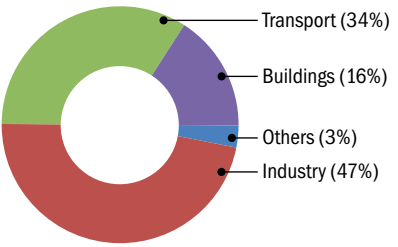
Information on the energy situation in the country was gathered from published reports, publications and websites; energy related data were obtained from the Bhutan Power Corporation (BPC), Druk Green Power Corporation (DGPC) and the Department of Hydropower and Power Systems. The data was then analyzed using statistical tools to provide relevant information on the energy situation of the country. Interviews were conducted with officials from Bhutan Power Corporation, the Department of Hydropower Systems, Bhutan National Bank and Bank of Bhutan. A small questionnaire based survey was also conducted.

[2] 1 Million BTU = $2.5219021687207 \times 10^{-8}$ MTOE

Energy Situation in Bhutan

The total energy consumed in Bhutan in 2011 according to the Bhutan Energy Efficiency Baseline Study was 326,687 metric tonnes of oil equivalent (MTOE), which was worth Nu. 9.57 billion (E&Y 2012). Out of the total energy consumption (Figure 1), industries accounted for 47 per cent, followed by the transportation and building sectors accounting for 34 per cent and 16 per cent, respectively. Agriculture accounted for only 3 per cent.

Figure 1: Sector-wise total energy consumption



Source: Data from BEEBS (2012)

Figure 2 shows the bifurcation of energy consumption in Bhutan into two categories viz., electrical and thermal. Electrical energy is the energy produced from electricity generated by hydropower plants. Thermal energy is the energy produced by combustion of fuel. For example, the energy generated from fossil fuels such as Liquefied Petroleum Gas (LPG), petrol, diesel, and fuel wood requires combustion to generate the energy required for different services.

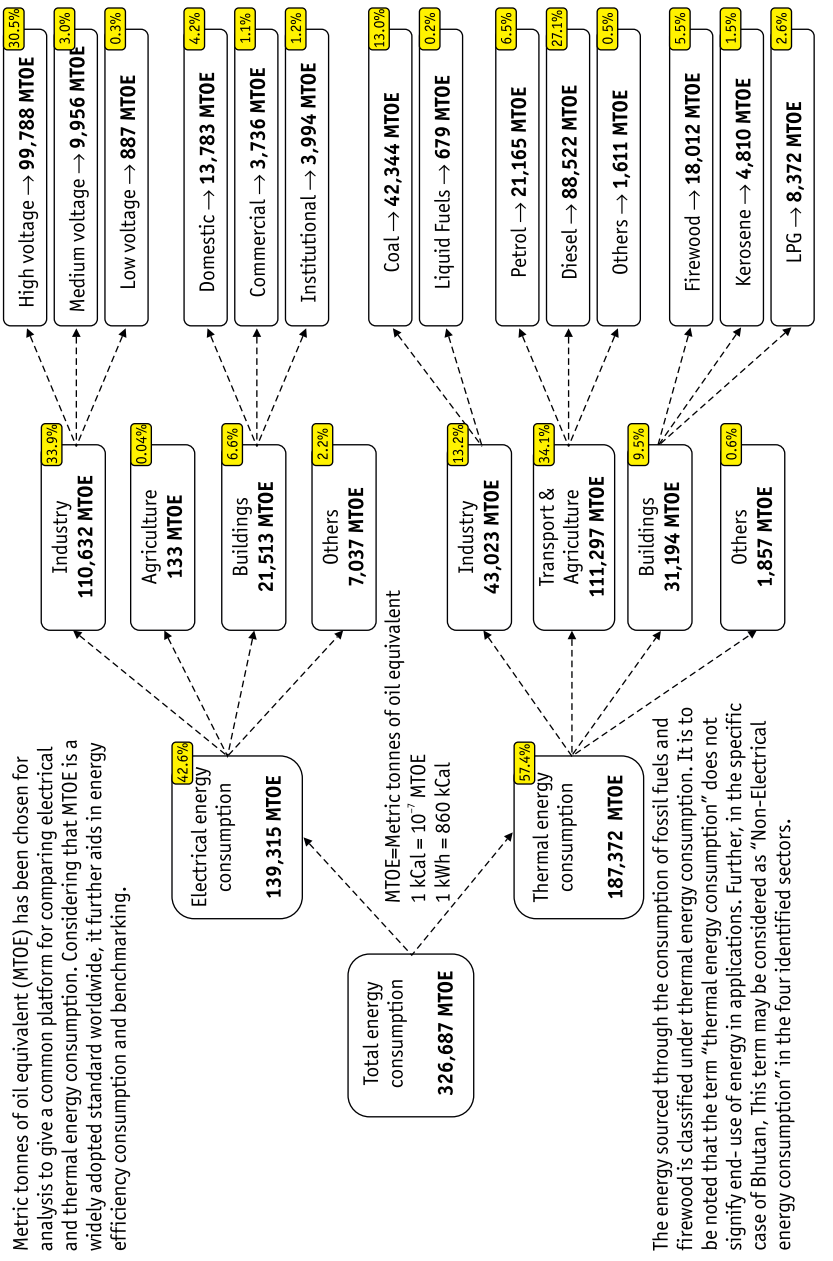
Thermal energy comprises 57.4 per cent of the total energy consumption whereas the electrical energy comprises 42.6 per cent. The transport sector is the major consumer of thermal energy comprising 34.1 per cent of the total energy consumed in the country. The industry sector is the main electricity consumer accounting for 33.9 per cent of the total energy consumed in the country. Together, the two sectors make 81 per cent of the total energy demand. According to the BEEBS, the consumption of fossil fuel in the agriculture sector has been observed to be not significant at the macro level.

Thermal Energy

In terms of thermal energy, 59 per cent of the thermal energy is consumed by the transport sector, followed by 23 per cent from the industry sector as depicted in Figure 3. Thermal energy emitted 651,315 tonnes of CO_2 equivalent greenhouse gases (GHG) out of which 51.6 per cent was from petrol and diesel consumption. In general terms, the total GHG emission is equivalent to adding 137,119 cars on the road.

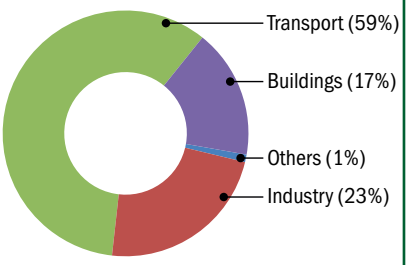
From an economic point of view, it is important to understand the cost implications. The maximum cost of energy comes from transport sector. Examining the data specified in BEEBS, it was observed that 52.4 per cent of the cost of energy came from transport sector (Figure 4). Within the transport sector, the diesel cost contributed the most with 37.2 per cent of the total cost of energy in the country.

Figure 2: Energy composition of Bhutan



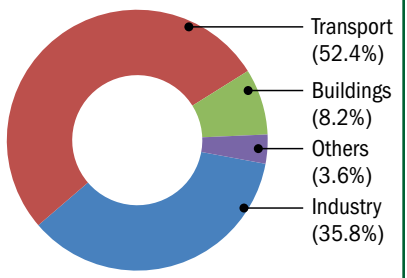
Source: Data from BEEBS (2012)

Figure 3: Sector-Wise thermal energy consumption



Source: Data from BEEBS (2012)

Figure 4: Cost-wise energy consumption in each sector



Source: Data from BEEBS (2012)

Considering the percentage share of different transport fuels consumed, diesel fuel is the largest consumer accounting for 79.5 per cent of the fuel consumed within the transport sector. The fuel is used to run diesel engines of heavy earthmover machineries, diesel generators operated by Bhutan Power Corporation and telecom offices and diesel vehicles (heavy, medium, and light vehicles).

In 2012, diesel consumption accounted for 59 per cent of the total oil import of Bhutan (Table 1) followed by petrol accounting for 21 per cent (NSB 2013). This tells us where we should focus if we are to go for efficiency in the transport sector because generally, more the consumption, the more is the saving potential. Although diesel is also consumed by Diesel Generator (DG) sets run by hydropower generating stations, telecommunications service providers, and institutions, such as hospitals are major consumers of diesel. A majority of this consumption in diesel is reported to be by passenger cars and earthmovers. For instance, Bhutan Telecom is reported to have 132 DG sets of 10–25 kVA across the country, but the diesel consumption was only 70 KL in 2012. There were 9,124 MW or 7299.2 kVA, 0.8 pf installed capacity of DG sets in the country (NSB 2013). However, these generators are mostly for emergency situations and some of them are as old as 50 years; it is not known as to how many of them are still functional.

Table 1: Bhutan's oil import in 2012

Petroleum products	Mn. Nu.	Kilolitre/MT	Cost percentage
Diesel	4,695.27	1,24,209.22	59%
Petrol	1,636.28	29,316.90	21%
Kerosene	73.86	5,567.01	1%
LPG	194.96	7,480.71	2%
Others	1,364.94	16,649.26	17%

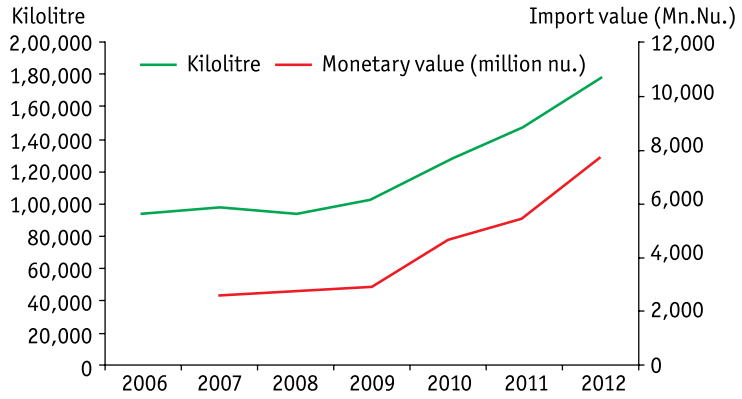
Source: Statistical Year Book of Bhutan (2012)

The Statistical Year Book of Bhutan (2012) states the existence of 1,842 earthmovers and 8,243 heavy vehicles in 2012 (NSB 2013). The diesel consumed by the excavators can be estimated assuming that an excavator operates for on an average two hours a day and consumes 11 litres of diesel in one hour, thus providing a figure of 14,791 KL diesel consumption in a year by 1,842 excavators. Similarly, if 8,243 heavy vehicles consumed 200 litres of diesel a month, all heavy vehicles would consume 19,783 KL a year. Therefore, earthmovers and heavy vehicles can make a significant impact on the consumption of diesel.

Over the years, the rate of import of petroleum products has been rising significantly. Figure 5 shows the overall trend of growth in oil consumption. It also tells us that more than the fluctuation of oil price; it is the consumption that is growing. In 2010, the oil import grew by 23 per cent compared to the year before and 16.5 per cent in the following year. The LPG consumption in 2011 was 7411MT, an 8 per cent increase from the previous year. The monetary value of petroleum products import was Nu. 7.88 billion in 2013.

It is also to be noted that the border towns of India refuel at gas stations inside Bhutan where the fuel is cheaper. Collection of how much fuel is actually consumed by Bhutanese cars will need another exercise since separate data was not maintained by the concerned agency. Therefore, the total consumption of fuel also includes consumption by neighbouring towns in India.

Figure 5: Growth in oil Import in Bhutan over the years



Source: Data from the Department of Trade, Ministry of Economic Affairs, Bhutan (2013)

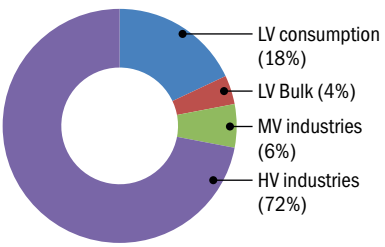
Electrical Energy

The electricity tariff approved by Bhutan Electricity Authority defines high voltage (HV) consumers as those that consume 66 kV and above, medium voltage consumers as those that consume a supply voltage of 6.6 kV, 11 kV and 33 kV, and LV consumers as those that consume below 6.6 kV, viz., 440 kV, and 230 kV.

The difference between an LV customer and an LV bulk customer is the contract demand according to the terms and conditions of supply of electricity to LV and LV bulk customers (BPC 2009). Those customers that fall under 100 kW to 300 kW are categorized as LV bulk customers, whereas those customers with contract demand lower than 100 kW are categorized as LV customers.

In 2013, the electricity consumed by industries accounted for 78 per cent of the domestic electricity in the country. Around 72 per cent was from about 16 high voltage industries including ongoing hydropower construction projects and 6 per cent was from MV industries (Figure 6).

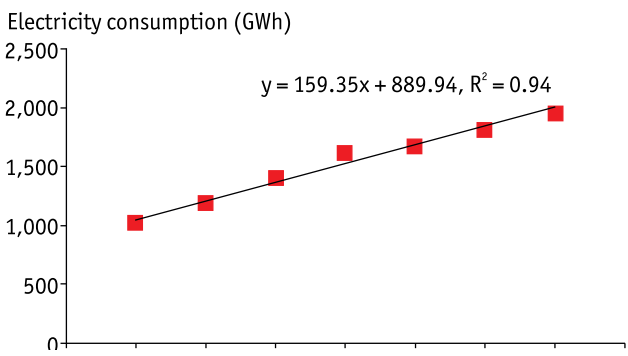
Figure 6: Electricity consumption of Bhutan in 2013



Source: Data from Annual Report, Bhutan Power Corporation (2013)

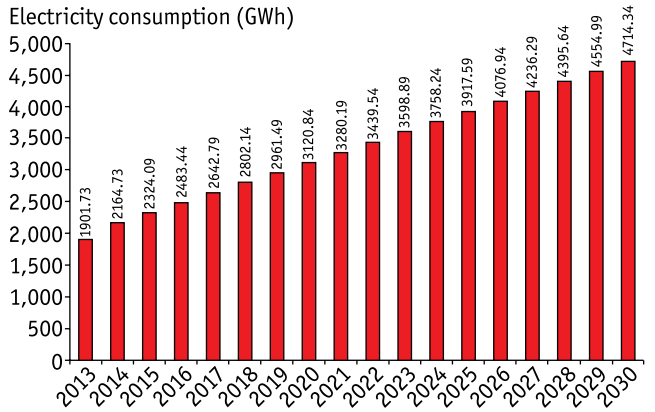
This makes it easier to obtain the maximum electricity saving in the industrial sector because the 16 HV industries consume almost three-quarters of the electricity. The overall trend of total electricity consumption in Bhutan has been growing constantly. In the same year, the country consumed 1901 GWh of electricity, which is equivalent to the annual generation of Chhukha Hydropower Plant (DGPC 2013).

Figure 7: Rise in electricity consumption in Bhutan over the years



Source: Data from Annual Report, Bhutan Power Corporation (2013)

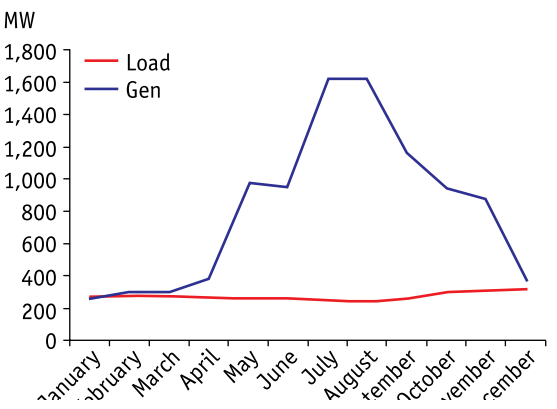
Figure 8: Projection of growth in electricity consumption in Bhutan (GWh)



Source: Data from Annual Report, Bhutan Power Corporation (2013)

At the same growth rate, we can project consumption 10–15 years down the line. (Figure 7) Looking at the projections of electricity consumption obtained using linear regression, it is observed in Figure 8 that Bhutan will consume 4714.34 GWh of electricity in 2030, which means that it will consume all the electricity generated from Tala Hydropower Plant (4913.63 GWh of electricity in 2013) (DGPC 2013).

Figure 9: Power demand in Bhutan - Generation Vs. Load in 2013 (MW)



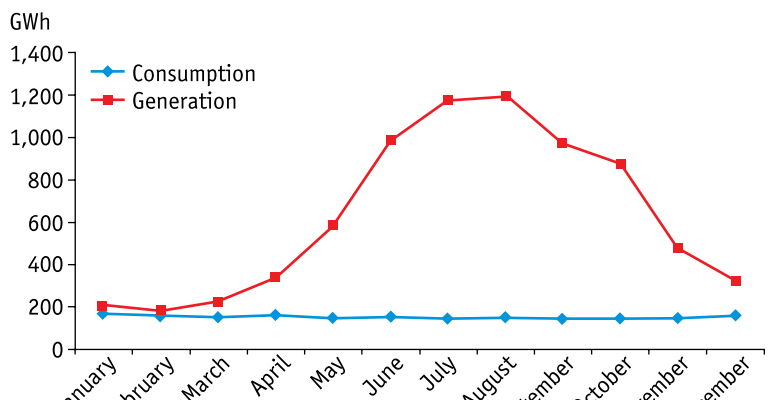
Source: Data from Annual Report, Bhutan Power Corporation (2013)

Looking at the generation side of electricity, the summer months are monsoon months. Bhutan receives a good amount of rainfall during this period but the winter months are dry with no rain. Therefore, the river in winter can generate only about one-sixth of the electricity generated in summer. In 2013, the highest generated capacity in the country was 1622.22 MW (NLDC 2013). The lowest generated capacity was 257.5 MW as recorded on

January 2013, and in the same month, the power demand was 271.26 MW, which is short of 13.76 MW of the supply. From Figure 9, it is clear that in January–March, the gap in power generation and power demand is very tight. However, during the summer month of August, the power demand was 242.64 MW. There could be some contribution of cooling load from southern Bhutan but it is clear that as high as 71 MW of load was added in January from the load of August.

On the actual energy generation, Figure 10 shows the generation vs. consumption pattern in 2013. The lean period of hydropower generation is from December to February. However, during these months, the domestic electricity demand in Bhutan is the highest. From Figure 10 we can see that generation and demand of electricity are touching each other in the winter months. It should be noted that the generation figures include electricity imports from India through hydropower plants and Bhutan Power Corporation. Bhutan imported 108.19 GWh of electrical energy from India out of 1,901.73 GWh consumed in Bhutan in 2013, which is an increase of almost 100 per cent in import compared to the import figures of 2012 (DGPC 2013). The electricity import accounted for 5.7 per cent of the total domestic energy consumed in that year.

Figure 10: Electricity Generation Vs Consumption in Bhutan in 2013 (GWh)

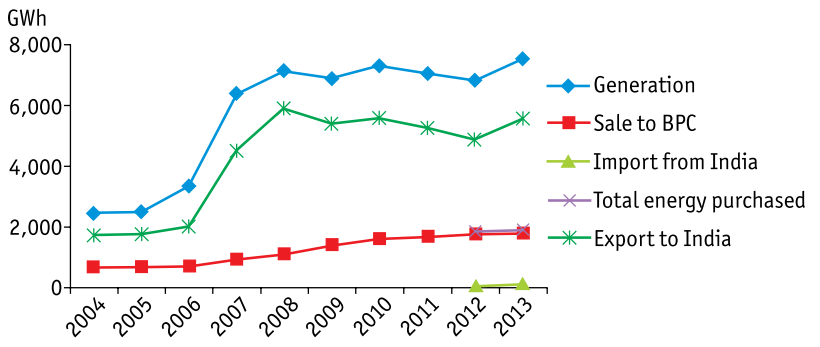


Source: Data from Annual Report, Bhutan Power Corporation (2013)

According to an official from National Load Dispatch Centre of Bhutan (NLDC), while there are system deficiencies or breakdowns that could cause imports for such instants, the peak energy demand mainly seems to have caused import of energy. Bhutan does not have an import agreement with any country as such. The reason is said to be because the import figures are still not very significant compared to what is exported and Bhutan is still a net exporter in a billing cycle. Nevertheless, it is clear that during the past few years, peak demand has exceeded the generation in winter.

Every time a new hydropower plant comes into existence, the electricity generation increases sharply. In 2006–07, when Tala Hydropower Plant was commissioned, the generation of electricity almost tripled (Figure 11).Thereafter, the generation has remained constant till today. However, the rising demand and economic activities has caught up with the firm power. As shown in the graph, in 2012 and 2013, Bhutan saw import of electricity to meet the demands for some hours. The figure shows the domestic consumption of electricity in Bhutan, excluding the electricity imported to meet the demand during the lean seasons; the quantity of electricity exported to India; the sum export and domestic consumption. The graph also depicts the total import of electricity to meet domestic consumption and the total domestic consumption including the imported electricity between 2012–13.

Figure 11: Electricity generation, sales, purchase, export, and import pattern in Bhutan

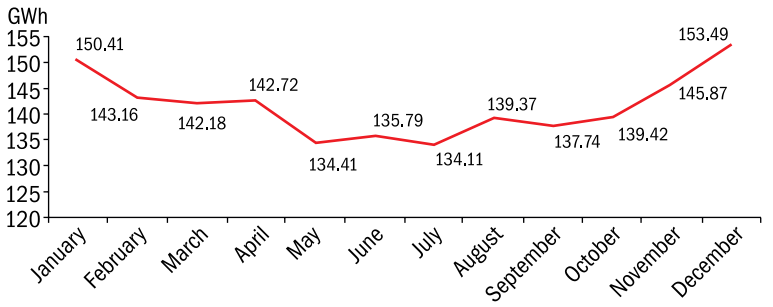


Source: Data from Annual Report, Bhutan Power Corporation (2013)

If we examine the electricity consumption closely and analyse the monthly consumptions, it is observed that the demand of electricity is lower in the summer months and higher during the winter. As depicted in Figure 12, the month of July has the lowest electricity demand and the month of January, the highest. Therefore, the preferred pattern of monthly energy generation is just the opposite, with higher generation during the winter months.

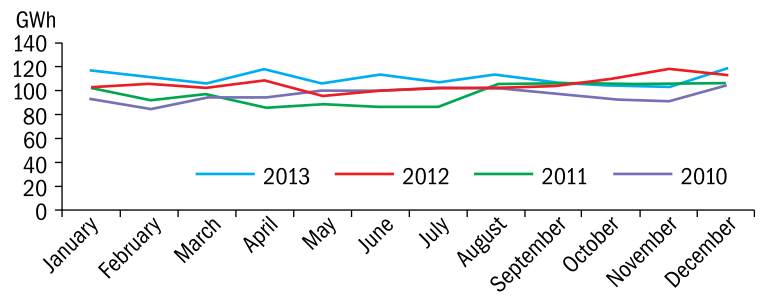
Further, to see what causes the higher consumption in winter months and lower consumption in summer months, different graphs were plotted for each consumer block. Figures 13 and 14 shows that the industrial consumption (HV and MV) as expected does not vary with seasons. It is constant over the years because energy consumption in industries does not seem to vary with change in ambient temperature.

Figure 12: Monthly domestic electricity consumption pattern in Bhutan – Average of three years (2010–13)



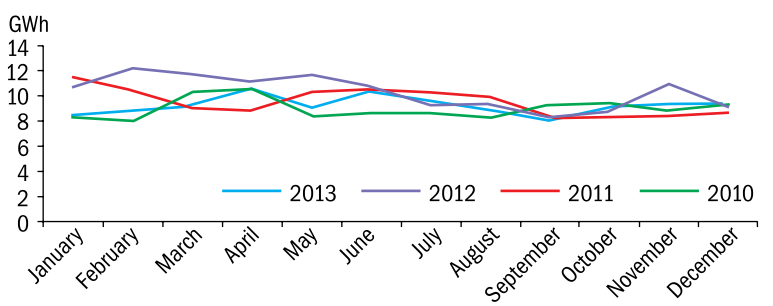
Source: Data from Annual Report, Bhutan Power Corporation (2013)

Figure 13: Monthly electricity consumption of high voltage industries in Bhutan



Source: Data from Annual Report, Bhutan Power Corporation (2013)

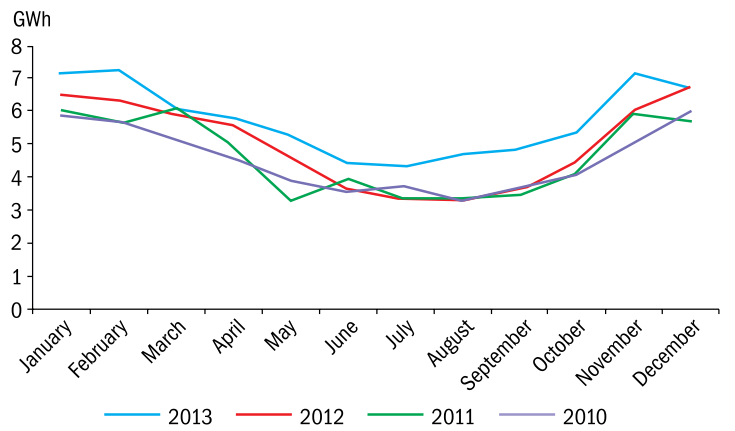
Figure 14: Monthly electricity consumption of medium voltage industries in Bhutan



Source: Data from Annual Report, Bhutan Power Corporation (2013)

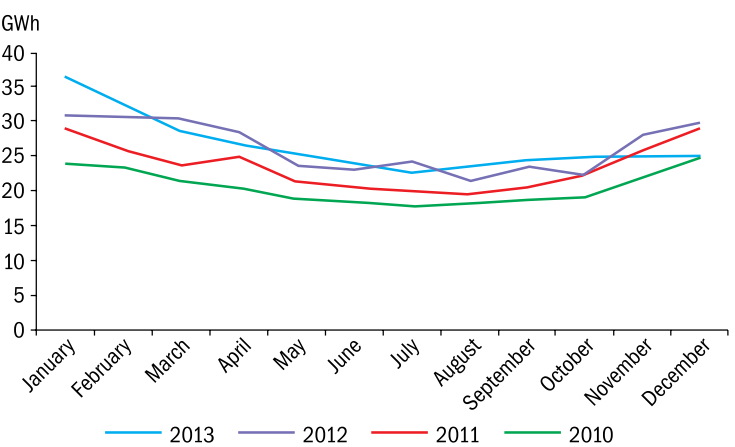
On the other hand, the consumption graphs, Figures 15 and 16 for LV bulk and LV consumers respectively, which comprise residential, commercial sectors, and institutions show high demand in winter months compared to the summer months to meet the requirement of room heating and water heating during the cold weather of winter. Therefore, the LV consumption pattern is skewed towards winter months. Together, the two blocks of consumers account for 22 per cent of the total consumption, which is a significant enough percentage to give a U shaped curve for the overall consumption of the country.

Figure 15: Monthly electricity consumption of low voltage bulk consumers in Bhutan



Source: Data from Annual Report, Bhutan Power Corporation (2013)

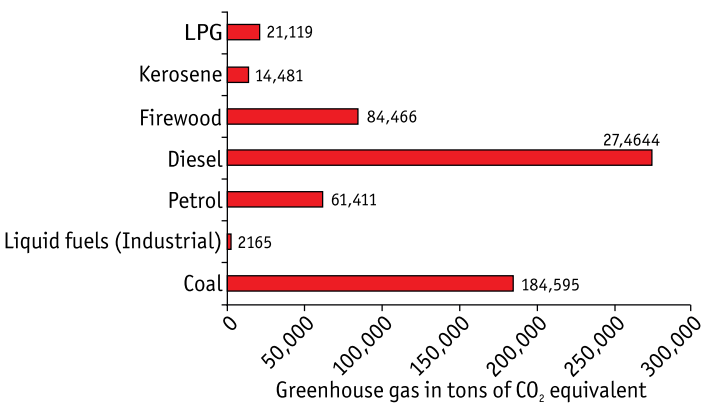
Figure 16: Monthly electricity consumption of low voltage consumers in Bhutan



Source: Data from Annual Report, Bhutan Power Corporation (2013)

On the GHG emissions side, understanding the impact of climate changes, such as glacial lake outbursts on small Himalayan nations, Bhutan has pledged to be carbon neutral for all times and a net sink of GHG. This declaration was made at the 15th session of the Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) held in Copenhagen in 2009. Today, Bhutan is a net carbon sink but with the growth of economy, Bhutan will face serious challenges to remain carbon sink or even carbon neutral. It will require a series of mitigation and adaptation actions including EE improvement in thermal energy. In 2011, the BEEBS observed 53.3 per cent of the total GHG emissions in the transport sector. Diesel consumption caused 42.2 per cent of the total emissions followed by coal in industries with 28.3 per cent. The bar chart in Figure 17 shows the GHG emission based on the fuel type.

Figure 17: Fuel type-wise GHG emissions from energy consumption in Bhutan (tons of CO_2 equivalent)



Source: Data from BEEBS (2012)

Energy Efficiency and Energy Conservation in Bhutan

The growth in Bhutan's energy consumption is causing immense pressure on the supply side (hydropower plants, forest, and imported fuels) especially during the winter season when the hydropower is at its minimum generation and the domestic energy demand is at its peak due to the cold weather. We have seen in the three mentioned stations that the amount of hydropower generated is dependent on the rainfall or snowfall in their hydrological basin. The power plants rely exclusively on the availability of water in the river, which is seasonal. This poses direct risk to the national energy sufficiency, in other words, to the energy security. We have also seen that Bhutan has already started to display insufficiency of generation to meet domestic demand for at least some hours in the winter months of 2012 and 2013.

Although addition of hydropower plants will come as a relief, the pace at which they are completed does not seem to be catching up with the rising demand.

Hydropower generation has strategic significance to Bhutan's economy. Hydropower is the single largest contributor to the national revenue with 15.3 per cent of the total revenue of the country in 2012–13 according to the *National Revenue Report 2013* (MoF 2014*)*. Whatever is left after domestic consumption is exported for revenue generation. Therefore, any energy saved through energy conservation has direct benefit to the country by adding to the quantity of energy sold.

Bhutan may be a net exporter of energy; however it exports green energy to earn revenue and imports a tremendous amount of fossil fuel for transportation, diesel generators and cooking needs. In 2012 alone, it imported Nu. 7.7 billion worth of petroleum products, while the vehicle inventory of the country rose at about 9 per cent annually before the ban of import on vehicles was imposed. The increasing import of petroleum products causes pressure on energy security and further, on the balance of trade. Moreover, the oil price volatility causes a big impact on the government's foreign currency reserve. The rising consumption of petroleum products also causes huge pressure on the country's pledge to remain carbon neutral.

Transport Sector Efficiency Potential

Bhutanese transport system has the potential to improve its mileage (E&Y 2012). According to BEEBS, a fuel saving potential of 5–29 per cent is possible (Table 2). Many SUVs are observed to be inefficient. They have a mileage of 9.2 km per litre (km/l) of fuel while 13 km/l efficiency was found to be obtainable. Petrol cars were observed to be most efficient for the reason that they gave 15–16 km/L mileages. Nevertheless, it has to be noted that mileages achieved in plain roads may not be achieved in hilly and winding roads of Bhutan. Besides, the pot-holes caused by stone quarries, road widening, snowfall, etc., which is quite commonly observed in Bhutan affect the transport mileages in Bhutan. Therefore improving road conditions or regular road maintenance has direct impact on the fuel consumption.

Table 2: Energy Efficiency Potential of Vehicles in Bhutan

Vehicle category	Energy efficiency level assessed (km/l)	Benchmark data for energy efficiency (km/l)	Estimated potential (per cent)
Truck	3.4	3.8	11%
SUV	9.2	13	29%
Petrol Car	13-14	15-16	7%
Diesel Bus	3.6	3.8	5%

Source: Data from BEEBS (2012)

Given the cost of energy in the transport sector (Figure 4), an energy saving of 5–29 per cent can contribute a reduction in Bhutan's import by Nu. 385 million to Nu. 2.31 billion annually. However, this will entail various investments and initiatives on energy conservation. EE in the transport sector has maximum benefits in reducing greenhouse gas emissions because transportation relies on fossil fuels. Moreover, EE in this sector will have a significant positive impact in the balance of trade because import of fossil fuels results in revenue outflow. Furthermore, most of the goods are imported in Bhutan. Therefore, a very significant cost of commodities in Bhutan is due to the added transportation cost. For example, a small survey conducted found that a 25 kg bag of rice costing Nu. 650 in Phuntsholing costs Nu. 700 in Thimphu. Transportation in this case has escalated the price by 7.7 per cent. Improving efficiency in this sector can minimize cost of transportation by reducing the cost of fuel and thereby reducing the cost added to the commodity to cover transportation cost.

Industrial Sector Efficiency Potential

The industrial sector which is the most energy intensive sector accounting for 47 per cent of the total consumption has a lot of energy savings potential. For example, the energy audits conducted in 2006 in three energy intensive industries, namely, Penden Cement Authority Ltd, Bhutan Carbides & Chemical Ltd, and Bhutan Ferro Alloys Ltd predicted a total annual energy saving worth of Nu. 5.04 million, Nu.13.4 million and Nu.0.4 million, respectively (TERI 2007). Moreover, Table 3 indicates as high as 30 per cent energy saving potential in most energy intensive industries. Bhutan consumed Nu. 9.6 billion worth of energy in 2011 and emitted 651,315 tonnes of CO_2 equivalent from its thermal energy consumption alone in the same year (E&Y 2012). The report also identified energy saving potential of 9–30 per cent in HV industries, which if converted into monetary value, is Nu. 308.3 million to Nu. 1,028 million annually. Bhutan Ferro Alloys Ltd, which had the largest energy saving potential, has a saving potential of Nu. 10.3 million annually.

If the objective is to save cost, energy price matters a lot but if the objective is to reduce GHG emissions, fuel type matters the most. The energies that cost higher have more benefits compared to the energies that cost lesser because energy saved has higher monetary value. Therefore, it is important to note that the cost savings obtained in Bhutan may not be as high as the cost savings obtained in other countries for the same energy saved. In terms of emission, green energy such as hydropower has less or no emission compared to the fossil fuel generated energies. However, in Bhutan's context, because India has high energy demand, hydropower energy saved in Bhutan can be absorbed by India and that avoids the use of thermal generated electricity in India.

Examples of EE Practices in the Cement Industry

As an example of energy saving in the industrial sector, Table 4 shows some of the energy saving measures in a cement plant. A simple recovering of waste heat

Table 3: Energy saving potential in key high voltage industries of Bhutan

Industry name	Main product	Installed capacity (MT)	Production (MT)	Specific energy consumption (kWh/T)	Average benchmark energy consumption (kWh/T)	Conservative potential energy efficiency improvement	Estimated potential per year (MWh)	Financial savings to the facility per year (MM BTN)	Financial savings to the country per year (MM BTN)
Druk Iron & Steel Pvt. Ltd	MS Ingot	61,200	23,746	851	534	30%	6,062	10.4	1.8
Bhutan Steel Industries Limited	MS Ingot	8,580	7,777	800			1,866	3.2	0.5
Bhutan Ferro Alloys Limited	Ferro Silicon (FeSi)	31,000	27,605	9,000 (72–74% Si,24–26% Fe)	8,166	9%	22,360	34.4	10.3
Bhutan Carbide & Chemicals Ltd (BCCL)	SiMn	NA	11,139	6,300	4,875	20%	14,035	21.6	6.5
	Calcium Carbide	22,000	24,486	3,800	3,000	20%	18,609	28.7	8.6
Penden Cement Authority Limited (PCA)	Cement	400,000	406,559 (cement)	131.33	80	35%	18,688	28.8	8.6
			261,405 (clinker)	1,053 (kcal / kg of clinker)	667 (kcal/kg of clinker)	35%			

Source: Data from BEEBS (2012)

for a 28 MTPA[3] of cement capacity saved 77, 396 MW or 77.396 GWh of energy and 70,796 tonnes of CO_2 equivalent annually.

Table 4: Examples of energy savings in a cement industry in Bhutan

Technology / measure	Description	Energy / fuel savings (per annum)	Emission reductions (tCO_2/ annum)
Fuel switch project (1.2 MTPA)	Partial substitution of Fossil fuel with alternative fuels like agricultural by-products, tyres and Municipal Solid Waste (MSW) in the manufacturing of Portland Cement	489,334 GJ 18,966 tonnes of coal	46,291
Energy efficiency improvement project (Plant Capacity: 4.2 MTPA)	Upgradation of pre-heater section from 5-stages to 6-stages resulting in a reduction in specific fuel consumption Upgradation of Clinker Cooler by redesigning and retrofitting the grate system with Omega Plate type system, resulting in an increase in the cooler recuperation efficiency	289,566 GJ 11,223 tonnes of coal	27,393
Fuel switch project (Production Capacity: 2.4 MTPA of Cement)	Partial replacement of fossil fuel by millet husk, soyabean husk, cotton sepal, mustard husk and saw dust (biomass) as an alternative fuel, for pyro-processing, which is the primary energy intensive process in cement manufacturing	1131,860 GJ 43,870 tonnes of coal	107,074
Waste heat recovery power project (Production Capacity: 2.8 MTPA of Cement)	Installation of 6 WHR boilers (one for preheater exit gases and one each for clinker cooler exit gas and DG exit gas) and one 13.2 MW steam turbine generator. Electricity generated by the project activity would displace an equivalent amount of electricity supplied by the grid	77,396 MWh	70,796

Source: Data from BEEBS (2012)

Buildings Sector Efficiency Potential

The buildings sector consists of residential, institutional, and commercial consumers. They fall in the LV and LV bulk electricity category. The consumption is mainly for heating, lighting, cooling, and appliances loads. Buildings energy usage varies with temperature and temperatures vary with elevation. Southern Bhutan has a cooling load during summer while Northern and Central Bhutan has substantial heating loads in winter. As observed, the consumption patterns of LV groups do not go hand-in-hand with the generation pattern. This has caused import of electricity from India during lean seasons. EE and conservation initiatives in

[3] Metric tonnes per annum

this sector can directly reduce the pressure on the firm power of hydropower and therefore, the need to import electricity. BEEBS discovered an energy saving potential of about 10 per cent annually. Residential houses have a consumption level of above 121 kWh/m^2/year. It can be observed from Figure 12 that power demand of as high as 71.3 MW was added in January 2014 on top of 242.64 during August 2014. The main cause of increasing load in winter is due to buildings loads (Table 5). Therefore, any intervention in the buildings sector can directly help reduce pressure on energy security.

As per BEEBS, Bhutan can achieve an energy performance index of 115.6 kWh/m^2/year in urban residences, which is a reduction of 6 kWh/m^2/year of energy. Given the huge number of buildings, the total savings in the buildings sector can be significant enough to reduce pressure on energy generation.

Table 5: Energy saving potential in the buildings sector in Bhutan

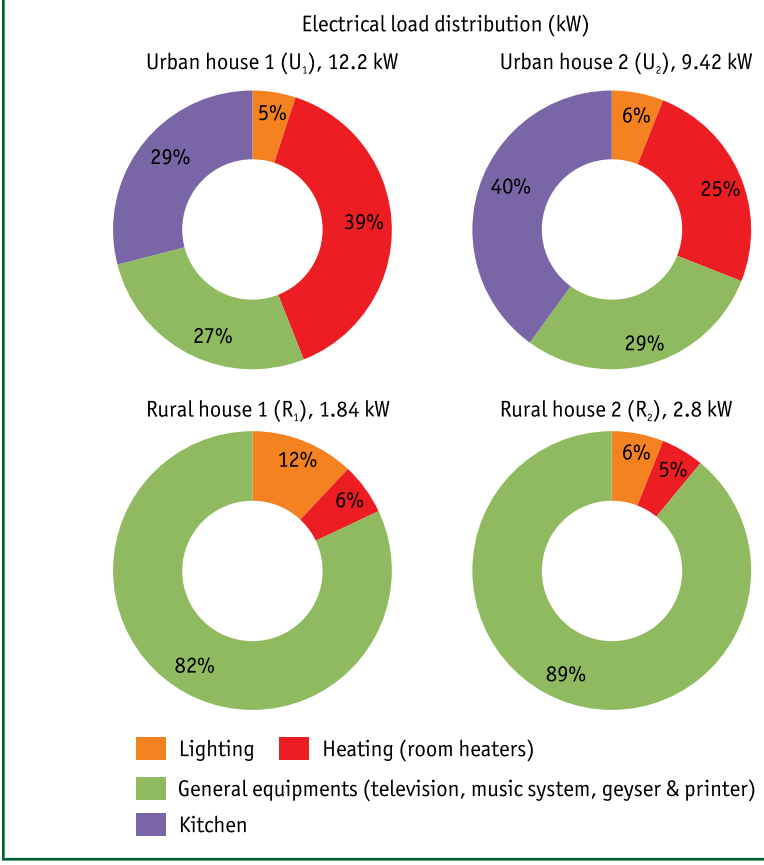
Consumer Name	Category	Specific energy consumption (kWh/m^2/year)	Average Benchmark energy consumption* (kWh/m^2/year)	Estimated potential per year (kWh)	Financial savings to the consumer per year (BTN)
Lhaki hotel	Commercial	391.2	360	30,427	61,509
Hotel Druk	Commercial	610.4	571	45,424	92,419
NHDCL	Residential - Urban	121.7	115.6	281	450
NHDCL	Residential - Urban	131.9	115.6	318	407
Director's house – Department of Labour, Phuentsholing	Residential - Urban	132.4	115.6	351	457
Kaila Guest House	Commercial	361	324	11,473	22,142
Yugarling Resort	Commercial	521.3	500	36,160	73,598
Village Household	Residential - Rural	5.1	1.9	438	373
Village Household	Residential - Rural	5.9	1.9	817	811
Hotel Druk Zom	Commercial	403.4	360	8,876	17,222

Note: The energy efficiency improvement potential mentioned is an indicative figure based on comparison of specific energy consumption with the best in comparable standards. A detailed energy audit is suggested to be conducted at representative buildings segment to ascertain the accurate energy efficiency potential available.

Source: Data from BEEBS (2012)

Figure 18 shows that heating energy is generally the highest form of energy consumed in residential houses or institutional setups in central and northern Bhutan. Although, it varies from urban consumers to rural consumers, generally heating load within a house in the central climatic zone ranges from 25 per cent to 40 per cent. Heating loads consists of geysers, electric water heaters, bukhari[4] and room heaters. The Energy Efficiency Study in the Buildings Sector observed that most of the heaters used in Bhutan have no energy labels and do not follow any standards (PWC 2014). Many heaters were found using about 25 per cent more energy than technical specification provided on their label. Further, the firewood used at homes were not properly dried thus reducing its efficiency because of the higher moisture content.

Figure 18: Random Samples of Household Energy Composition in Bumthang



Source: PWC (2013)

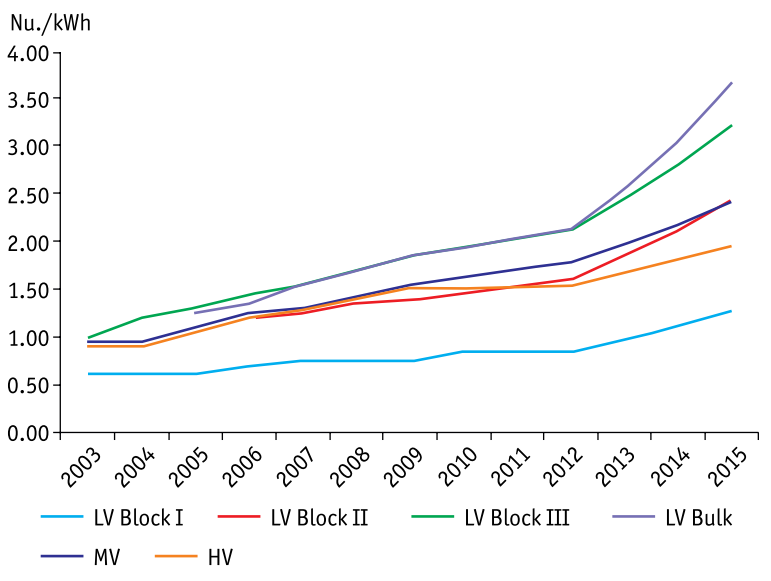
[4] Wood-fired room heating stoves

Figure 18 shows that most urban households use electric and kerosene heaters for space heating during winter months. However, in most rural households, fuel wood comprises 80 per cent to 90 per cent of the energy consumption to heat up rooms and for cooking. Understanding the importance, the Department of Renewable Energy is working on improving biomass stoves and disseminating efficient stoves across the country (UNDP 2014*)*.

End User Productivity/Competitiveness Enhancement

Electricity is one of the main advantages Bhutanese private sectors bank on for profitability and competition. Bhutanese manufacturers find it very difficult to compete with India and China because of their cheap labour cost and significant economy of scale. EE is an approach to enhance their productivity and long-term sustainability of their business. It reduces the energy bill for the same quantity and quality of production. Similarly, for owners of buildings such as hotels and institutions, high operating cost is a big concern because of the huge electricity bill. Reduction of heating load (cooking and room heating) or lighting load can help them cut down their energy cost. However, electricity tariffs in Bhutan have been rising over the years and have never shown a sign of remaining constant or reducing (Figure 19). Rising energy cost is of great concern for private entrepreneurs as evident from the appeal by industrialists to the government in the wake of rise in electricity tariff by 15 per cent in 2014 over 2013 (Kuensel 2014).

Figure 19: Electricity tariff in Bhutan (2003–15)



Source: Data from Department of Hydropower and Power System, Ministry of Economic Affairs, Bhutan (2014)

Challenges with Energy Efficiency in Bhutan

Bhutan faces technical, financial and regulatory challenges with regard to energy efficiency; these are listed below:

Technical

Limited or lack of sufficient knowledge of EE and conservation and the benefits can bring :

- Lack of sufficient technical capacity or experience at all levels, viz policymaking, financing institutes, and end users. There is insufficient capacity to identify, develop, implement and maintain EE investments.
- Lack of facilities for project preparations.
- Low cost of electricity impacts efficiency negatively because it results in long payback period.
- Lack of energy management priority.
- Lack of awareness of the market of EE materials, products or technology.

Financial

- Due to the high upfront costs and dispersed benefits associated with efficient technologies, it is difficult for interested owners to invest in the technologies.
- Lack of specific and clear financing mechanism to support EE investments.
- Lack of fiscal measures, such as tax holidays, incentives, subsidies, etc., to promote EE at policy level.
- Lack of sufficient knowledge of carrying out cost-benefit analysis at all levels.
- Limited market for energy efficient products and services.

Regulatory

- Lack of policies to promote EE.
- Absence of energy standards to ensure procurement of energy efficient products.
- Lack of dedicated formal institutional framework or regulatory body to monitor EE and assist private sectors and financing institutes to provide technical assistance for EE investment proposals.
- Lack of accreditation of service providers of energy auditing and energy managers to validate capacity of energy auditors and energy managers.
- Absence of recognition or reward for energy efficient end users through certificates or medals.
- High penetration of low efficiency appliances.
- Lack of Minimum Energy Performance (MEPs) and technology standards.

Towards Energy Efficiency: A Discussion

Legal Framework

Bhutan does not have any act or legislation that addresses energy efficiency, and given the low energy costs, end users can have little motivation to implement energy efficiency. The Royal Government of Bhutan (RGoB) recognizing the need to promote EE to enhance energy security had initiated studies like BEEBS and energy efficiency in buildings sector. Furthermore, the Alternative Renewable Energy Policy (AREP) states that a separate Energy Efficiency Policy shall be developed (DRE 2013).

India has a regulatory authority set up by the Government of India called Bureau of Energy Efficiency, whose sole responsibility is to enhance energy efficiency in India.[5] There is a need of a similar champion or legal regulatory body in Bhutan which is dedicated to enhance Energy Efficiency. The legal authority can monitor energy efficiencies and Minimum energy performance (MEP) standards and technologies. This institution can also manage the use of revolving funds and verify investments proposals to help them secure funds from banks and other sources.

Financial

On interviewing key financial institutions, such as Bank of Bhutan and Bhutan National Bank, it was understood that there is no capacity to assess energy efficiency financing proposals. Moreover, the current interest rate of loans (11 per cent or higher) provided by the commercial banks may not encourage end users adequately in investing in EE projects (BOB 2014). Therefore, low interest loans may be necessary.

Many countries have established revolving funds to stimulate private investment in energy efficiency. For example, the Government of Thailand has established the *ESCO Revolving Fund* with a budget of about USD 16 million[6] to encourage investments in renewable energy and EE. Such funds are also used to facilitate EE owners to sell certified carbon credits (CER) at the international markets thereby making EE an even more attractive investment. Bhutan has established a Renewable Energy Development Fund to promote renewable energy and energy efficiency (DRE 2013). However, the fund is yet to be launched. It can be utilized to promote energy efficiency.

Technical

For sector-specific energy consumption, we have seen that the industrial sector has maximum energy consumption. However, if we focus on saving cost, we have

[5] www.beeindia.in

[6] 500 million baht (@ 1 USD = 30 baht)

seen that the transport sector has the best opportunity to save money because it contributed to 52.4 per cent of the total energy cost of the country. Even from the environmental point of view, the transport sector has the maximum opportunity of reducing GHG emission. A 10 per cent improvement in efficiency in the transport sector can save Nu. 501 million and about 34,000 tonnes of CO_2 equivalent of GHG emission annually. This study finds the following EE intervention targets ranked on a priority basis in terms of cost:

- Diesel consuming sectors (SUVs, earthmovers, heavy vehicles, buses).
- Sixteen high voltage industries.
- Petrol consuming sectors (light and medium vehicles).
- Medium voltage industries.
- Commercial buildings (hotels, institutes, offices).

Some can argue that EE measures in the industrial sector would be the first choice because this sector's energy consumption is concentrated in certain locations whereas in the transport sector, energy consumption is scattered. Hence, it is easier to get concrete results in the industrial sector and therefore it would be best to pick low hanging fruits first.

Transport Sector

Following are some of the measures that can improve efficiency in the transport sector:

- Mass transport facilities for goods and people through electric trams and cable cars.
- Improvement of road conditions, such as road widening and regular maintaining of roads to minimize potholes and improve transportation mileage.
- Green tax for fossil fuels to make alternative fuel cost effective.
- Promote electric and hybrid cars and two wheelers.
- Facilitate charging stations for electric cars.
- Explore fuel substitution opportunities through alternatives like biofuel.
- Improvement of public transportation services to discourage individual cars.
- Efficient urban planning to reduce distance covered and traffic congestions.
- Investing in infrastructures, such as flyover bridges wherever feasible to minimise travel distances and traffic congestions.
- Incentives for fuel-efficient public transports such as buses and taxis and trucks.
- Dedicated bicycle lanes and pedestrian footpaths where feasible.
- Dedicated parking space for electric vehicles.

Industry

As observed, industries have the highest consumption and have maximum opportunities of saving energy. Initiatives to invest in industries will have the best returns and have significant impact at the macro-economic level. Even among the industries, HV industries have best opportunities.

Similar to the transport sector, some of the measures that can be taken up in industries are as follows:

- Advanced training programme for industrialists.
- Appointments of energy managers for HV industries to monitor and record energy consumptions.
- Setting benchmarks for energy consumptions for production of a certain number of unit of a goods and levy tax for those failing to comply with the benchmark.
- Periodic energy auditing through competent/recognized authorities and reporting for energy HV industries.
- Subsidies and tax exemptions for investments in efficient technologies.
- Introduction of co-financing mechanisms for green initiatives with the industrialists.

Buildings

The buildings or LV sector give the undesirable pattern of monthly electricity consumption vs. generation. When hydropower plants generate the minimum in winter, building sectors consume the maximum. Therefore, investing in this sector will directly help reduce the pressure on the generating stations and Bhutan Power Corporation during the lean season. Although more hydropower projects are under construction, which will add to the lean season generation, it is to be noted that hydropower constructions may not catch up with the rate at which peak demand is growing unless demand side management is done. The benefit of these sectors will be spread out to maximum consumers across the country because building sectors have maximum users. Some of the generic suggestive ways to improve efficiency in building sectors are as follows:

- Mandatory energy efficiency activities in public institutions because public institutions are major consumers in the buildings sector and it is easier to enforce such programmes in public institutions.
- Advanced level capacity building for engineers and architectures in both private and government sectors, on efficient building designs.
- Introduction of EE in the curriculum of technical institutes.
- Access to energy efficient building materials.
- Promotion of efficient building materials through subsidies and tax holidays.
- Acknowledgement of efficient buildings through green certificates.

- Introduction of energy standards and labelling for appliances or adoption of regional energy standards for appliances.
- Adoption of energy standards for heavy appliances and then making standards mandatory gradually for a few intensive appliances such as AC and room heaters.
- Appointment of energy managers in selected large establishments such as Dzongs, referral hospitals, colleges and 5 star hotels and mandatory periodical data maintaining.
- Develop building codes for voluntary adoption initially and mandatory adoption for new institutional constructions gradually.

Conclusion

Bhutan is still a net energy surplus country. But the situation gets worrisome during the lean season of hydropower generation. This calls for measures for efficient use of energy as the efficient use of energy has direct benefit to the economy, environment, and energy security of the country.

This study finds that among the sectors, the transport sector has the best opportunity when it comes to saving costs on energy and reducing GHG. However, the transport sector covers a large range of consumers and the consumers are scattered all over the country. The transport sector EE interventions varied from encouraging efficient cars and mass transport to improving road conditions to get better mileage and urban planning to reduce travel distance. Such interventions could save as high as Nu. 2.3 billion of the energy cost in fuels.

On the other hand, energy consumption in industries is mostly gathered in certain locations and therefore, it is simpler to make EE interventions. Millions of Ngultrums was observed to be savable annually from each HV industry. The building sector is similar to the transport sector in terms of being scattered in adopting energy efficiency; however the building sector has direct benefit to the maximum population. The study also presented that the consumption pattern in building is undesirable from the energy security point of view because its maximum consumption coincides with minimum generation by hydropower plants due to the heating requirements in winter. It was observed that the winter power load was 71.3 MW higher compared to that of summer load. Therefore, interventions in the building sector can directly help reduce pressure on Bhutan's firm power generation.

This study indicates figures of 5–29 per cent annual energy saving potentials and suggested approaches to move towards EE. However, it is to be noted that, like any projections, projecting the future scenario takes into account many assumptions such as, human behaviour and economic situations may be assumed to remain constant. One of the interesting topics in EE is the rebound effect. However this study does not take into consideration the rebound effect.

Although Bhutan is a net electricity exporter, its challenges are very unique. Most of the current solutions and arrangements from the government are more from the generation point of view (Kuensel 2012, 2013). It is deemed necessary that there should be more demand side management to cope with the issues. The demand side management initiatives should include policies, programmes, projects, financing mechanisms, and education on energy conservation and energy efficiency improvements.

Finally, without a strong participation from all the stakeholders, EE will remain a far-fetched dream. There is a need for strong adaptive capacity development to improve the understanding on the need of energy efficiency for all stakeholders according to BEEBS. To secure capacity, sector-specific trainings may need to be conducted. To inculcate the habit of energy conservation and efficiency in the general public, awareness campaigns through brochures, radio jingles, advertisements in local television channels, websites, and newspapers have to be initiated.

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COMMENTARY

Africa Rising: What does it Mean for African Citizens?

RUMBIDZAI FAITH MASAWI[1]

Abstract: *The past decade has seen African economies registering headline Gross Domestic Product growth rate. Will GDP growth lift Africa's bottom pyramid populace which is a majority of its citizens? Even more, will GDP growth effectively contain the risks imposed by climate change? The paper observes that too many of Africa's citizens remain ensnared in poverty despite the du jour GDP growth. African countries are also the most vulnerable to climate risk in terms of adaptation and disaster preparedness. The article argues that Africa's growth remains fleeting and fragile as long as the continent endures adverse assimilation in global trade, finance, and multilateral systems. Relatedly, possible revenue from Africa's vast natural resources is lost to various forms of tax evasion and corruption within the extractive industry. The status quo holds mainly because African ruling and managerial elites have partnered capital.*

Understanding the African Growth Conundrum

Africa is in the limelight. The continent has witnessed impressive Gross Domestic Product (GDP) growth rate in the past decade and the trend is anticipated to continue as evident in Figure 1. The year 2012 saw Angola, Niger and Sierra Leone overtaking China while Ghana, Mozambique and Zambia outpaced India in GDP growth (APP 2013). Resultantly, 27 African countries have attained middle income status and as many as 40 are projected to attain the same by 2025 (EYAS 2013). According to Ferreira (2014), Sub-Saharan Africa (SSA) was the world's third fastest growing region in 2013–14 with a stable GDP of 4.6 per cent per annum. Further, the GDP growth rate of SSA is projected to increase from 4.9 per cent to 5.5 per cent in 2014–15 (WEO 2014) with economic activity expanding by more than 5 per cent in each of the past three years (WEFS-WEO 2012). Even in the midst of the global recession, SSA's economy has remained robust with output growing on average at a rate of 5.1 per cent in 2012, 5.4 per cent in 2013 and 5.7 per cent in 2014 (WEFS-REO 2013). It is notable that RBSC (2012) ranks South Africa, Rwanda and Botswana ahead of the Czech Republic, Poland, Spain, and Turkey in ease of doing business while Nigeria is in league with India

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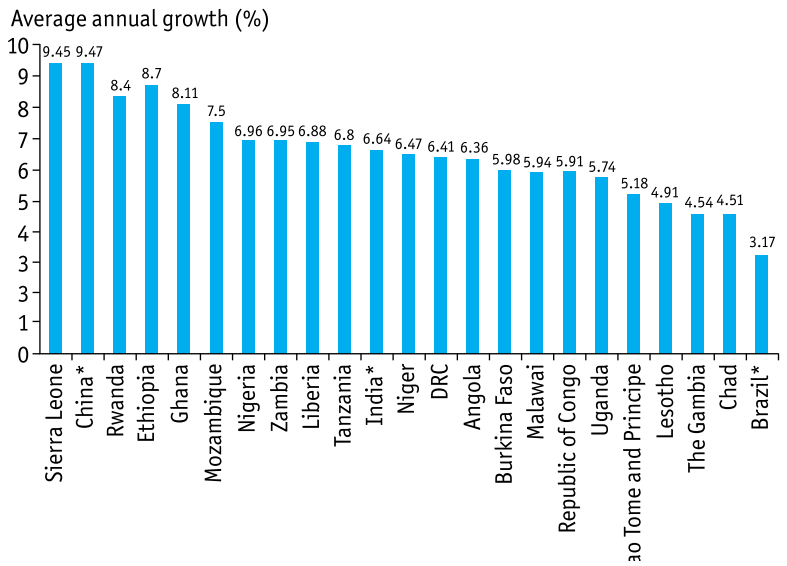
and Brazil. In sync, AEO (2013) projected growth by 4.8 per cent in 2013, to accelerate to 5.3 per cent in 2014. Evidently, Africa's economic performance is reaching a crescendo with daring statements that projects Africa as out-competing the developed world. According to RBSC (2012), "Kenyan banks saw profitability levels between 21 per cent and 38 per cent of return on equity levels that banks in Europe, US or Japan could only dream of." RBSC further notes that Sub-Saharan Africa has half of the world's 10 fastest growing countries, with economic output set to double and per capita income to grow by 50 per cent within the next 12 years.

Figure 1: Africa's 20 fastest-growing economies (Average Annual Growth 2008–13) and other major developing economies



Source: IMF (2014). World Economic Outlook database-http://www.imf.org/external/pubs/ft/weo/2014/01/weodata/index.aspx.

Media houses, private capital, emerging economies and multi-lateral finance institutions are projecting Africa as the future hub of foreign capital and investment. Pertinent questions, however, arise in the midst of Africa's growth story. What does GDP growth mean to the ordinary African citizen? Will GDP growth address the endemic lack in basic social services, infrastructure, and skilled workforce? Will GDP growth create productive employment and decent work for Africa's youthful population? This article argues that GDP growth rate is an insufficient measure of progress as long as growth benefits are not realized by Africa's poor.

The GDP growth is superficial as long as manufacturing remains Africa's most underdeveloped section with the continent providing just 1 per cent of the global

industrial output (RBSC 2012). Similarly, the GDP growth rate is flawed when African countries occupy the bottom places in terms of adaptation and disaster preparedness to climate change. Indeed, GDP growth rate remains futile as long as the continent's natural resource wealth does not translate into real development outcomes. Africa's natural resource-based economic growth is yet to translate into employment opportunities and poverty reduction despite the continent accounting for about 15 per cent of the world's oil reserves, 40 per cent of its gold, 80 per cent of its platinum metals and wide-ranging solid mineral base, 23 per cent of the total world land area, 7 per cent of forests and 4 per cent of inland water (AFDBG 2015). Similarly, in a foreword to the 12th Edition of the Africa Progress Report, Kofi Annan rightly poses a pertinent question, "Will we invest our natural resource revenue in people, generating jobs, and opportunities for millions in present and future generations? Or will we squander this opportunity, allowing jobless growth and inequality to take root?" According to Annan, Africa's decade of highly impressive growth has not brought comparable improvements in health, education and nutrition. In a similar vein, UNDP (2014) advised that 40 per cent of workers in Sub-Saharan Africa still live in households earning less than USD 1.25 per person and progress in countries, such as Ghana, Tanzania, and Zambia has been held back by disparities in human development linked to poverty, the rural–urban divide and other markers of disadvantage (APP 2013). Paradoxically, the 20 fastest growing economies in Africa occupy the bottom places in the Human Development index (HDI) (Table 1); this anomaly renders GDP growth an ineffective measure of progress and development for Africa.

Table 1: Africa's 20 fastest-growing economies very low on HDI rank

No.	Country	Rank
1	Sierra Leone	183
2	Rwanda	151
3	Ethiopia	173
4	Ghana	138
5	Mozambique	178
6	Nigeria	152
7	Zambia	141
8	Liberia	175
9	Tanzania	159
10	Niger	187
11	DRC	186
12	Angola	149
13	Burkina Faso	181
14	Malawi	174
15	Republic of Congo	140
16	Uganda	164
17	Sao Tome and Principe	142
18	Lesotho	162
19	The Gambia	172
20	Chad	184

Source: UNDP (2014)

It is also imperative to point out that any attempts to view Africa's current GDP growth through the same lens that we use for the developed world is misguided, taking into cognisance that developed countries have already attained the vital threshold in terms of human development and basic social service delivery. In contrast, in the middle of high GDP growth rate, many Africans remain trapped in poverty and are yet to benefit from the continent's headline growth. According to AEO (2013), there was slow progress in HDI, a widening income inequality, deteriorating education and health indicators in the midst of the African growth story. In agreement, APP (2014) revealed that three-quarters of African adults do not hold an account at a formal financial institution despite a decade of growth that saw African banks registering some of the world's highest profit margins, with returns on equity of 20 to 30 per cent.

Instead of investing in people as indicators of real economy, African banks prefer to build profits on a lucrative trade in treasury bills (APP 2014). As AP (2013) pointed out, even though projections for SSA remain strong, growth is vulnerable to sharp decline in commodity prices and progress on reducing poverty is hindered by high inequality. In the same vein, Arbache *et al*. (2008) observed that the blueprint for success in Sub-Saharan Africa is yet to be secured, and even though there is acceleration of growth, its sustainability is fragile. African Development Bank (AfDB) (2011) rightly warned that "unless the continent's leaders can find a way to promote inclusive growth, growth itself may become a source of instability." This is a crucial pointer; Africa's growth is insidious as it breeds stark inequality. The gap between the rich and poor widens, which partly explains cases of civil unrest in North Africa as well as terrorism in Nigeria.

Meanwhile, drivers of the African growth story orbit around and are overly dependent on rising commodity prices, increased investment in the extractive industry, improved macro-economic policy and diversification and expansion in the agriculture sector. This is evidenced by a slump in current growth with falling oil prices. AP (2015) brings this to light when he warns that Africa's growth will slow down in 2015 because of falling commodity prices and weakening terms of trade. *The Economist* also ascribes growth to huge pick-up in investment "as African governments work hard to make life better for investors." AEO (2013) mentioned expected agricultural expansion, healthy growth in services, rise in oil production and increased mining activities in resource-rich countries. APP (2013) on the other hand, explained Africa's growth in terms of underlying market conditions and majorly mining investments which increased more than four-fold between 2000 and 2010, reaching almost USD 80 billion annually, and the value of world metals production, rising at twice the rate of global GDP. Likewise, Baldauf (2012) attributed Africa's growth "to African natural resources being dug up, chopped down, or pumped out and sold to global consumers who still have cash, mainly China, India, Brazil, and Russia as well as a rising elite African middle class consumption."

In spite of the gaping evidence, there is still a recurring thought that Africa's rise is beyond commodity prices and increased investment in the extractive industry. On the same, Baldauf observed that a number of African countries have improved in terms of managing their own fiscal affairs. He picks out Kenya, South Africa, and Rwanda as having diversified their economies into technology and services, so that they are not so dependent on commodity prices for their economic future. According to APP (2014), Africa's growth has been helped not only by booming commodity prices but also by improvements in macro-economic policy. It is GDPN (2014) who gave a very clear picture when he argued that Africa's overhyped growth is fuelled by exploitation of oil and gas reserves, investment in the telecommunications industry, and infrastructural development with most profits going to investors, shareholders, and government officials. In sync, HDR (2014) justifiably described Africa's growth as fragile for it is anchored in commodity prices.

The African growth oxymoron is old. As early as 1970, the President of The World Bank, Robert McNamara, had acknowledged that the "attainment of high rates of growth of GNP in low-income countries left infant mortality high, life expectancy low, illiteracy widespread, unemployment endemic, and growing and the distribution of income and wealth severely skewed." In confirmation, BDI (2015) argued that even though economic growth, stimulated largely by oil revenues, dithered between 3.5 per cent and 8 per cent of GDP over the last decade in the Republic of the Congo, the country is ranked 140th out of 187 countries on HDI and around one in two Congolese continue to live below the poverty line. Similarly, South Africa has an unemployment rate of 40 per cent despite being the strongest economy within the Southern African Development Community (SADC). Likewise, 70 per cent of Angolan's population lives on USD 2 per day and one in four children die before their fifth birthday despite Angola having earned more than USD 30 billion in 2008 from its oil exports (Weinstein 2008).

What is the reason behind Africa's growth paradox? Africa's economic performance is concentrated in extractive and service sectors which are capital intensive and uses little labour, thus selectively delivering benefits to particular population groups and geographical areas, which in turn results in wide regional disparities. Further, poor infrastructure eliminates rural areas from benefitting from growth in the urban centres (AfDB 2011). Africa's robust growth continues to be ineffective in reducing poverty because growth is taking place elsewhere whilst most Africa's poor work in agriculture (Ferreira 2014). Its growth is fragile because real economic transformation is yet to be established. Africa's vulnerability lies in the fact that recent growth has been spurred by economic activity in climate sensitive sectors, including "agriculture and fisheries, sectors which are affected by rising temperatures, rising sea level, and erratic rainfall" (IPCC 2014).

The irony of the African growth story brings to light literature which has long questioned GDP as a unit of measure for a country's progress. The dissatisfaction

with GDP as a measure of growth and development continues. For instance, UN-GSDR (2014) reported that in 2012 alone, more than 40,000 authors published some 150,000 articles on sustainable development. Likewise, the United Nations Open Working Group on Sustainable Development Goals of the General Assembly established that people are at the centre of sustainable development. Consequently, the Open Working Group committed to strive for a world that is just, equitable and inclusive, as well as promote sustained and inclusive economic growth, social development and environmental protection (UN-OWG 2014). In addition, the 66th Session of the United Nations General Assembly (2012) endorsed the outcome document of the United Nations Conference on Sustainable Development titled 'The Future We Want.' The third common vision for the outcome document "is mainstreaming sustainable development at all levels, recognizing interlinkages and realizing all its dimensions"(UNCSD 2012).

GDP has been found defective in that it hides more than it reveals. It only measures market output without taking into account the economic costs of social and environmental impoverishment (Ian 2014). According to Shiva (2013), GDP "measures the conversion of nature into cash, and commons into commodities. Thus nature's amazing cycles of renewal of water and nutrients are defined into nonproduction. The peasants of the world, who provide 72 per cent of the food, do not produce; women who farm or do most of the housework do not fit this paradigm of growth either. A living forest does not contribute to growth, but when trees are cut down and sold as timber, we have growth. Healthy societies and communities do not contribute to growth, but disease creates growth through, for example, the sale of patented medicine. Water available as a commons shared freely and protected by all provides for all. However, it does not create growth. But when Coca-Cola sets up a plant, mines the water and fills plastic bottles with it, the economy grows. But this growth is based on creating poverty — both for nature and local communities."

Correspondingly, Costanza *et al*. (2014) explained how increased crime rates do not raise living standards but can lift GDP by raising expenditures on security. He cites the Deep-water Horizon oil spill in 2010 and Hurricane Sandy in 2012, where both events boosted US GDP because they stimulated rebuilding. In the same vein, The World Bank in "Where is the Wealth of Nations?" calculates that Gabon's citizens lost USD 2,241 each in 2000, as oil companies rapidly depleted the country's tangible wealth. Further calculations reveal losses in the following countries: the Republic of the Congo (–USD 727), Nigeria (–USD 210), Cameroon (–USD152), Mauritania (–USD 147) and Cote d'Ivoire (–USD 100) (WB 2005). Relatedly, a High Level Panel of Eminent Person's Forum (2014) on the post-2015 Development Agenda called for sustainable development to be the core within international community dialogue. Despite the call, countries are yet to integrate social, economic, and environmental dimensions of sustainability into a growth matrix. This has remained just an aspiration for the past 20 years leading to alarming levels of environmental degradation and climate change (HLPF 2014).

It is also a gaping aberration that Africa's headline GDP growth is silent on the impact of climate change on the continent.There is a rising body of evidence pointing to the uneven negative impact that climate change will have on the poorest countries who are ironically the least contributors to climate change (CCMDG 2012). Evidence shows that climate change has increased incidence of malaria in East Africa, driven changes in South African farmers, impacted production of wheat and maize in parts of Africa, lowered productivity of fisheries in the Great lakes and Lake Kariba as well as fruit bearing trees in the Sahel. As a result, Africa will grapple with food security, livelihoods, health, and wellbeing in the face of climate change for the remaining part of this century (IPCC 2014; ODI & CDKN 2014).

In the meantime, the first Africa Adaptation Gap Report (2013) commit Africa to adaptation costs of USD 7–15 billion per year by 2020 from past global emissions for which costs could rise to USD 50 billion per year by 2050 if the world does not move from the current path which is heading towards 4 ^{o}C of warming. Regardless of future emissions, the world is already committed to further warming mainly due to past emissions and inertia in the climate system (ODI & CDKN 2014). Moreover, AAGTR (2015) warns that a warming of 2 ^{o}C will put over 50 per cent of the African continent's population at risk of undernourishment "yet right now we are heading to 4 ^{o}C of warming". Even more, the climate change challenge surpasses the capacity of the continent to respond to anticipated damages and impacts through domestic resources even if "the base to rise additional funding is raised" (*ibid*.). Overall, adaptive capacity is low in Africa because of economic, demographic, health, education, infrastructure, governance, and natural factors (Vincent 2007, Ludi *et al*. 2012).

In a major complication, the climate change challenge comes when SSA still grapples with provision of basic services to its general population. Portable water, sanitation, shelter, electricity, education, jobs, and health facilities remain inaccessible to most African citizens. According to UNDP (2010), the nexus between climate change and the first Millennium Development Goal (MDG) establishes that climate change is inextricably linked to poverty and hunger for it threatens food security and livelihoods. Vulnerability is exacerbated by limited adaptation strategies especially amongst the poor (UNDP 2010). Meanwhile "climate change impacts are projected to slow down economic growth, make poverty reduction more difficult, further erode food security, and prolong existing and create new poverty traps"(IPCC 2014). Compounding Africa's problems is lack of skilled expertise and technologies to confront climate risk. According to Schaeffer *et al*. (2014), arrangements in addressing challenges of climate change fall short due to lack of scientific, technical, and technological capacity as well as funding and insurance schemes.

Africa's ill preparedness to climate risk is unnerving. The ND-GAIN index ranks 178 countries both by vulnerability and readiness to adapt to climate change. The index shows countries' level of preparedness to climate change induced risks.

The results (Table 2) reveal that the most vulnerable and least prepared countries are in Africa (ND-GAIN 2014).

Table 2: Africa's vulnerability and readiness to climate change

Rank	Country	Score	Rank	Country	Score
1	Norway	82.7	174	Democratic Republic of Congo	34.0
2	New Zealand	82.2	175	Central Africa Republic	33.9
3	Sweden	81.6	176	Eritrea	33.7
4	Finland	81.5	177	Burundi	33.7
5	Denmark	81.4	178	Chad	31.5

Source: ND-GAIN Index, Vulnerability and Readiness. Available at http://index.gain.org/ranking

The preceding discussion firmly establishes that Africa's headline growth is non-transformational. The majority of African citizens remain stuck in poverty as governments fail to deliver on basic services. This prods the questioning of GDP growth as a sufficient measure of Africa's progress. There is an urgent need for sustainable development as a holistic measure which recognizes society, economy and environment considering that Africa's growth mantra overlooks the threat posed by climate change for which the continent is most vulnerable. Much more needs to be done to reassure the general African public that waits to benefit from headline growth, which is yet to permeate to the bottom of the pyramid. The succeeding section delves into a deeper examination of why the continent is trapped in endemic lack despite growth potential and opportunities.

Explaining Superficial Growth

Dating back to colonialism, Africa has been structurally disadvantaged in the global economic system. This systemic inequality still endures. Human development reports after 25 years of international development intervention acknowledge "structural vulnerability" (HDR 2014) and use the same in their vocabulary. In view of that, AfDB (2013) recognized 'structural' lacunae in the fact that many African economies rely on raw materials with limited diversification of their productive structures. Similarly, Fioramonti (2013) fundamentally argued that Africa's economic outlook may look bright in GDP terms, but this conceals 'structural deficiencies' and deep imbalances.

Africa exports about USD 6 billion worth of coffee; value addition takes place only in foreign lands to be resold for USD 100 billion. Nigeria exports crude oil and at great cost, imports petroleum. Drawing a comparison between South Africa

and Italy, the latter makes more from exporting jewellery than South Africa does from exporting gold (Elebute 2014). According to RBSC (2012), manufacturing remains Africa's most underdeveloped section with the continent providing just 1 per cent of global industrial output. In addition, as African economies are heavily dependent on exports, mainly commodities and raw materials, high international commodity prices inflate growth statistics. Thus, African economies remain vulnerable to price fluctuations. Adversely, as commodity prices increase, policymakers and businesses have little incentive to embark on serious industrial redesign (Fioramonti 2013). It is therefore evident that as long as Africa remains an exporter of primary goods and an importer of processed products, its growth, no matter how incredible, will remain a farce.

The entrenched history of Africa's disadvantaged position in the global economic system date back to the 15th century, where SSA's developmental paradigm has been "defined by its enforced place in the international economic (capitalist) division of labour to produce and export raw materials and primary commodities in line with its perceived comparative advantages. Meanwhile value adding by way of processing, manufacturing, packaging, branding has been the preserve of developed, industrialized countries" (Ong'wena and Pambazuku 2004). In reality, nothing summarizes the African enigma more than the story on mobile phones. Sub-Saharan Africa has more cell phones than North America and Europe combined. However, none of the thousands of the components of those cell phones are made in Africa. Correspondingly, Ian (2014) argued that there is little added value for African producers; reality is glossed over by the 'Africa rising' mantra, which focuses on growth whilst "African economies remain integrated in the global economy in ways that are generally unfavourable to the continent and ensure structural dependence".

According to McKinley (2011), the global spread and dominance of neo-liberalism has further entrenched this systemic arrangement, predominately through the institutional vehicles of the International Monetary Fund (IMF), The World Bank (WB) and the World Trade Organization (WTO). In sync, Sharma (2005) disclosed how WTO structurally underdevelops the South. Between 1995 and 2004, Europe alone has been able to increase its agricultural exports by 26 per cent, much of it because of the massive domestic subsidies it provides. Sharma revealed that each percentage increase in exports bring in a financial gain of USD 3 billion. Meanwhile, the Third World, in the first 10 years of WTO, has turned into food importers. In validation, the APP (2014) reported that African countries spent USD 35 billion on food imports in 2011. As a result, recent discussions within development cooperations are seeking redress. UN-OWG (2014) called for correction and prevention of trade restrictions and distortions in world agricultural markets including the elimination of all forms of agricultural export subsidies. Relatedly, Fanon (1963) observed financial imbalances, "unequal exchange" in trade including the rising African trade deficit with South Africa as another route for the extraction of super profits from Africa. Fanon makes a crucial

observation. South Africa has become a hegemony and thus, a spring board for foreign capital expanding into the regional economic groupings meant to promote African intra-trade. The African Union and its institutions are yet to address this imbalance.

For decades, development cooperation have offered various solutions to Africa's poverty with little success. Sharma (2005) rightly posed a crucial question on "whether self-reliant development strategies which were the necessary condition for most industrialization in the past can be applied if low-income exporting countries remain mired in the commodity trap. In line with that view, ATN (2009) revealed that continued dependence of African countries on the export of a narrow basket of primary commodities, and on the import of manufactured goods, "is a reflection of a very weak domestic industrial sector, shallow national and fragmented regional markets and financial systems, services and infrastructure geared chiefly to external trade and the needs and circuits of international capital." Likewise, Sharma (2005) accurately observed that "these structural vulnerabilities have been exacerbated by decades of consistent application of neo-liberal policies of indiscriminate trade and investment liberalization, deregulation, and the dismantling of the public sector in Africa." It is implausible that the African region will be developed by capitalism, especially where take off into manufacturing for internal consumption is blocked by an inability to compete with imports (Saul and Leys 1999).

The African conundrum is best explained in terms of the pure theory of trade which is an expansion of Ricardo's comparative advantage. The theory of free trade which is embedded in the African Union (AU), African Economic Commission (AEC) and Regional Economic Communities (RECs) assert that competition is perfect and public interest is best served through private economic activity. The entire theoretical construct assumes that historically entrenched and sustained structural inequality will, through the practice of 'free trade' eventually lead to structured equality and free trade. Resultantly, the practical implementation of Free Trade Areas (FTAs) under the existing conditions of global and regional capitalist ownership, production and distribution, entrenches economic inequality, and catalyses social marginalization (Constantini 1999). It is therefore clear that there are features deliberately structured into economic interrelationships within the advanced capitalist world and between the North and South with the central one "being formation of a transnational neoliberal managerial elite and compliant African politicians" (Bond 2006).

Correspondingly, Melamed (2005) drew a close correlation between trade openness and worsening poverty: "African elites have lifted protective tariffs excessively rapidly, leading to the premature deaths of infant industries and manufacturing jobs, as well as a decline in state customs revenue. As a result, trade liberalization has cost Sub-Saharan Africa USD 272 billion over the past 20 years…" In the same vein, GFI (2008) calculated African annual losses at USD 1 trillion due to crime, corruption and tax evasion, which is more than what

Africa receives in foreign direct investment and foreign aid combined. Similarly, Cockcroft (2001) estimated that in 1994, 14 per cent of the total value of exported oil "was not accounted for in national trade figures as a result of various forms of transfer pricing and smuggling." Likewise, APP (2014) gave a conservative estimate of USD 50 billion annually that Africa loses to illicit financial outflows. To that end, Bomba (2014) indicted the developed world for the global structures and policies that enable illicit flows and for being recipients of the bulk of illicit flows from Africa.

As a survey by the United Nations Conference on Trade and Development on income shifting as part of transfer pricing reveals that developing countries with sufficient evidence to make an assessment, 61 per cent estimated that their own national Transnational Corporations (TNCs) were engaging in income shifting, and 70 per cent deemed it a significant problem. The income-shifting behaviour of foreign-based TNCs was also appraised and 84 per cent of the developing countries felt that the affiliates they hosted shifted income to their parent companies to avoid tax liabilities, and 87 per cent viewed the problem as significant (UNCTAD 1999).

Further to illicit financial outflows, Africa's disadvantage is intricately structural and veiled even in aid and development cooperation. Bagooro (2015) appropriately calls for an analysis beyond illegality, corruption, and governance. "There is need to focus on the interplay of economic surpluses generated in Africa, the players in generation and the distribution of the surplus as well as the examination of finance, financial systems and architecture, taxation, foreign direct investment, the extractive sector, and the role of the state"(Bagooro 2015). In related circumstances, Sachs (2005) unveiled how the 'famous' aid into Africa is a farce. Total gross foreign aid from all donors to all developing countries in 2002 was USD 76 billion. Of that, USD 6 billion were debt relief grants, which do not correspond to any actual flow of resources.

Moreover, developing countries paid close to USD 11billion in loan repayments to rich countries, leaving a net flow of foreign aid of USD 59 billion. The remainder was mostly emergency assistance and technical cooperation with major payments going to "expensive foreign consultants rather than local experts" (Sachs 2005). In comparison, Boyce and Ndikumana (2012) indicated that by 2010, the total stock of external debt outstanding for the continent stood at USD 297 billion and its annual debt service bill was USD 22 billion. Similarly, the World Bank (2002) revealed that Africa repays more than it receives. Whereas in 1980 in Africa, loan inflows of USD 9.6 billion were higher than the debt repayment outflow of USD 3.2 billion, however, by the year 2000, only USD 3.2 billion flowed in, and USD 9.8 billion was repaid. Concerns has also been against debts accrued by ruling elites without the consent or benefit to the people as 'odious' debts under international law (Boyce and Ndikumana 2012).

Underhanded aid activity is also explained by Alesina and Dollar (1998) when they showed considerable evidence that those patterns of aid allocation by bilateral donors were far more robustly dictated by the political and strategic

interests of the donors. Correspondingly, a research on the European Union (EU) disclosed that the 'aid for trade' programme was really about further pushing developing countries to promote trade liberalization. EU aid includes "support for the implementation of existing and future WTO agreements and support for policy reforms and investments necessary to enhance economic efficiency and to ensure greater participation in the world economy" (Curtis 2005). Resultantly, Africa remains trapped in structural dependence. Even more, brain drain ensures when skilled African labour migrates to the developed world in search of better opportunities. There has been justification that Africans in the diaspora invest back home through remittance but even those resources, mainly meant for subsistence to the poor, are not spared. According to APP (2014), remittance charges are unethically expensive, remitting USD 1,000 to Africa costs USD 124 compared with a global average of USD 78 and USD 65 for South Asia. UN-OWG (2014) has raised the same issue in sustainable development goal 10.c suggesting for a reduction of less than 3 per cent the transaction cost of migrant remittances by 2030 and doing away with remittance corridors with costs high than 5 per cent.

Discussion

It is increasingly being established that it is the resilient and sustainable smallholder farmer who holds the key to global food security. Small holder agriculture is too vital to employment, human welfare and political stability in SSA to be regarded as "just another small adjusting sector of the market economy" (Delgado 1999). Several case studies in Africa prove that smallholder farmers are the answer to global food security and governments should treat them as entrepreneurs and invest in "clear linkages along value chains from production to processing, marketing and consumption" (Nwaze, 2011). A study of small holder agriculture covering 286 projects, 37 million hectares in 57 developing countries discovered that when sustainable agriculture was adopted, average crop yields increased by 79 per cent (FAO 2012).

Africa's headline GDP growth is fleeting. Thus, the conventional reading of GDP as a sufficient measure of Africa's progress remains questionable. There are deep-rooted complex structural deficiencies beyond GDP. These include the continent's unfavourable integration in the global economy, economic performance based on extractive industry and primary commodities, terms of trade, weak domestic industrial sector, neo-liberal policies, illicit financial outflows, climate change and elite capture. To that effect, too many Africans are still stuck in paucity despite impressive GDP growth. The continent's leadership is yet to address endemic poverty and dearth in basic service delivery. Even more, Africa's headline growth overlooks climate change risk where the continent is most vulnerable in terms of adaptation and disaster preparedness. Consequently, GDP is a flawed assessment of progress, for it overlooks society and environment in pursuit of economic growth.

Africa's decade of growth has been largely attributed to rising commodity prices. Thus the continent remains vulnerable to the market and price fluctuations. The fundamental reason why Africa remains trapped in non-progress is its unfavourable integration in the global economy where it remains an exporter of raw materials and an importer of processed products. The continent also suffers huge financial outflows due to opaque deals and tax evasions by multinational companies and organizations.

Further crippling Africa is a huge debt burden most times acquired to serve elite interests while aid from the developed world remains a vehicle to extend vested interest. Brain drain through the immigration of skilled African workforce perpetuates stagnation in development. Africa remains ensnared because of a deliberate calculation by the neo-liberal agenda. The complex systemic architecture disadvantaging Africa remains entrenched because the continent's ruling and managerial elites have partnered capital — elite capture.

Agriculture remains the "achilles heel of Africa's development success story". As the global discourse increasingly recognizes traditional knowledge in farming methods, biodiversity, organic practices, traditional seed varieties and livestock, it is time to unleash the smallholder farmer and in the process, foster inclusive growth and sustainable development. Against this background, the article concludes that the onus is not only on African civil society and the middle class, but also on the general population to demand service delivery, democratic governance and inclusive decision-making from leadership. It is the general African population that can rewrite the African story through the power of their voter choice for leadership. The leadership will need to concentrate on smallholder/rural/ family farming where the majority of Africans — more than 70 per cent — are stuck.

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Action Plan for Green Budgeting in Punjab, India

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India is a federal country where states and union territories are empowered to legislate, administer, and govern over different issues as specified in the Indian Constitution. Punjab is one of the fastest developing states in India. The state has posted a steady growth during the last decade with the average real Gross State Domestic Product (GSDP) of the state at current prices to have grown at around 12.5 per cent during the last decade (2002–11).

Like many other economies, this growth in Punjab has not come without a cost to the environment, especially to water and soil resources. According to the Central Groundwater Board, the stage of groundwater development is 170 per cent. The state has to promote policies and interventions for enhancing forest cover and quality of natural resources including soil, water, and biodiversity. The state also needs to catch up with the national average in terms of installed capacity in renewable energy. The state has to prepare and respond to both local and global environmental issues.

According to the Punjab State Action Plan on Climate Change, climate projections with respect to the base line 1961–1990 for 2021–50 indicate an increase in annual average precipitation and an increase in annual mean minimum and maximum temperatures. Punjab is also enlisted as a frequent drought prone

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area according to the Indian Meteorological Department (IMD) classification of drought incidences in the 1875–2004 period.

In the context of increasing vulnerabilities due to resource depletion and climate change, institutional frameworks need to be strengthened to respond to global and local environmental challenges. The state of Punjab has to diversify to more sustainable forms of cropping patterns while considering implications of climate change on future agricultural growth. It is inevitable that the state steps up measures to allow for resource conservation (water, energy, and waste recycling) in various sectors of the economy including energy supply, industry, urbanization, transport, buildings, and natural resource management.

It is the government that will have to take the lead in creating a framework to maximize the environment's potential for sustainable, broad-based growth. For this, strengthening the financial framework for public expenditure keeping in mind priorities and potential for environmental sustainability becomes essential.

Preparing green budget statements can be an opportunity to encourage proactive mindsets among government departments regarding environmental sustainability while engaging in a key decision-making process, i.e., annual state budget formulation. With support from the Department of Science, Technology & Environment, the Punjab State Council on Science and Technology along with The Energy and Resources Institute (TERI), facilitated a process for developing an Action Plan on the Green Budget for the state of Punjab. The project involved literature review, data analysis, and documentation of similar policy initiatives. A brainstorming session was organized on January 30, 2014 for receiving inputs from departments on the departmental priority areas (Exhibit A). Another follow-up visit was organized in March 2014 to select departments.

Exhibit A: Consultative brainstorming session organized for developing Action Plan for Green Budgeting in Punjab

The working definition for 'green budgeting' from the process is:

> "Every year, government agencies (Departments/Directorates/Boards/ Councils/ Commissions) through the Annual Budget Circular, by preparing Green Budget Statements, will highlight the quantum of public expenditure earmarked in the state budget for environmental sustainability initiatives as well as reducing expenditure in unsustainable sectors."

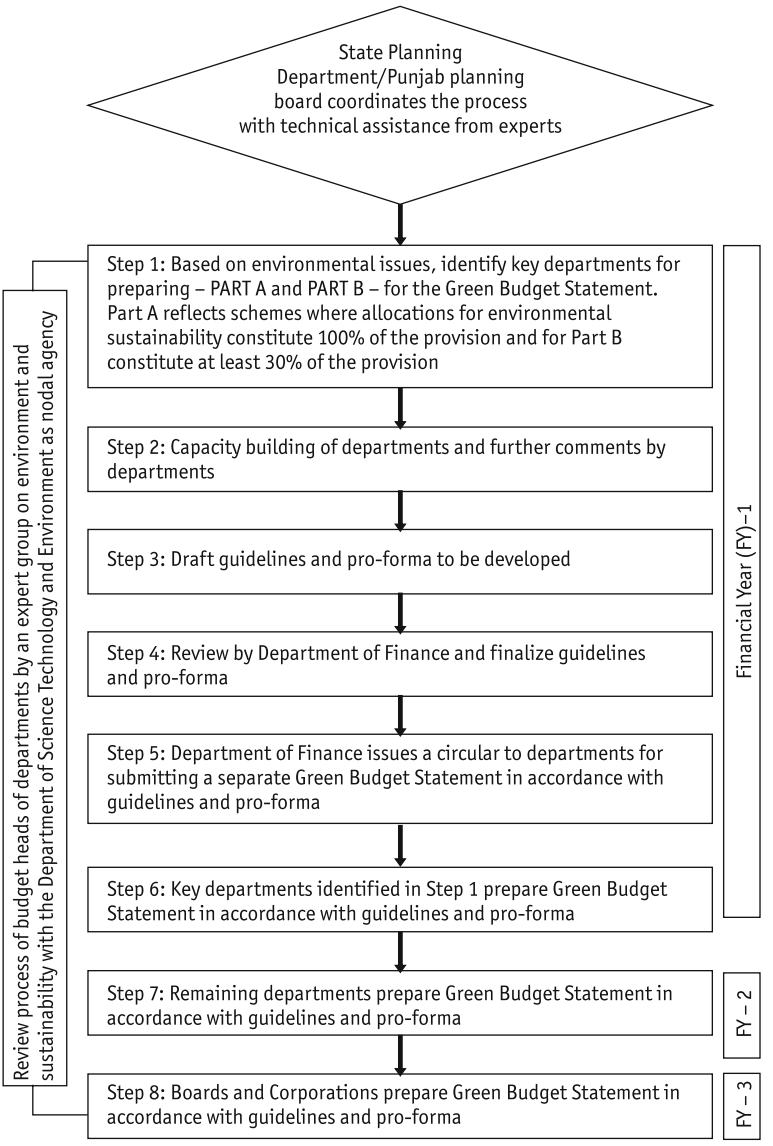
The rationale for this green spending by using 'green budget statements', as an instrument, is based on the premise that earmarked public expenditure will send policy signals and hence, encourage other actors (including businesses and industry, communities, and individuals) to contribute to sustainability initiatives. Thus, green budgeting (through green budget statements) has the potential to play an important role in helping developing countries raise revenues, while creating incentives that generate environmental benefits and supports poverty reduction efforts. 'Green budgeting' is a specific tool which involves preparing separate green budget statements while preparing annual budgets (state budgets in this case). It can be said that green budgeting by preparing 'green budget statements' is one of the strategies which is a subset of the broader environmental fiscal reform.

Green budget statements can be modelled on the lines of gender budget statements followed in the Union Budget process in India. In order to ensure effectiveness of green budgeting, it is highly essential to adopt an ex-ante planning and then ex-post monitoring and evaluation of environmental expenditures and the resulting outcomes. The process of developing a roadmap was done in a consultative manner and involved brainstorming with representatives from various departments of the government of Punjab and other stakeholders. The process that emerged is explained in the schematic diagram shown in Exhibit B.

The initiative also recommends that there will be a review process of the budget heads of the various departments by an expert group on environment and sustainability with the Department of Science, Technology and Environment coordinating the process.

Unless environmental sustainability concerns are integrated with social progress and economic growth objectives, sustainable development that treats future generations equitably will remain a distant objective.

Exhibit B: Flow chart for Action Plan for Green Budgeting in Punjab



POLICY SHOWCASE

Green Growth Initiative of Khyber Pakhtunkhwa Province, Pakistan

MALIK AMIN ASLAM KHAN[1]

"We do not inherit the earth from our ancestors; we borrow it from our children."

— Chief Seattle

Accepting the challenge of stewardship of the earth's resources today, to bequeath a more liveable future for our next generations, is the primary motivation behind the concept of 'Green Growth'. The concept is designed to revisit, revise, rethink, and improve the clearly unsustainable growth model that the world is currently following and start thinking on alternate pathways to development. Over the past few years, many countries have been trying to cope with this challenge by firstly defining what "green" actually means and secondly endeavouring to translate it into practical action on the ground. Within this context, lack of strong and unflinching political commitment has been often cited as one of the most difficult barriers to implementation.

Pakistan's Tehreek-e-Insaaf (PTI) took the initiative of politically conceptualizing the notion of a green economy in Pakistan. This was based upon a philosophical premise that for the successful implementation of any 'green' agenda, it has to be politically owned and passionately driven. This has been the fundamental philosophy behind the unique political experiment currently underway in Khyber Pakhtunkhwa (KPK) province.

The first steps along this roadmap started before the elections of 2013. After extensive consultations and expert input, a 'Green Growth Vision' was unveiled by the party and laid out a strategy for the 'greening' of growth in Pakistan. Subsequently, after the elections it was imperative for PTI to plan and deliver this promised 'green' vision in KPK—the province where it formed the Government. To operationalize the promised vision on environmental sustainability and development, the 'Green Growth Initiative' (GGI) was launched and is currently underway in the province of KPK.

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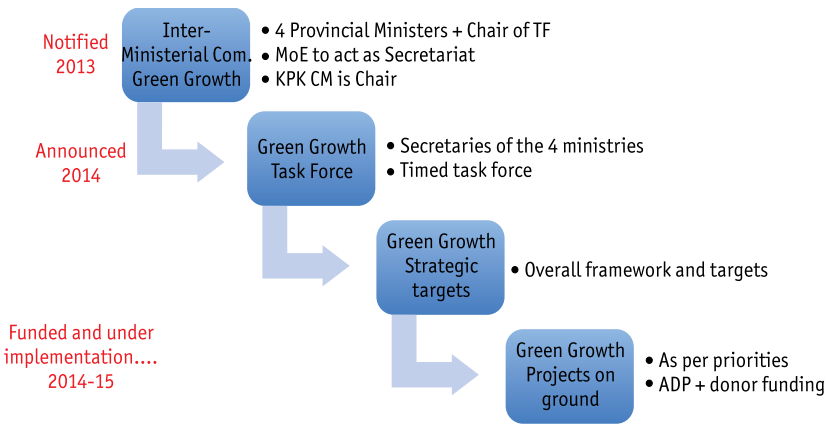
While gearing up for implementation of PTI's promised 'green vision', it had to be firstly tailored to meet the economic needs, social demands, and political aspirations in KPK. Secondly, parallel to this, an effective institutional mechanism, had to be put in place to oversee delivery. The PTI coalition Government met both the challenges by setting up a two-layered institutional structure consisting of an Inter-Ministerial committee on Green Growth, technically supported by an Expert Task Force on Green Growth. The important factor being that the Chief Minister chairs the Inter-Ministerial Committee on Green Growth (ICGG), a clear signal of strong political commitment, while the Expert task force was challenged to tailor the vision for KPK within a short and restricted time frame, which it successfully achieved in 2014.

Figure 1: Institutional Mechanism for KPK Green Growth Initiative



Thus, driven by strong political commitment and supported by a delivery-based institutionalized structure, the *six focal sectors* were outlined including the Forestry, Protected Area/National Parks, Clean Energy, Climate Resilience, Water/Sanitation, and Waste Management sectors. Furthermore, after expert deliberations and stakeholders' input, the *5-year targets* for the first four priority sectors were announced during the GGI launch in 2014. These quantifiable and measurable targets were designed to drive the implementation process.

The litmus test for any political policy or strategy, however, lies in translating it into projects on the ground and allocating them a share out of the budgetary resources. The initiative resulted in flagship projects including—the 'Billion Tree Tsunami', the 'KPK National Parks' project, and the '365 community micro-hydel' project. These projects were given a shape after a detailed consultation and development process. The projects have now been allocated government funds in

the annual development programme of 2014–15 to operationalize the initiative. This article showcases the Billion Tree Tsunami project; KPK National Parks and Wildlife Protection; and Combating Climate Change and Zero carbon growth.

The Billion Tree Tsunami

The province of KPK houses 40 per cent of Pakistan's dwindling forests and is also the storehouse of its natural biodiversity. It was, thus logical for forestry and national parks to be a primary focal area for the GGI. Within the forestry sector, through a number of revolutionary measures, the KPK Government has committed to not only reverse the high rate of deforestation but also shift the current philosophy from treating forests as a 'revenue' machine towards preserving them as a valued 'natural capital'.

Exhibit A: The Billion Tree Tsunami

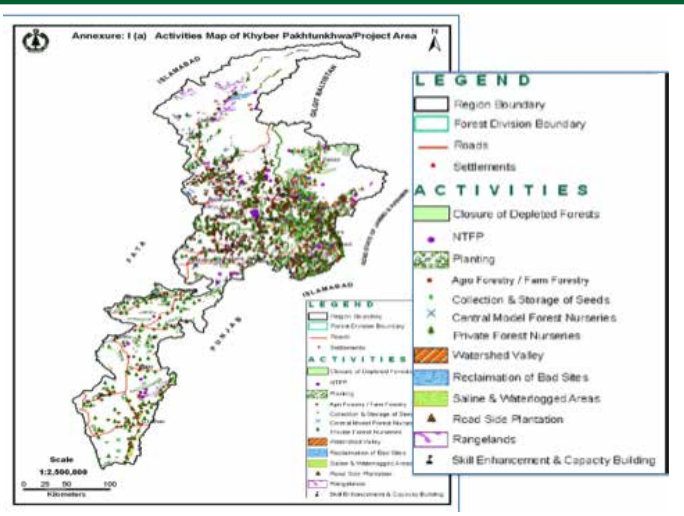
For the first time in the history of Pakistan, the forest area in KPK is targeted for a major enhancement from 20 per cent to 22 per cent by 2018, which would entail converting, at least, 30,000 hectares of additional forests through a massive afforestation drive. In addition, through enrichment measures, the tree cover in existing forests would be increased from 20 per cent to 30 per cent by 2018. This would entail protection and gap plantations on, at least, 27,000 hectares each year.

Exhibit B: Nursery for new plants in Manshera

The above-mentioned ambitious targets would be achieved through the massive 4-year 'Billion Tree Tsunami' project, which is now underway. The project has been designed to include various new facets such as:

- A programme for establishing 'youth nurseries' which should create decent and green jobs for the youth of KPK. The Government will have secure buyback agreements with small scale nursery owners to encourage green employment. Detailed village level GIS mapping has been done for the whole province to identify the sites for these nurseries as well as the plantations.
- It innovatively focuses on outsourcing new forest growth to the private sector in order to ensure survival of planted forests through financial incentives spread over three years.
- Community ownership and protection of enrichment forestry has been proposed under the project. Trained 'Forest *nighabans*' will be hired by the communities and financed by the Government.
- The Government is also in the process of establishing rules for REDD+, an innovative global financial instrument that aims to reverse deforestation by providing cashable carbon value to standing forests.
- A complete ban on cutting and felling of trees in the reserved forests of KPK has already been imposed and it will be converting, in a phased manner, all these state-owned forests into protected areas.
- To ensure accountability and transparency, the project entails an independent third party monitoring regime to be put in place, which will use tools such as GIS monitoring and Google Earth, to ensure compliance with what has been committed.

Exhibit C: Detailed GIS mapping for informed interventions



The above project concept has been preliminarily accepted for inclusion under the global 'Bonn Targets—a regime where voluntary forestry targets are recognized. Once officially recognized, KPK will be the first sub-national entity in the world to receive this honour of recognition.

National Parks and Wildlife Protection

Being the custodian of a major portion of Pakistan's natural biodiversity, the KPK Government has committed to not only expanding the Protected Areas/National Parks in KPK but also ensuring their professional and proper management and preservation by integrating this with ecotourism. To oversee and manage this transformation, the GGI has announced:

- The formation of a high powered and autonomous 'Wildlife and National Parks Management Board' through a legislative bill.
- A specialized 'Wildlife and Park Management' Youth force, given special powers under this legislation, will be professionally trained to act as nature's guards and create tremendous employment opportunities.
- The legislation includes formation of a provincial level 'Wildlife and Parks Fund' which will be connected with small conservation funds to be set up at each National Park.
- The above fund has been allowed powers to do direct raising of funds and spending it for purposes of protection of wildlife and managing national parks.
- The 'National Parks Management' project has been designed and includes funds for the above purposes.

The target is that area under protected areas increases from 11 per cent to 15 per cent by 2018. All of these steps would also generate green jobs while raising awareness and sensitizing the public to KPK's unique natural heritage. KPK is also aiming to achieve global linkage for this initiative by enlisting it under the recently formulated 'Asian National Parks Authority'. The work for doing so has already begun and would again give KPK global recognition for a locally implemented environmental initiative.

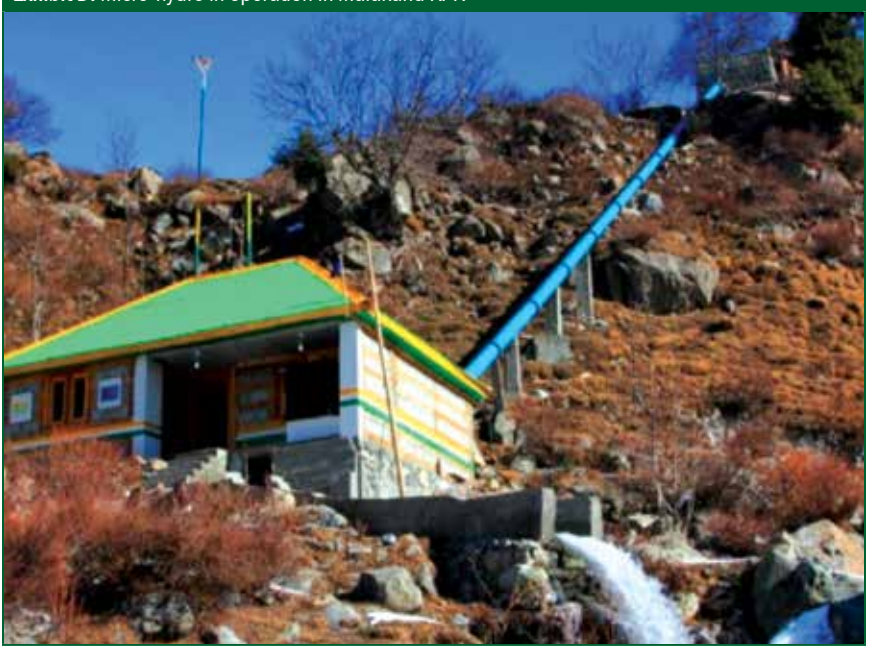
Combating Climate Change and Targeting 'Zero Carbon' Growth

Climate change remains a pressing challenge for the KPK province, which, owing to its geography and topography, is the province in Pakistan, most vulnerable to climate change impacts. The repeated ravaging floods in the past few years have been a stark reminder of the devastation and infrastructure loss which this vulnerability can cost. Thus, the GGI logically targets enhancing the climate resilience of the province through vulnerability mapping and climate proofing of its infrastructure.

The fourth important sector of the GGI is also linked with the climate responsibility that KP is undertaking by voluntarily committing to 'zero carbon' growth. This would encompass the efforts for promotion of clean energy and carbon sequestration.

- The Forestry and National Parks initiative have been outlined above and relate to climate mitigation through sequestering carbon in forest and protected rangelands.
- In addition, by 2018, KPK will expand its energy base by adding an additional 3,000 MW to 4,000 MW but will remain committed to clean energy by ensuring that, at least, 80 per cent of its power generation is based on clean renewable energy, namely hydro and solar.
- A hallmark of this initiative is the project bringing online 356 community driven small hydro projects amounting to 35 MW of clean off-grid energy delivering clean energy and community jobs across the province. All the sites of these micro-hydro projects have already been identified and many of them already launched through a public-private partnership. The aim is to provide cheap and affordable electricity (INR 2/unit) to offgrid villages and to deliver this service without any load shedding.
- In addition, a plan is also envisaged for piloting a 'solar roofs' project in Peshawar as well as a 'solar tube wells' provision for the farmers of KPK thus moving the province towards a greener development pathway.

Exhibit D: Micro-hydro in operation in Malakand KPK



Discussion

The Green Growth Initiative of KPK is now firmly on its feet after an extensive planning and development phase. This revolutionary initiative aims to be a flag bearer of a green revolution in Pakistan and to ensure a better quality of life to the citizens of KPK, creation of decent and clean job opportunities for the youth and become a means for social upliftment and poverty eradication in the province.

The politics of change demands shifting from sloganeering towards delivery. Hopefully the successful implementation of the GGI will not only establish the notion of political ownership being a pre-requisite for catalysing green growth in Pakistan, and the world, but also create a paradigm shift in KPK's growth trajectory—leading to prosperity, poverty reduction, and a better quality of life for the people while fulfilling the imperatives for a cleaner environment.

KNOWLEDGE SHOWCASE

Developments in Global Renewable Energy: A Review

JANET L SAWIN [1], RANA ADIB[2], CHRISTINE LINS[3] AND LAURA E WILLIAMSON[4]

The evolution of renewable energy over the past decade has surpassed all expectations. Global installed capacity and production from all renewable technologies have increased substantially; costs for most technologies have decreased significantly; and supporting policies have continued to spread throughout the world.

Developments in the early 2000s showed an upward trends in global renewable energy investment, capacity, and integration across all sectors; yet, most mainstream projections did not predict the extraordinary expansion of renewables that was to unfold in the coming decade. Numerous scenarios projected levels of renewable energy for 2020 that were already surpassed by 2010.

Today, governments are increasingly aware of the potential impacts of renewable energy on national development. While the primary objective of developing a renewable energy sector is often to maintain or expand energy services, the far-reaching impact of these technologies adds further value to their use: reducing the health and environmental impacts of energy use, mitigating climate impacts, improving educational opportunities, creating jobs, reducing poverty, and increasing gender equality.

Global perceptions of renewable energy have shifted considerably since 2004. Over the last 10 years, continuing technology advances and rapid deployment of many renewable energy technologies have demonstrated that their potential can be achieved. The renewables advanced further towards realizing that potential in 2013.

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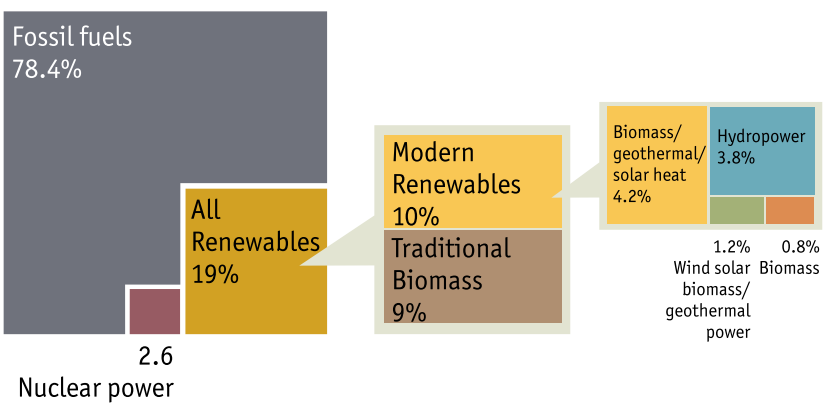
Continued Renewable Energy Growth

By the end of 2013, global renewable power capacity exceeded 1,560 gigawatts (GW), equalling an 8.3 per cent increase over 2012. Hydropower rose by 4 per cent to approximately 1,000 GW, accounting for about one-third of renewable power capacity added during the year. Other renewables collectively grew nearly 17 per cent to an estimated 560 GW. For the first time, more solar PV than wind power capacity was added worldwide. Overall, renewables accounted for more than 56 per cent of net additions.

Figure 1: Estimated renewable energy share of global final energy consumption, 2012

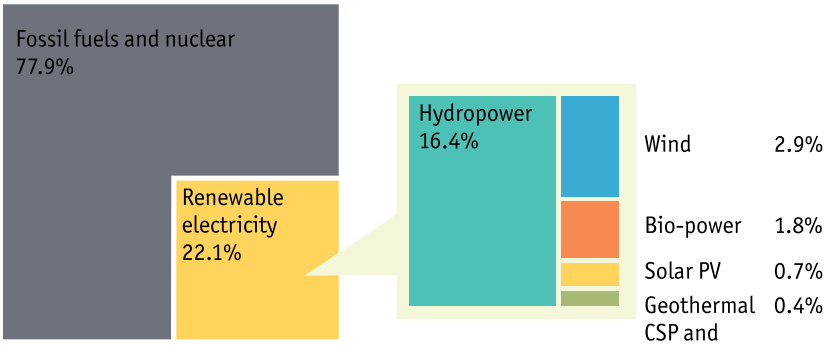


Around the world, policy support and investment in renewable energy have continued to focus primarily on the electricity sector. Consequently, renewables have accounted for a growing share of electric generation capacity added globally each year. In 2013, renewables made up more than 56 per cent of net additions to global power capacity and represented far higher shares of capacity added in several countries around the world. In the EU, renewables accounted for the majority of new capacity for the sixth year running.

China, the United States, Brazil, Canada, and Germany remained the top countries for total installed renewable power capacity; the leading countries for non-hydro capacity were China, the United States, and Germany, followed by Spain, Italy, and India. China's new renewable power capacity surpassed new fossil fuel and nuclear capacity for the first time.

In the heating and cooling sector, trends included the increasing use of renewables in combined heat and power plants; the feeding of renewable heating and cooling into district systems; hybrid solutions in the building renovation sector; and the growing use of renewable heat for industrial purposes. Heat, from modern biomass, solar, and geothermal sources accounts for a small but gradually rising share of final global heat demand, amounting to an estimated 10 per cent.

Figure 2: Estimated renewable energy share of global electricity production, End 2013



Based on renewable generating capacity in operation end-2013.
Data do not add up due to rounding off

The use of modern renewable technologies for heating and cooling is still limited, relative to their vast potential.

The growth of liquid biofuels has been uneven in recent years, but their production and use increased in 2013. Liquid biofuels provide about 2.3 per cent of the global transport fuel demand. In 2013, global production rose by 7.7 billion litres to reach 116.6 billion litres. New plants for making advanced biofuels, produced from non-food biomass feedstocks, were commissioned in Europe and North America. However, overall investment in new biofuel plant capacity continued to decline from its 2007 peak.

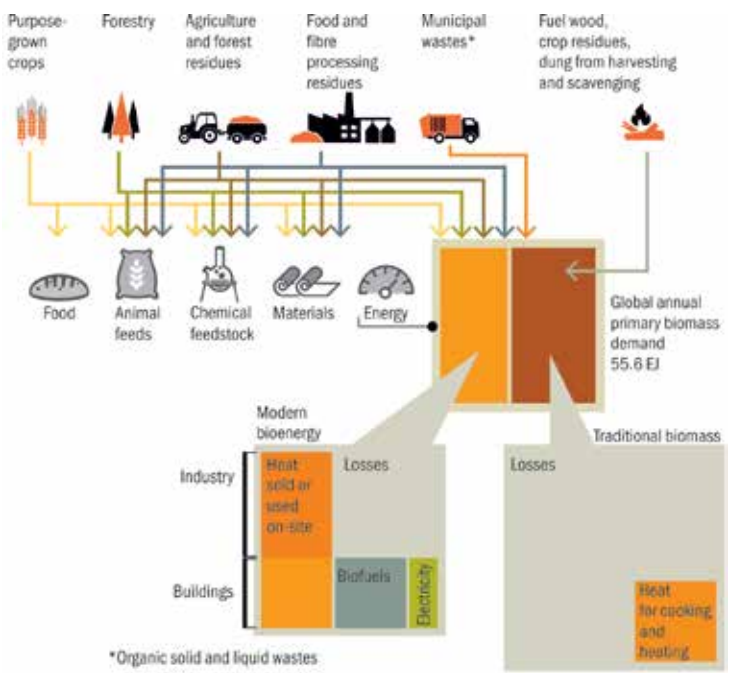
This is because the rapid growth in modern renewable energy is tempered by both a slow migration away from traditional biomass and a continued rise in total global energy demand.

Status of Renewable Energy Markets and Industry

Biomass

Biomass consumption continues to increase worldwide for the provision of heat and electricity. The production of liquid and gaseous biofuels for transport and stationary applications is also rising. Approximately 60 per cent of total biomass used for energy purposes is traditional biomass—fuel wood (some converted to charcoal), crop residues, and animal dung that are gathered by hand and usually combusted in open fires or inefficient stoves for cooking, heat for dwellings, and some lighting. The remaining biomass is used for modern bioenergy.

Figure 3: Biomass resources and energy pathways



For modern bioenergy, the many forms of energy carriers produced from a variety of biomass resources—including organic wastes, purpose-grown energy crops, and algae—can provide a range of useful energy services, such as lighting, communication, heating, cooling, and mobility. The ability of the solid, liquid or gaseous biomass resource to act as a store of chemical energy for future use can be employed to balance variable electricity generation from wind and solar systems, when integrated into mini-grids or an existing main grid.

In 2013, biomass accounted for about 10 per cent of global primary energy supply—or an estimated 56.6 Exajoule (EJ). The 'modern biomass' share included approximately 13 EJ to supply heat in the building and industry sectors; an estimated 5 EJ converted to produce around 116 billion litres of biofuels (assuming 60 per cent conversion efficiency of the original biomass), and a similar amount used to generate an estimated 405 TWh of electricity (assuming 30 per cent conversion efficiency). Useful heat is also often generated in bioenergy Combined Heat and Power (CHP) plants, but the total quantities are unknown because much of this is consumed on-site and not tracked.

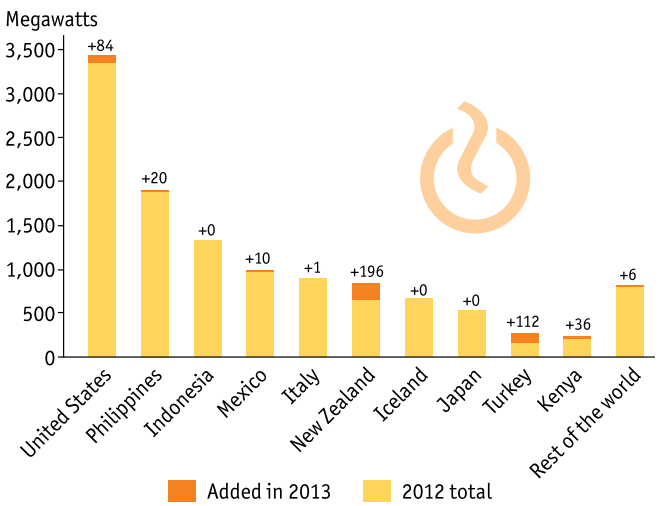
The leading markets for biomass energy are diverse and vary depending on the fuel type. The use of modern biomass is spreading rapidly, particularly across Asia. Biomass is meeting a growing share of energy demand in many countries and

accounts for a significant portion of total energy in some countries. For example, end-use shares exceed 25 per cent in Sweden, Finland, Latvia, and Estonia.

Geothermal

Geothermal resources provide energy in the form of electricity and direct heating and cooling, totalling an estimated 600 PJ (167 TWh)[5] in 2013. Geothermal electricity generation is estimated to be a little less than half of the total final geothermal output, at 76 TWh, with the remaining 91 TWh (328 PJ) representing direct use. Some geothermal plants produce both electricity and thermal output for various heat applications. At least 530 MW of new geothermal power generating capacity came on line in 2013, bringing total global capacity to 12 GW, generating an estimated 76 TWh annually. Accounting for the replacement of some existing units, the net increase in total world capacity was at least 465 MW. This growth in cumulative capacity of about 4 per cent compares to an average annual growth rate of 3 per cent for the two previous years (2010–12).

Figure 4: Geothermal power capacity and additions, top 10 countries and rest of world, 2013



In 2013, the geothermal industry, often with the support of governments, continued to pursue technological innovation for expanded resource access and improved economies of extraction. Objectives included improving the efficiency of conventional geothermal resources utilization, as well as advancing technologies that allow expanded use of low-temperature fields for both power and heat, thereby increasing the application of geothermal energy beyond high-temperature locations.

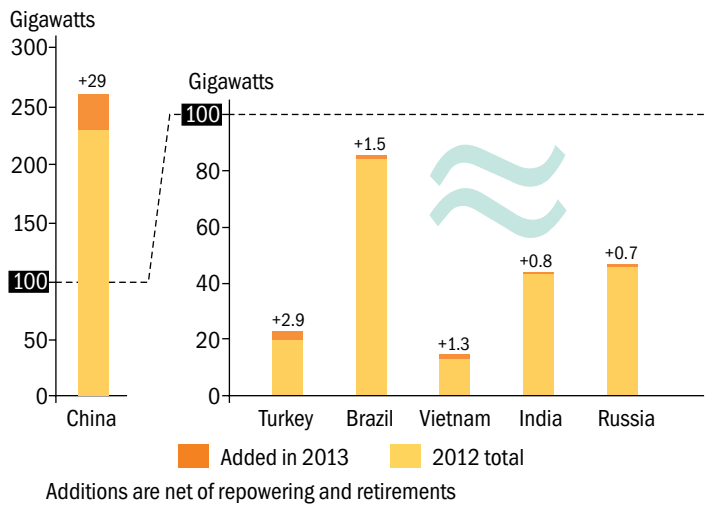
[5] This total does not include the output of ground-source (geothermal) heat pumps.

Hydropower

An estimated 40 GW of new hydropower capacity was commissioned in 2013, increasing total global capacity by about 4 per cent to approximately 1,000 GW. Global hydropower generation, which varies each year with hydrological conditions, was estimated at 3,750 TWh in 2013. The top countries for hydropower capacity and generation remained China (260 GW/905 TWh), Brazil (85.7 GW/415 TWh), the United States (78.4 GW/269 TWh), Canada (76.2 GW/388 TWh), Russia (46.7 GW/174.7 TWh), India (43.7 GW/estimated 143 TWh), and Norway (29.3 GW/129 TWh), together accounting for 62 per cent of global installed capacity. An estimated 2 GW of pumped storage capacity was added in 2013, bringing the global total to 135–140 GW.[6]

The lion's share of all new capacity in 2013 was installed by China, with significant additions by Turkey, Brazil, Vietnam, India, and Russia.

Figure 5: Hydropower capacity and additions, top six countries for capacity added, 2013



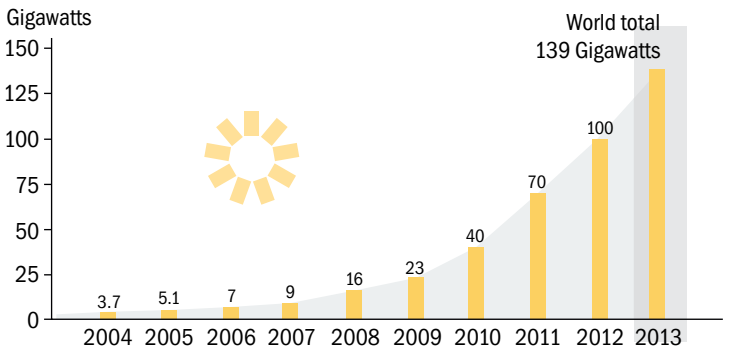
Hydropower capacity additions in the five-year period end-2008 to 2013 were significantly greater than during the previous five years. However, despite a significant jump in new capacity in 2013, the intake of new orders for some major companies declined relative to 2012.

[6] Pumped hydro plants are not energy sources but means of energy storage. As such, they involve conversion losses and are powered by renewable or non-renewable electricity. Pumped storage can play an important role as balancing power, in particular for variable renewable resources. Some conventional hydropower plants also have pumping capability.

Solar PV

The global solar PV market had a record year, after a brief slowdown, installing more capacity than any other renewable technology except perhaps hydropower. More than 39 GW was added, bringing total capacity to approximately 139 GW. Almost half of all PV capacity in operation was added in the past two years, and 98 per cent has been installed since the beginning of 2004.

Figure 6: Solar PV total global capacity, 2004–13



The year saw a major shift geographically as China, Japan, and the United States became the top three installers, and Asia surpassed Europe—the market leader for a decade—to become the largest regional market. China's spectacular growth offset Europe's significant market decline, and hid slower-than expected development in the United States and other promising markets.

Following a two-year slump, in which oversupply drove down module prices and many manufacturers reported negative gross margins, the solar photovoltaic (PV) industry began to recover during 2013. It was still a challenging year, particularly in Europe, where shrinking markets left installers, distributors, and others struggling to stay afloat. Consolidation continued among manufacturers, but, by late in the year, the strongest companies were selling panels above cost.

Concentrating Solar Thermal Power

The Concentrating Solar Thermal Power (CSP) market continued to advance in 2013 after record growth in 2012. Total global capacity increased by nearly 0.9 GW, up 36 per cent, to more than 3.4 GW. The United States and Spain continued their global market leadership. However, a global shift to areas of high Direct Normal Irradiation (DNI) in developing-country markets is accelerating. Global installed capacity of CSP has increased nearly 10-fold since 2004; during the five-year period from the end of 2008 to the end of 2013, total global

capacity grew at an average annual rate approaching 50 per cent. The industry continued expanding into new markets in 2013. Yet, while global growth of the sector remained strong, revised projections, fed by increasing competition from declining solar PV costs, led a number of companies to close their CSP operations.

Solar Thermal Heating and Cooling

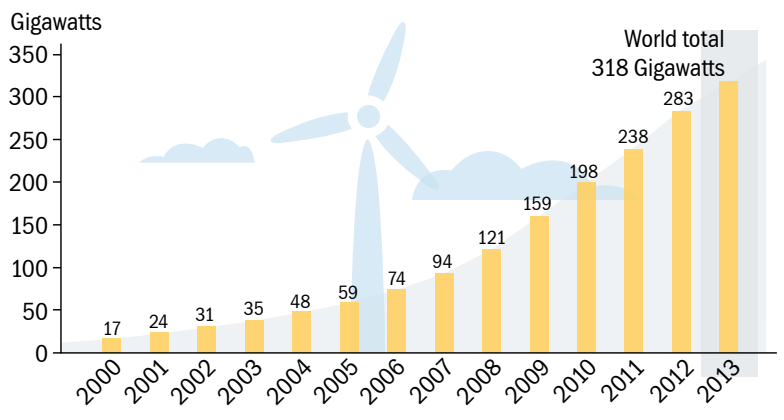
Solar thermal technologies contribute significantly to hot water production in many countries, and increasingly to space heating and cooling as well as industrial processes. In 2012,[7] the world added 55.4 GWth (more than 79 million m^2) of solar heat capacity, increasing the cumulative installed capacity of all collector types in operation by over 14 per cent for a year-end total of 283.4 GWth.

China maintained its multi-year lead in the global solar heating industry, producing an estimated 50.1 GWth (71.6 million m^2) of collectors in 2013. Export activities remained negligible (1.8 per cent in 2012 or USD 300 million) compared to the industry's total turnover, but they continued to increase. The market shares of Chinese vacuum tubes continued to rise. By contrast, Europe saw accelerated consolidation during 2013.

Wind Power

More than 35 GW of wind power capacity was added in 2013, bringing the global total above 318 GW. Following several record years, the wind power market declined nearly 10 GW compared to 2012, reflecting primarily a steep drop in the US market.

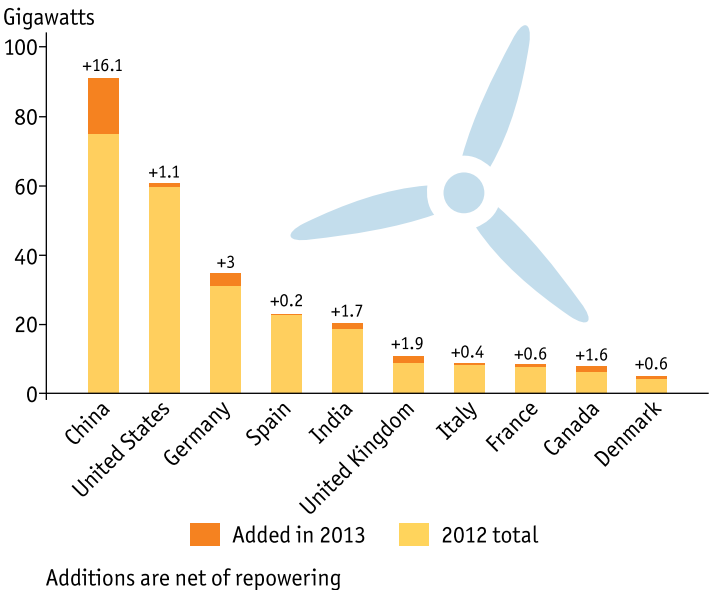
Figure 7: Wind power total world capacity, 2000–13



[7] The year 2012 is the most recent one for which firm global data and most country statistics are available.

The top 10 countries accounted for 85 per cent of year-end global capacity, but there are dynamic and emerging markets in all regions. By the end of 2013, at least 85 countries had seen commercial wind activity, while at least 71 had more than 10 MW of reported capacity by year's end, and 24 had more than 1 GW in operation. Annual growth rates of cumulative wind power capacity have averaged 21.4 per cent since the end of 2008, and global capacity has increased eightfold over the past decade. Asia remained the largest market for the sixth consecutive year, accounting for almost 52 per cent of added capacity, followed by the EU (about 32 per cent) and North America (less than 8 per cent). Non-OECD countries were responsible for the majority of installations

Figure 8: Wind power capacity and additions, top 10 countries, 2013



Offshore wind is still small compared with global onshore capacity, but it is growing rapidly. A record 1.6 GW was added to the world's grids for a total exceeding 7 GW in 14 countries by year's end. More than 93 per cent of total capacity was located off Europe, which added 1,567 MW to the grid for a total of 6,562 MW in 11 countries.

Increased Policy Support and Shifting Investments

Supporting policies clearly played a central role in driving global renewable energy capacity to a new record level last year. The number of emerging economy

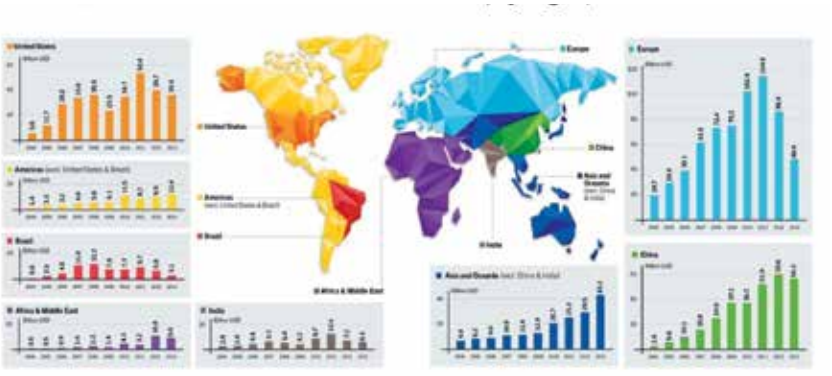
nations with policies in place to support the expansion of renewable energy has surged more than six-fold in just eight years, from 15 developing countries in 2005 to 95 early this year.

These 95 developing nations today make up the vast majority of the 144 countries with renewable energy support policies and targets in place. This rise in developing-world support contrasts with declining support and renewables policy uncertainty (and even retroactive support reductions) elsewhere in the world.

Robust policies coupled with continuing technological advances, falling prices, and innovations in financing have made renewables increasingly affordable for a broader range of consumers worldwide. Global new investment in renewable power and fuels was at least USD 249.4 billion in 2013 down 14 per cent relative to 2012 and 23 per cent lower than the record level in 2011.

The second consecutive year of decline in investment—after several years of growth—was due in part to uncertainty over incentive policies in Europe and the United States, and to retroactive reductions in support in some countries. Europe's investment was down 44 per cent from 2012, and for the first time ever, China alone invested more in renewable energy than all of Europe combined. The year 2013 also saw an interruption to the eight consecutive years of rising renewable energy investment in developing countries.

Figure 9: Global new investment in renewable power and fuels, by region, 2004–13



Data include government and corporate R&D. Data Source: UNEP FS / BNEF Global Trends in Renewable Energy Investment 2014

Lower costs and efficiency improvements made it possible to build onshore wind and solar PV installations, in a number of locations around the world, in 2013 without subsidy support. Considering only net investment in new power capacity, renewables outpaced fossil fuels for the fourth year running.

Even with the overall downward trend in world investment, there were significant exceptions at the country level; for example, Canada, Chile, Israel, Japan, New Zealand, the United Kingdom, and Uruguay all increased their investment in

2013. Despite the overall decline in China's investment, for the first time ever China invested more in renewable energy than did all of Europe combined. Moreover, it invested more in renewable power capacity than in fossil fuels.

The impacts of these developments on employment numbers in the renewable energy sector have varied by country and technology, but, globally, the number of people working in renewable industries has continued to rise. An estimated 6.5 million people worldwide work directly or indirectly in the sector.

Figure 10: Jobs in renewable energy

[i] Employment information for large-scale hydropower is incomplete and not included

Conclusion

The past decade has set the wheels in motion for a global transition to renewables, but a concerted and sustained effort is needed to achieve it. With increasingly ambitious targets and innovative policies, renewables can continue to surpass expectations and create a clean energy future. The question is no longer whether renewables have a role to play in the provision of energy services, but rather how we can best increase the current pace to achieve a 100 per cent renewables future with full energy access for all.

For this to become reality, current thinking needs to change; continuing with the status quo of a patchwork of sometimes contradictory policies and actions is no longer sufficient. Instead, technology and market developments, finance models, as well as stable and predictable renewable energy policies need to be systematically linked across the public and private sectors in order to support and drive the transition process.

Facilitating more Rigorous Adaptation of the Energy System to Increase Shares of Renewable Energy

Today, the penetration of renewables is no longer a question of technology or economics but one of developing more flexible markets and smarter energy systems. Thus, the policy focus should be on transforming power grids to become more flexible, increasing demand-side integration, and integrating power systems with transport, buildings, industry, and heating and cooling sectors, with the support of regulations, business, and finance models. Support policies, such as feed-in-tariffs or premiums, have been primary drivers of renewable energy market growth so far and have proven to be excellent market-introduction policies. With increasing renewable energy shares, however, support policies need to evolve. New policies are needed to restructure the electric power and heating markets, and to develop regulations to provide a fair and efficient basis for blending centralized and distributed generation with demand-flexibility measures. Future energy systems need to focus on how existing infrastructure must be adapted and enhanced with on going integration of large shares of renewable energy.

Creating a Level Playing Field for the Entire Energy Sector

Global subsidies for fossil fuels and nuclear power remain high despite reform efforts. The exact level of subsides is unknown; estimates range from USD 544 billion (The World Bank) to USD 1.9 trillion per year (International Monetary Fund), depending on how 'subsidy' is defined and calculated. Whatever number is chosen, the fact is that subsidies for fossil fuels and nuclear power are significantly higher than financial support for renewables. Frequently, governments do not know how much they spend to subsidize fossil fuels, as many forms of support are often not quantified. Where information does exist, it is often scattered across various ministries, making it difficult to assess. These problems are exacerbated by poor budgetary transparency and limited resources for data gathering. Creating a level playing field can lead to a more efficient allocation of financial resources, helping to strengthen initiatives for the development and implementation of energy efficiency and renewable energy technologies. Removing fossil fuel and nuclear subsidies globally would better reflect the true cost of energy generation.

Securing Stable Policy Frameworks for Renewables

Globally, policies have largely driven the expansion of renewable energy. Since 2004, the number of countries promoting renewables through direct policy support has nearly tripled, and an ever-increasing number of developing and emerging countries is setting renewable energy targets and enacting supporting policies. However, recent years have also seen policy regression, with some countries reducing renewable energy support, at times retroactively, slowing market and industry development. Stability and predictability of policy frameworks are needed to underpin sustained deployment of renewable energy. Policymakers need to ensure that these frameworks are not short-lived but are designed to establish continuity.

The uptake of renewables is necessary not only to mitigate climate change but also to drive universal energy access.

Harnessing Local Action to Ensure Global Renewable Energy Uptake

Over the past decade, local governments have become leaders in the advancement of renewable energy—particularly in combination with energy efficiency improvements—regularly exceeding efforts taken by state, provincial, and national governments. Motivated to create local jobs, reduce energy costs, address pollution issues, and advance their sustainability goals, hundreds of local governments worldwide have set renewable energy targets and enacted fiscal incentives or other policies to foster the deployment of renewables. Around the world, governments at the community, city, regional, island, and even country levels have begun to forge their own transition pathways towards a 100 per cent renewable energy future. A better linking of local renewable energy developments with those at the national level will be the key for driving the energy transition.

Ensuring Long-Term and Differentiated Policies to Sustain and Increase Investment Levels

Investment levels and regional allocation have shifted considerably over the past couple of years, with certain regions emerging as investment leaders. Developing and developed countries alike saw reductions in renewable energy investments during 2013, largely due to unstable policy frameworks, but also due to decreasing per-unit costs of renewable energy technologies. As solar, wind, biomass, and other energy sources gain market share, the Levelized Cost of Energy (LCOE) is becoming an important metric in the decision-making process for building new power generation. Strong policy signals from governments are essential to ensure that renewables are a central component of national energy supply chains. Achieving universal access will take bold and diverse policy action aimed at doubling or tripling current financial flows.

Paying Greater Attention to the Heating and Cooling and the Transport Sectors

To achieve the transition towards renewable energy, more attention needs to be paid to the heating and cooling and transport sectors, as well as to integrated approaches that facilitate the use of renewables in these sectors. Globally, heating and cooling accounts for almost half of the total global energy demand. However, this sector continues to lag far behind the renewable power sector when it comes to policies that support technology development and deployment. Experience has shown that well-designed support policies have been highly effective in increasing the market expansion of renewable heating and cooling technologies. Mandatory regulations in the building sector can help increase the penetration of renewable heating and cooling technologies. Improving the accuracy of national data collection on heating and cooling supply and demand is also important. The distributed nature of heat supply and local demand make it difficult to know what

sources are available and what is needed; this information is crucial for good policy development.

Improving Energy Data to Monitor Advancements in Achieving a Renewable Energy Transition

Reliable, timely, and regularly updated data on renewable energy are essential for establishing energy plans, defining targets, designing and continuously evaluating policy measures, and attracting investment. The data situation for renewable energy has improved significantly in recent years. Better record-keeping and accessibility, and advances in communication and collection methods have contributed greatly to this development. Nonetheless, a number of significant challenges still remain. Untimeliness as well as poor data availability, accessibility, and quality cause data gaps, especially for technologies characterized by small-scale installations and distributed in nature. To overcome some of these existing data gaps, it is essential to develop innovative and collaborative approaches to data collection, processing, and validation. Until recently, 'acceptable data' have been limited to official statistics (formal data). For an accurate and timely understanding of the status of the renewable energy sector, official renewable energy data needs to be supplemented by informal data. The addition of informal data can improve coverage of sectors and regions and help resolve the lack of data; however, it requires the inclusion of previously uninvolved actors from varying sectors. Many of these individual or institutional actors typically have already engaged in some form of data collection but are unaware of the importance of their data or lack the means of sharing them. Additionally, cross-sector methods and approaches for data collection must be considered. By utilizing links between energy and other sectors, such as health and agriculture, data gaps can be filled and data quality improved. There is a critical need to broaden the definition of renewable energy data, to collect data in a regular and more systematic manner, and to increase transparency.

Notes

First released in 2005, the Annual Renewables Global Status Report (GSR) provides a comprehensive and timely overview of renewable energy markets, industries, investments, and policy developments worldwide. It enables policymakers, industry, investors, and civil society to make informed decisions. The report covers recent developments, current status, and key trends on all renewable technologies and end-use sectors. By design, it does not provide analysis or forecast. The Renewables Global Status Report relies on up-to-date renewable energy data, provided by an international network of more than 500 contributors, researchers, and authors. Unless otherwise noted all data in this article has been drawn from: Renewables 2014 Global Status Report, REN21, 2014. (Paris, REN21 Secretariat). More details can be found from www.ren21.net/gsr.

Wildlife Conservation Beyond Protected Areas: A Konkan Case Study

ATUL SATHE [1]

For a long time in modern India, the general belief and priority has been wildlife protection through a network of protected areas. While, properly protected areas certainly help in conserving wildlife populations and biodiversity hotspots, this in itself is not sufficient for the long-term survival of any species or the larger resource rich landscape. It is quite well known, at least among naturalists, researchers, and local villagers that a lot of wildlife still exists outside our protected areas, which are often vital corridors for migration and dispersal. It would be interesting to have a glimpse of this wilderness and understand the factors that ensure conservation of these 'unprotected' wildlife populations.

The Konkan Case Study

The narrow strip of land between the Western Ghats or Sahyadri (of which it is a part) and the sea is called Konkan, from about Surat to Mangalore. Further south, it is known as Malabar. This region is known for its rich biodiversity in myriad habitats, such as forests, rivers, creeks, coastal plateaus, and mangroves, forming a mosaic with semi-altered landscapes, such as orchards, fields, and villages. In Maharashtra, the northern Konkan districts have a mixture of government forests, croplands and urbanized areas. But the southern districts of Ratnagiri and Sindhudurg are dominated by privately-owned forests seamlessly merging with human landscapes.

The presence of Tiger, Wild Dog, and Giant Squirrel is clearly documented by researchers and reported in regional and English newspapers, from the talukas of Sawantwadi, Dodamarg, and Kudal. In the past decade, Elephants have also migrated here for the first time in known history. While the presence of the first three mammals indicates good forest cover, the elephant presence also points out to partial degradation of its original habitats in Karnataka. Gaur and Sambar are

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Exhibit A: Coastal plateau merging into mangroves and moist deciduous forests in Rajapur Taluka

found in all talukas abutting the main range of Western Ghats from Dodamarg to Chiplun, with some sightings of the former are reported even from the coastal talukas of Ratnagiri and Guhagar. Studies by the Bombay Natural History Society (BNHS) indicates presence of Leopard, Barking Deer, Mouse Deer, Small Indian Civet, Palm Civet, Porcupine, Golden Jackal, Wild Boar, Grey Mongoose, Smooth Indian Otter, and several bat species across most forested patches, creeks, and plateaus. Recently, a Black Panther accidently fell into a well in Rajapur taluka, which was reported by regional newspapers.

Most typical birds of Western Ghats are widespread here. The near threatened Malabar Pied Hornbill has been regularly sighted by BNHS staff in mango orchards, mangroves, plateaus, and amidst the hustle-bustle of towns like Ratnagiri and Chiplun, indicating presence of huge trees for roosting. The near-threatened Great Pied Hornbill is common in talukas along the main range of Sahyadri. Malabar Whistling Thrush charms one's ears near human habitations in talukas as far apart as Chiplun and Kudal. Critically endangered White-backed Vulture has regular nesting sites in the talukas of Dapoli and Mandangad, including among coconut groves, as identified by researchers of Sahyadri Nisarg Mitra. Birds like Sri Lanka Frogmouth, Malabar Grey Hornbill, White-bellied Sea Eagle, and Brahminy Kite are commonly found in a mixed habitat of forests and plantations.

Exhibit B: Malabar Pied Hornbill in coconut grove in Kudal Taluka

Photo credit: Atul Sathe

Sustainable Lifestyles

From the ancient Vedic times to the present day rural hinterland, sustainable lifestyles have been the norm in India. These practices have been rooted in the philosophy of 'live and let live', since Indians have been considering all forms of life as sacred. The lifestyles evolved such that all basic needs were met from local natural resources, without robbing the same for satisfying excessive greed. Such sustainable philosophy and action, nicely echoed in Gandhiji's thoughts in modern times, always ensured the presence of wildlife, including mega mammals, in close proximity of human settlements. This fact has been highlighted even by foreign researchers working in India. The BNHS studies in Konkan region bring out the following facts about eco-friendly way of life:

- Low carbon lifestyles with limited dependence on motorized commuting and energy usage for basic needs
- Decentralized habitation with few urban pockets and rural housing that continues to be in sync with the environment
- Options pertaining to consumption of goods and services, which are not energy intensive
- Belief systems that promote co-existence and festivals that honour nature when celebrated in the original form
- 'Idea of Success' among locals still involves retaining the rural ambience of villages and livelihood options that are in harmony with nature, while ushering in relevant development

Exhibit C: Traditional house in close proximity to nature in Mandangad Taluka

The Future

Wildlife conservation away from protected areas would entail humans living in harmony with nature. Having said this, as is observed elsewhere, the simple eco-friendly ways of life in Konkan are fast changing, particularly in the district and taluka headquarters. Misplaced notions about wasteful development are catching the fancy of these largely self-sufficient communities, which may translate into lifestyles that do not necessarily conserve and respect nature. But one can hope that discretion will prevail in the thinking and planning process at all levels to ensure sustainable development without robbing Konkan of its green cover.

Disclaimer

The views expressed by the author are personal. For more details, contributor can be contacted at atulsathe@yahoo.com.

Introducing the Smart Villages Concept

JOHN HOLMES[1] AND MEREDITH THOMAS[2]

Many argue that the developing world is exposed to the impact of climate change in two ways. Geography, exacerbated by economic weakness, has left many countries vulnerable to climate extremes and natural disasters. Additionally, much of the developing world faces an opportunity cost for climate resilient low carbon growth and socio-economic development in comparison to established economies, which were able to utilize fossil fuels freely to support their development.

Nearly 1.3 billion people across the globe remain without access to electricity today and will find it challenging to achieve parity of development should they follow conventional models of development. Many such communities are often situated in remote areas, far away from urban centres and beyond the reach of national grid extensions.

However, an exciting tranche of recent innovations in finance, renewable energy, Information and Communication Technology (ICT), mobile healthcare and biotech offer a unique opportunity for those 1.3 billion individuals to bypass the highly centralized and gas-guzzling model used by the established economies. In short, sustainable rural development can offer considerable advantages over historical approaches, reaping benefits for a demographic comprising 70 per cent of the world's poor.

The 'smart village' is a model in which, energy access acts as a catalyst for a range of development outcomes. If managed correctly, technology 'leapfrogging' could lead to rapid improvements in healthcare, nutrition, education, and economic security. Villagers could thus have the opportunity to capture many of the benefits of urban life while retaining valued aspects of rural life, and ensuring balanced development at a national level.

Villagers can be empowered to realize their unique ambitions by picking and choosing the aspects of modernity they wish to incorporate into their communities. In doing so, they can take control over their own future, giving them a real choice between life in a city or a smart village. Residents would consequently be able to

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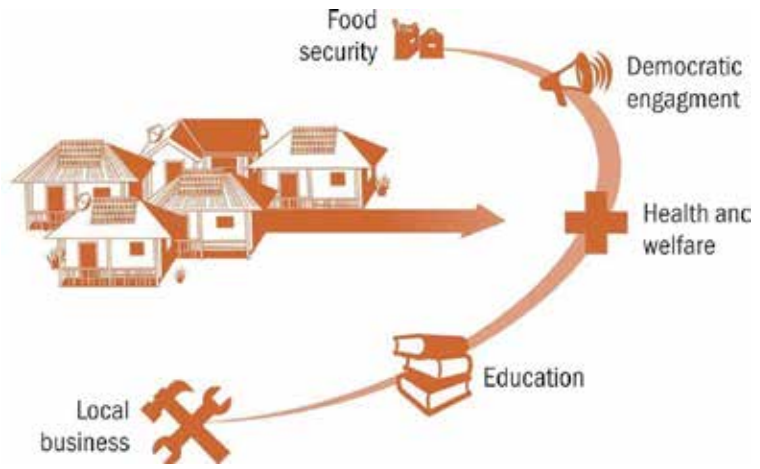
Figure 1: Access to energy can catalyse a range of development outcomes



lead healthy and fulfilling lives, achieve their development potential, earn a viable living, and stay connected to the wider world.

This model must consider not just the potential outcomes, but practical ways of sourcing, financing, and sustaining the requisite energy generation. Fortunately, in many off-grid locations, renewable energy is increasingly seen as the most practical and economic option. For example, the increasing cost-effectiveness of photovoltaic-based technology applications and further scope of small hydroelectric resources offer development models involving new forms of energy generation.

Sustainable energy access can enable the provision of good education and healthcare, access to clean water, sanitation and nutrition, the growth of productive enterprises to boost incomes, and enhanced security, gender equality, and democratic engagement. This vision is not without pitfalls. History is littered with expensive and ultimately flawed attempts by governments and development agencies to parachute infrastructure or technology into underdeveloped rural communities. Many of these actors have yet to realize the potential of energy access to transform lives and fail to take simple measures to promote progress. The Smart Villages Initiative aims to mitigate these difficulties.

Our three-year 'smart villages' project (www.e4sv.org) will collect, analyse, and apply good practices and expertise from around the world on how sustainable energy can catalyse development. This collected knowledge will be presented directly to policy-makers and funders, enabling them to support and promote sound interventions.

One early finding of our investigations is the importance of supporting local enterprise. Entrepreneurial ambition is both a driver and an outcome for the development of functioning smart villages. Small businesses generate not only wealth and employment but also demand for energy. Local entrepreneurs are also the best people to take ownership over power generation schemes and ensure that they are supported and maintained.

The ingenuity of the Maasai in Terrat in northern Tanzania is a notable success story. The village has built a 300 kW diesel-generating plant, fuelled by biofuel produced from locally grown *Jatropha*. The generator supports a mini-grid, which supplies electricity over 100 households, a radio station, a dairy, a village training and social centre, and several small shops and workshops. The social impact of the scheme has included improved health and new opportunities for income generation, giving to villagers reasons to stay within the community.

Exhibit A: A stable power supply in Terrat has allowed local business, such as this small workshop, to flourish

Location: TERRAT Maasai village, Tanzania June 2014 Photo Credit: Smart Villages

Exhibit B: The village mirco-grid is powered by a 300 kW biofuel generator fuelled by locally grown Jatropha

Location: Ngarenairobi village, Tanzania, June 2014 Photo Credit: Smart Villages

Introducing regulatory frameworks and financial instruments that support innovation and enterprise will be instrumental in promoting similar examples of sustainable rural development. The smart village model offers a unifying framework that is also flexible enough to allow for different development pathways for a multitude of diverse rural communities. In turn, the smart village vision is potentially the key to achieving the post-2015 development agenda and the UN target of sustainable energy for all by 2030.

By maintaining an inclusive network of stakeholders, ranging from governments, international development agencies, local NGOs, and the villagers themselves, the Smart Villages Initiative can facilitate vertical information exchange. The benefits of integrating knowledge across this spectrum are potentially significant, merging practical insight with strategic vision, all the while keeping our feet on the ground. By working closely with networks of science academies in each region, we also ensure our briefs are held to academic standards of rigour and are influential at a high level.

The global scope of our engagement also provides a rare opportunity for information exchange between disparate regions. To date, Smart Villages has held workshops in East Africa and Southeast Asia. More workshops and other engagement activities are planned in South America, Central America, South Asia and West Africa.

Whilst our vision may be ambitious, we believe that with broad engagement, and support from key institutions, governments, and media outlets it is eminently achievable. Most importantly, this model of sustainable development has the potential to significantly improve the lives of village communities worldwide and help ensure a sustainable future for everyone.

Acknowledgements

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Lighting a Billion Lives: Social Impact in Karnataka

LASYA GOPAL[1] AND SWAROOP RAO[2]

Poverty and global climate change are widely seen as the most serious problems that the world as a whole is facing today. These two issues are interlinked—poorer people in developing countries are more vulnerable to the effects of climate change (Stern 2008). Around 1.6 billion people in the world are without access to electricity, and about 2.4 billion still rely on traditional, biomass-based energy which is not necessarily environmentally friendly. Without access to cleaner energy, it is difficult to undertake any kind of industrial activity which can drive growth in the region. Often, incomes are also low, prohibiting people from investing in clean energy initiatives (Pedersen 2012). Strong positive correlations have been shown between energy consumption, Gross Domestic Product (GDP), and Human Development Index (HDI) (Kanagawa and Nakata 2008). Hence, there is a pressing need to enfranchise the underprivileged in developing countries through the introduction of clean energy.

Lighting a Billion Lives (LaBL) is an initiative conceived by The Energy and Resources Institute (TERI) and inaugurated in 2008. It aims to promote clean and affordable energy in rural areas so that over 360 million people in India and over 1.3 billion people worldwide can benefit. LaBL is venturing to replace the use of kerosene lamps by solar-powered lanterns. The introduction of solar lanterns is expected to have multiple benefits for the underprivileged, including increased access to healthcare, education, and to promote the empowerment of women. The replacement of kerosene lamps also means that there will be lesser oil being burnt and hence carbon emissions will decrease.

The programme has been implemented in 2,242 selected villages in 22 states of the country, with an operational model as shown in Figure 1. The hardware consists of solar panels (usually 5 in number), junction boxes (usually 5 in number), racks

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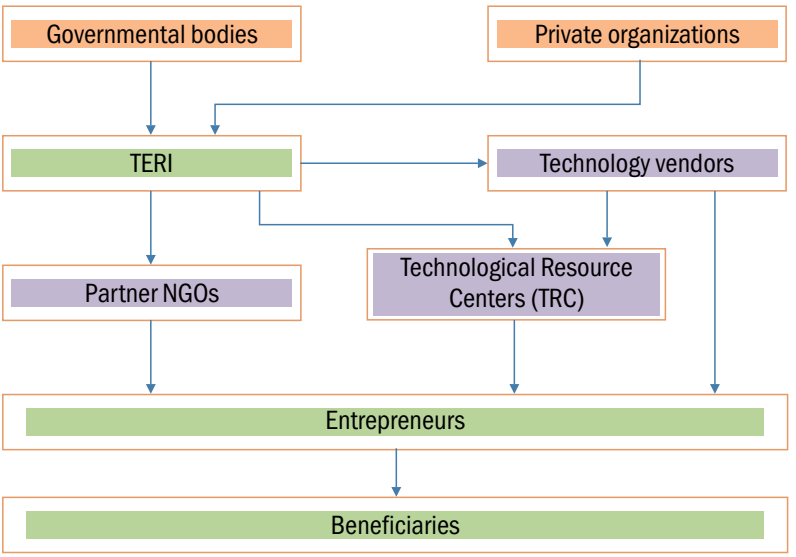
to house the lanterns, and some wires and pins to connect junction boxes to the lanterns. The lantern consists of a casing and single or multiple Light-Emitting Diodes (LEDs) powered by a battery. The entrepreneur then disseminates the lanterns among the villagers (henceforth called beneficiaries) and collects a fee. The amount collected and the frequency of collection varies.

Figure 1: Model of LaBL



In Karnataka, 12 villages are part of LaBL and two of the villages received two stations each, making it 14 stations in Karnataka. Eight stations are in Raichur district and six are in Gulbarga district. In most of these stations, LaBL was implemented over a year ago, except in four stations in Raichur where it was implemented two months prior to the study. On an average, these villages faced power cuts of 18 hours per day. The cuts were usually unscheduled and erratic.

Survey Methodology

A techno-social impact assessment was carried out in the 14 LaBL stations in Karnataka to assess the technical status of the stations as well as to assess the social impact of the programme on the entrepreneurs and beneficiaries. Village demographic information was recorded in one sheet, and the technical assessment was done using a questionnaire presented to each entrepreneur, as well as by on-ground observations. All the 14 entrepreneurs were interviewed to comprehend the value addition to their lives through their involvement in LaBL. Of the 14 entrepreneurs, seven were women and seven were men. The social

assessment was primarily done using a questionnaire which elicited information from beneficiaries on lantern usage, impact on livelihood, education, health, and safety. Usage patterns of the lanterns were noted, and any changes in working hours or study hours were noted. A total of 120 beneficiaries were selected randomly as respondents to the survey; 55 of them were men and 65 were women. Their mean age was 43. All the respondents were adults and their ages ranged from 20 to 80. In addition to the individual beneficiaries, the study took into view the perception of 61 non-users to understand the scope for expansion.

Findings

"The solar lantern doesn't give me headaches like the kerosene lanterns do" says Nagamma of Belamogi, Gulbarga district. Ayyamma of Kuppigudda, Raichur district states emphatically, "My shop now gets twice as many customers than two years ago, when I didn't have the lantern". These are just a few examples of the utility of the LaBL in the villages studied. In keeping with this, the users were generally very satisfied with the brightness of the light from the lanterns—on a scale of 1 to 5 with 1 denoting "very poor" and 5 denoting "very good", 70.8 per cent of the users rated the lantern a 5/5, and 28.3 per cent of the users rated it 4/5.

The solar lanterns have had several positive outcomes in the villages studied. It has enabled women to bring out the entrepreneurship in them, thus leading them towards the path of social and economic empowerment. The study delved to find out the extent of such impact on various aspects of daily life like livelihood, education, health, and safety.

Exhibit A: Mallamma, a LaBL entrepreneur in Roudala Banda Lingsugur taluk, Raichur District

"Due to the extra income from the LaBL station, I have enough money to start a milling business"

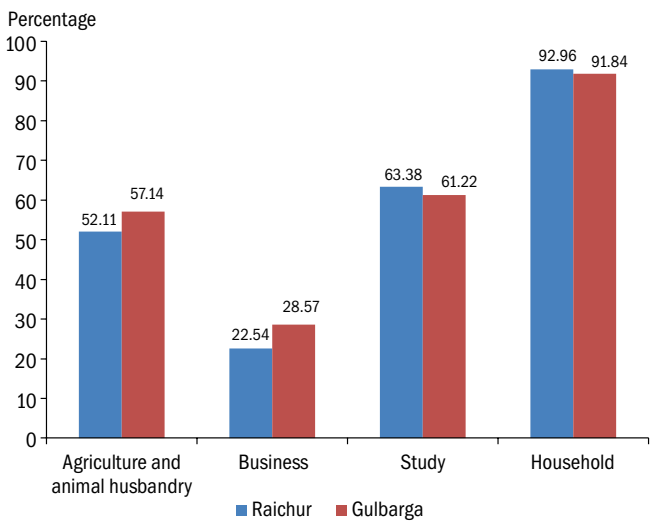
Livelihoods

Agriculture was the predominant occupation of the people of both the districts. In two villages, animal husbandry was predominant, and there was an established milk collection centre in place. Over half, i.e., 54.11 per cent of the respondents reported using the lantern to aid in farming, especially to turn on irrigation pump sets at night and during harvest time. More often than not, the lanterns replaced battery operated torches as the lighting used for agriculture purposes. Around 5 per cent more respondents in Gulbarga district used the lantern for agriculture purposes than in Raichur district.

A majority of respondents used the lantern for household purposes like lighting for cooking and washing clothes. It can be seen from Figure 2 that lantern use for household purposes was almost the same in both Gulbarga and Raichur districts—around 92 per cent of the respondents used the lantern for household purposes.

All of the respondents reported a saving in income due to the reduction in use of kerosene lanterns, battery operated torches or candles. The savings were in the range of INR 40 to INR 120 per month per household, with the average savings being INR 68.18 per month per household. The major issue with kerosene lamps as expressed by the respondents was the cost of kerosene and its availability. Once a household crossed the monthly legal limit on subsidized kerosene, they were forced to buy them in the black market at prevailing black market rates. Batteries for torches were expensive, ranging from INR 10 per standard AA cell to around INR 20 for a higher capacity cell. A fewer number of respondents used candles, especially in shops.

Figure 2: Chart showing the percentage of respondents using the lantern for various purposes in Raichur and Gulbarga districts



Among the respondents surveyed, eight people were found to have started new Income Generating Activities (IGAs). In most of the cases, women were the ones involved in these new IGAs. The new activities included tailoring, ironing, milling, dairy activities as well as opening grocery stores. Those beneficiaries who have started new IGAs report that they have increased their incomes by around INR 500–1,000 per month, or 21 per cent on an average. Additionally, around 71.4 per cent of respondents who already owned or operated IGAs reported increased number of customers or increased business.

The solar lantern was well appreciated especially by beneficiaries using it for business purposes. Barbers, eatery owners, and shopkeepers were generally quite happy with the good illumination the lantern provides them, and they report increased business because their establishment appeared 'brighter' and more attractive to customers, as compared to kerosene lanterns used earlier. Out of 21 respondents who already owned or operated commercial establishments, 15, or 71.4 per cent of them reported an increase in business. Increased business due to more attractive lighting was also noted in a study by Johnstone *et al*., in 2009 in Kenya (Johnstone *et al*., 2009). In addition to the illumination, tailors and eatery owners were very happy with the good Color Rendering Index (CRI) that the solar lantern affords them, especially in contrast to the poor CRI of kerosene lanterns.

In many places, respondents noted an increase in working hours. Thirty of the respondents, or 25 per cent of them reported that they could work for longer durations because of the lanterns, and the increase in work hours per household was 1.6 hours per day on an average. Most of the increase was due to a rise in working times for home-based activities, such as tailoring, ironing or milling, or sometimes due to increased working times in eateries or shops. A similar increase in working hours was noted in a study by Hiremath *et al*., 2009 (Hiremath *et al*., 2009).

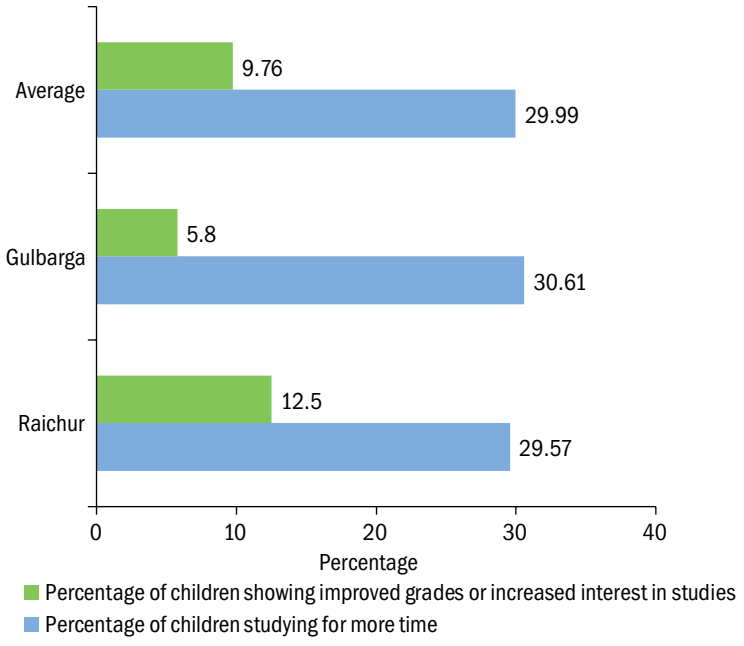
Exhibit B: Parzan Begum of Roudala Banda earns around INR 400 per month from her ironing shop which she set up after she got an LaBL lantern.

Education

Around 62 per cent of the respondents reported using the lanterns for study purposes, usually to enable their children or grandchildren to study. Thirty-six of the respondents (30 per cent of them) noted that the children in their house were studying more because of the

introduction of lanterns. On an average, those who studied longer studied for nearly 1.4 hours more.

Figure 3: Chart showing conversion rates of increased study time to increased interest in children in the villages part of LaBL in Gulbarga and Raichur districts



Source: Primary data collection

Many of the respondents were very happy about how the lantern was positively affecting the studies of their children at home. Around 9.7 per cent of the respondents noted that there was an increased interest in studies or increase in grades shown by the children. In Raichur district, 12.5 per cent of the respondents saw an increased interest in studies or improved grades, whereas this figure was much lower at 5.8 per cent in Gulbarga district.

However, as a recent Brown University study notes; increased study times are not necessarily indicative of improved scores or grades in school (Furukawa 2013). There has been a causal relationship demonstrated between increased study times and improved grades, but the extent of the causality has not been determined (Stinebrickner & Stinebrickner, 2007). While this study shows a marginal increase in study times, it should not be taken as indicative of improved grades in all cases. We can see that in the statistics presented above, while 30 per cent of the respondents reported increased study time, a much lower percentage of 9.7 per cent noted an increased interest in studies or improvements in grades.

Health and Safety

In most of the villages surveyed, there was no local hospital or a clinic that the villagers could go to. Any minor injuries or ailments were treated using over the shelf medicine, or in most cases was not treated at all. In case of severe ailments or injuries, they had to visit the nearest town, i.e., Lingasugur town in Raichur district or Gulbarga town in Gulbarga district. A government-run ambulance service exists which was used during emergencies. As such, no direct health benefit was gained out of the use of solar lanterns.

Many indirect benefits were observed, though. Around 30.1 per cent of the respondents reported that they faced some or the other health problem, even if it was minor, while using kerosene lanterns. Headaches and blackening of nostrils were the common complaints. Naturally, these health concerns were not prevalent after they started using the solar lanterns.

Safety from wild creatures like snakes and scorpions was a major benefit, with 41.6 per cent of the respondents listing it as a benefit to them. Users also felt safer when commuting in the dark, with 25.8 per cent of the respondents listing it so. However, it should be noted that the solar lanterns replaced other forms of lighting during commuting, such as battery operated torches. While respondents generally accepted that the light intensity and illumination of the solar lantern was superior, since the lanterns merely replaced torches as lighting sources, this was more of a financial benefit to the users rather than a distinct safety benefit.

Exhibit C: Child in Gudihal, Raichur district, studying using an LaBL lantern

Around 46 per cent of the respondents said that women of the house felt safe while commuting in the evenings if there was a lighting source. Again, the lantern has replaced the battery powered torch or the kerosene lantern as the preferred lighting device for commuting outside. With the relatively lower cost of the solar lantern, the women do seem to go out more often than before, with around 30 per cent of the respondents saying that the women move out of the home more often in the evenings.

Entrepreneurship and Empowerment

In many cases, the setting up of the Solar Charging Station (SCS) had a significant impact on the financial situation of the entrepreneur. The average monthly income of the entrepreneurs was INR 2,430, and the additional monthly income from the SCS ranged from INR 400 to INR 1,400. This is a significant increase in their income, especially in places where there are women entrepreneurs, this can go a long way in ensuring financial independence for them, and the reduced need to rely on (male) family members for financial support.

It was not applicable in all the places, though. Especially in Gulbarga district, some of the entrepreneurs were already quite well off financially, and the income from the SCS was not of much importance to them.

In 7 of the 14 stations, women were the entrepreneurs, and four of them said that they felt a distinct rise in prestige or social standing after they took up the stewardship of the SCS. They felt that they were able to contribute substantial amount of money to the family income, and that this increased their financial independence. This only increased their confidence, and two of them were able to establish new businesses or activities.

However, it may be noted that the mere position of entrepreneurship need not raise the prestige of a woman entrepreneur, but it needs to be tied strongly to income increase and hence financial independence.

The correlation between financial independence and rise in social standing may be noted here—the male entrepreneurs were already financially independent, and did not feel any increase in social standing.

Discussion

It is clear that the lanterns, due to their better brightness and illumination, have replaced kerosene lanterns as the preferred source of lighting during times of grid power cuts. This not only helps in reducing carbon emissions from the use of kerosene, but also eliminates the adverse health effects of kerosene lantern usage.

Apart from the direct benefits, there have been many indirect benefits as is evident. It was clear that the lanterns have touched various facets of routine life in the remote rural villages.

Entrepreneurs, especially women, have benefitted the most. Apart from the good income the SCS has provided, it has given them intangible benefits like increase in prestige in society and an improvement in leadership skills. In many places, these improvements were very apparent.

The introduction of solar lanterns have bettered the everyday lives of the beneficiaries, but at the same time it is important to note that without proper technical support readily available, the benefits can be negated in a short time.

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Sustainability Initiative in Mahindra Sanyo Special Steel Private Limited

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Sustainable Supply Chain Management (SSCM) is one of the important areas, both from research and implementation point of views, related to optimized and responsible use of resources. According to the definition given by Seuring and Müller (2008), SSCM is defined as "the management of material, information, and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental, and social, into account which are derived from customer and stakeholder requirements." It is important to note that the equal consideration of all three dimensions of sustainability is suggested, something that Elkington (1997) has termed as the Triple Bottom Line (TBL) approach. It also gives special attention to the stakeholders of a supply chain, which have to be recognized as having legitimate requirements to the supply chains' activities. This not only includes the customers and suppliers but also local community, non-governmental organizations and legal authorities (Sheu, Chou, and Hu 2005).

Mahindra Sanyo Special Steel Private Limited (MSSSPL) is a joint venture between Mahindra Ugine Steel Company (MUSCO), Sanyo Special Steel Company Limited and Mitsui & Company Limited. MSSPL is one of the subsidiaries under the Mahindra Group.[4] MSSPL is in the business of manufacturing and sales of special steel products including as-cast ingots, crown controlled-rolled products, rolled & ingot-forged bars and rings; and has its steel plant unit located in Khopoli,

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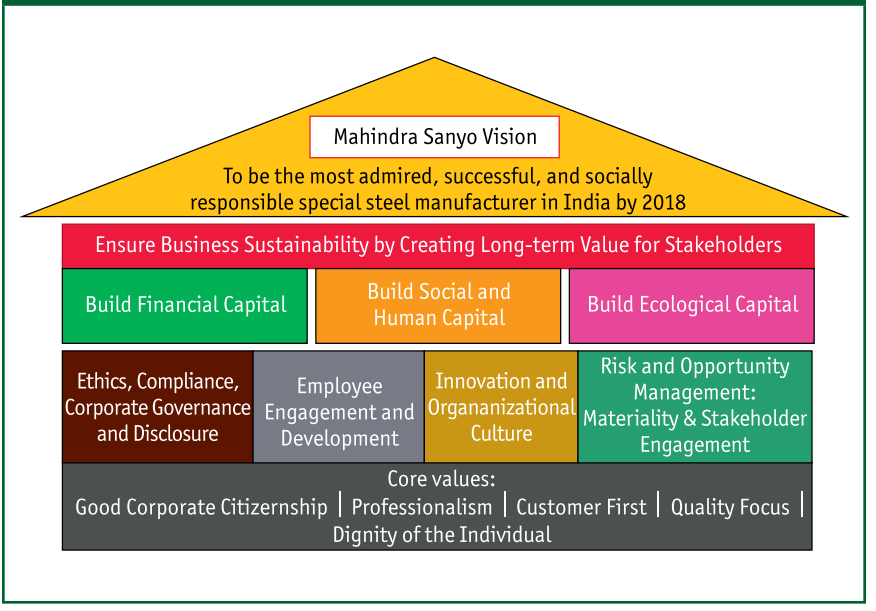
[4] Details available at <http://www.mahindra.com/Who-We-Are/Overview>, last accessed on 10 April 2015.

Maharashtra. Among others, the company has various international certifications accredited for environment, health, safety, and energy management.

The operations involved in a steel industry pose implications for all major environmental resources, land, water, and air. The industry also draws a significant portion of its workforce from the nearby locality. It is in this context, that it becomes important for steel industries to focus on efficient use of environmental resources and, adopt a responsible and proactive approach towards society, for ensuring long term sustainability and profitability of the businesses. The customers also have increasingly high expectations for both, high quality and sustainably produced steel; making a case for the steel industries to pursue 'sustainability' as their business strategy.

The sustainability framework of MSSPL is depicted in Figure 1. MSSPL's sustainability framework is supported by some of its key policies including Quality Policy, Employee Health Service (EHS) Policy, and Energy Policy and Sustainable Supply Chain Management (SSCM) Policy.

Figure 1: The sustainability framework of Mahindra Sanyo Special Steel Private Limited



Source: MSSSPL 2013

The company conducts Environmental-Life Cycle Assessment (or E-LCA) for its products. Recently, life cycle assessment for its 23 products was undertaken to assess their environmental impacts. A cradle-to-grave approach was adopted, which considered the end-of-life recycling scenario for steel. Using a statistical approach, different grades of steel were ranked on the basis of their performance

against environment impact categories. In future, MSSPL also aims to carry out a Social-Life Cycle Assessment (S-LCA)[5] for its products.

The concept of SSCM and its relevance in defining a company's sustainability has been discussed in the subsequent section. Analysis of Mahindra Sanyo's performance against its SSCM initiatives has also been presented. This note is based on site visit at MSSPL's steel plant unit in Khopoli, Maharashtra.

Being an energy intensive industrial unit, Mahindra Sanyo Special Steel Private Limited (MSSSPL) has established systems and processes necessary to improve the energy performance, which in turn results in the reduction in greenhouse gas emissions and energy cost through systematic management of energy. Mahindra Sanyo devised an energy policy to optimize the use of energy in their operations related to manufacturing and bring about overall continual improvement in their energy performance. The company has established energy consumption norms for all processes and conduct regular energy audits.

Exhibit A: Images from the plant site visit

[5] S-LCA is a method that can be used to assess the social and sociological aspects of products, their actual and potential positive as well as negative impacts along the life cycle. Read more at <http://www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/social-lca/>, last accessed on 10 April 2015.

A 10 per cent reduction has been observed in specific electricity consumption from 1,102 kWh/t in 2010–11 kWh/t to 997 kWh/t in 2013–14. Mahindra Sanyo also plans to reduce the scope-1 GHG emissions by 60 per cent by 2018. Also, there has been a 70 per cent reduction in the last four years in the river water intake—which has declined from 6651 m^3/day in 2010–11 to 1808 m3/day in 2013–14.

Mahindra Sanyo is working towards training and capacity building of its suppliers with respect to various aspects of energy efficiency, reduction of emissions, safety aspects, and others. MSSPL had engaged 64 of their Tier-I suppliers from the organized sector through six workshops for capacity building and educating them on environmental sustainability; and 25 Tier-1 suppliers in the unorganized sector were engaged through four workshops in 2012–13. Topics such as Greenhouse Gas (GHG) accounting and Life Cycle Assessment (LCA) are dealt with in great detail in these training sessions. Mahindra Sanyo has also installed a zero discharge system for plant waste water. The colony waste water gets treated through Sewerage Treatment Plant (STP) and around 400 KL (kilolitres) of the treated water is reused in the plant gardens, colony gardens as well as in the Biodiversity Park. The company came up with a Sustainable Supply Chain Policy in June 2013 and has developed a code of conduct for each of their vendors. MSSPL also maintains and runs a local village school in Khopoli.

Mahindra Sanyo actively engages with key stakeholders in its supply chain and has been handholding with suppliers and vendors (both big and small) in its stride towards sustainability. It would be worthwhile for the company to scale up its efforts in conducting collaborative workshops for its stakeholder groups. It will also be important for the MSSPL to extensively engage in activities related to knowledge sharing with its peers (including its competitors). The company should also initiate efforts to carry out Social-Life Cycle Analysis (S-LCA). It will be crucial to subsequently engage with its Tier-II and Tier-III suppliers, the company may begin to include them in their training programmes and awareness creating workshops. This could also help MSSPL gain strategic advantage over others in the industry. The company will need to continuously devise strategies to innovate and undertake new unique initiatives to support its overall sustainability initiative.

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Note

A team of researchers including Aparna Vashisht, Rinki Jain, and Chinmay Kinjavdekar from The Energy and Resources Institute (TERI); and Mr Amol Vasant Bhide, PhD scholar from National Institute of Industrial Engineering (NITIE) made the site visit.

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Book Review

Golden Rules for a Golden Age of Gas

R K BATRA[1]

The International Energy Agency (IEA), representing 28 member countries, has brought out a book titled *Golden Rules for a Golden Age of Gas*. This is a timely publication because it not only highlights the increasing role that natural gas will play in the global energy space but also argues that this will be possible only if the world's vast resources of unconventional gas can be developed profitably and in an environmentally acceptable manner. Unconventional gas is defined as shale gas, coal-bed methane, and tight gas. IEA brings together, in one volume, information on the three types of unconventional gases that is currently scattered in various reports and publications, some of which are not in the public domain.

The book defines shale gas as a gas that occurs in a rock classified as shale that due to its low permeability, requires a very different form of production compared to conventional gas. The main feature is the need to fracture the rock that contains shale gas in order to tap the gas. This requires not only conventional vertical drilling but also horizontal drilling at various depths. Injection of water, fine sand, and chemicals is required to open up the cracks in the rock, keep them open, and allow gas to rise to the surface. The downside is that the number of wells to be drilled is far more than for conventional gas. Also, large quantities of water is required, part of which remain underground, but a significant quantity rises to the surface as waste water and has to be disposed of in an environmentally friendly manner. The waste water can also seep into aquifers, thereby contaminating clean water.

Coal-bed methane, on the other hand, is natural gas contained in coal beds and the technique for production is somewhat similar though drilling is not as extensive. Water is present in the coal seams. This wastewater rises to the surface along with the gas and needs to be disposed of, in a similar manner to shale gas production. Tight gas is a general term for natural gas found in low permeability formations and is a poorly defined category compared to the other two unconventional sources as well as conventional gas.

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The book highlights, in considerable detail, the social and environmental concerns associated with the extraction of unconventional gas and emphasizes that companies will need 'a social license to operate'. It therefore sets out golden rules to address the environmental impacts of exploring and producing unconventional gas. It examines the current situation in the United States where shale gas has made a significant impact in natural gas availability and also Canada, Mexico, China, Australia, and Europe as a whole. The chapter on China is particularly interesting. It highlights that water availability may prove to be one of the biggest obstacles to unconventional gas development, particularly in the north and west of China where water is scarce and may be already strained by agricultural or urban needs. India also is a water-stressed country and although shale gas holds large promises, the water issue cannot be wished away and may prove to be the single biggest hindrance to shale gas exploration.

For countries exploring for coal-bed methane and looking to shale gas as a promising addition to the diverse sources of gas, this book is a 'must read' for policy-makers and all those who are in the energy business.

Bibliography

IEA. (2012). *Golden Rules for a Golden Age of Gas.* Paris: International Energy Agency.

Guide to Authors

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Type of contribution	Description	Length (approx.)	Illustration
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NOTES

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