Access to Energy

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EDITORIAL

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Can we quantify the multiplier effect of energy access on the needs of societies?

We acknowledge that in 2016, about 1.2 billion people (16% of world population) did not have access to electricity and 38% did not have access to clean energy for cooking. We also recognize that energy is an enabler to foster economic development, create jobs, facilitate education and health services, empower women, and in essence, forms the core of Sustainable Development Goals. Yet, energy access projects do not always make an attractive investment case because the cost of delivering energy is usually high and the expected returns from the sale of electricity are low. This is due to high project costs on one hand, and the small quantum of energy delivered and consumed on the other. The former is on account of complex logistical and other factors in most of the low energy access areas, and the latter is due to the use of energy efficient end-use appliances as well as limited ability to consume and afford electricity. However, is there a way to quantify the multiplier effect or positive externalities of energy access to capture the impact on communities and make a better investment case?

We know that infrastructure projects such as roads and bridges have multiplier benefits, their private rate of return may not be high and may not cover the cost of borrowing, but their social rate of return make these projects high impact or high importance. Can energy access projects be evaluated beyond the FIRR and ERR? Can we define a social rate of return or SRR as a metric to evaluate energy access projects?

One way of understanding the multiplier effect is to follow Amory Lovins' logic of negawatts, or the positive impact of saving one unit of electricity on the entire electricity input-output flow. Can a similar term – Xegawatts- X stands for multiplier, be thought of in a reverse manner i.e. how does one unit of energy given to a household trigger the socio-economic development of societies? And how does one energy access project stimulate creation of other allied businesses in the vicinity such as sale and servicing of end-use appliances? Can this trigger and stimulus be captured in the denominator of LCOE calculations?

Another point to consider is about institutionalizing the nexus of energy access and its multiplied benefits in the planning process for other infrastructure and development oriented projects. For instance, energy is required for improving health services infrastructure. Can we institutionalize the inclusion of energy access as a part of health or education or irrigation infrastructure planning by including a solar plant on the roof of primary health clinic or at school building as a part of the budgetary estimation and design/ construction process? The partnership between energy and non-energy entities holds the key to institutionalising this nexus. The providers of energy (i.e. solar companies) and recipients of energy services (i.e. food-processing units, cottage industries, rural health services) can jointly identify and implement an energy access project that will maximise the benefits to both the entities and multiply the outcomes of their efforts. Energy access projects have to be evaluated as a means, and not an end in itself.

A Roadmap for the Development of Offshore Wind Energy in India

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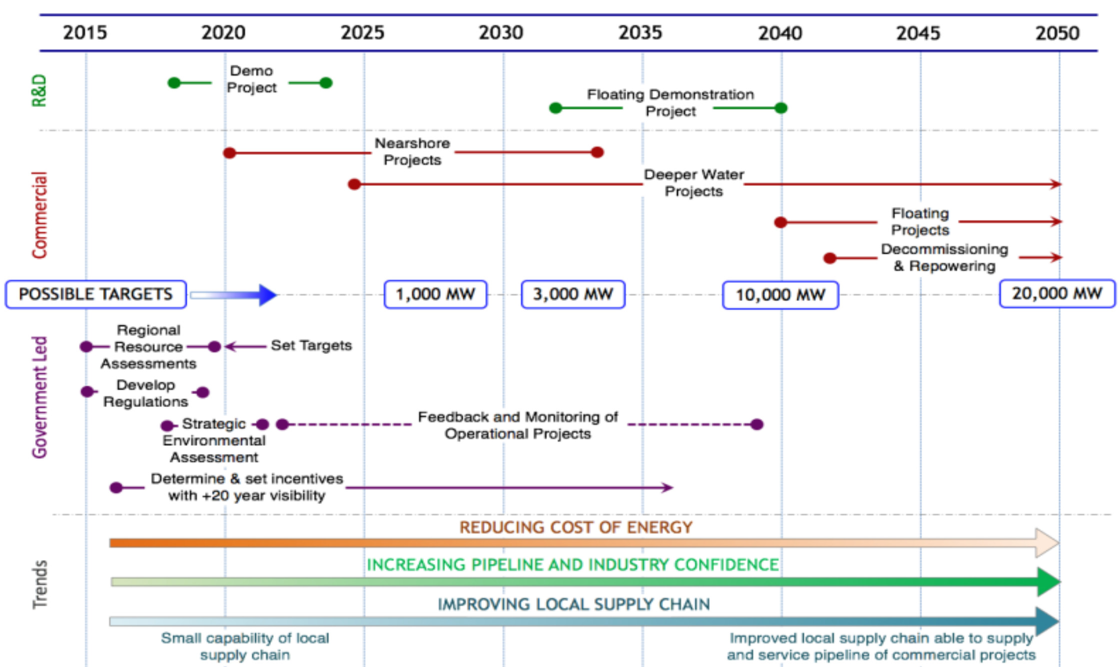
Only around 7 of India's 29 states have onshore wind energy resources that could meaningfully contribute to the country's energy mix; by looking offshore, India's wind energy potential could be increased from the estimated 100GW onshore (at 80m). Whilst offshore sites would avoid some of the issues experienced onshore, they will introduce challenges and complexities of their own, with much higher risks and capital costs.Understanding these challenges, barriers, risk factors and favorable conditions is crucial if the industry is to succeed.

An offshore wind project is a large undertaking, requiring vast amounts of capital and infrastructure. There can often be many years between projects being conceived and then starting to generate power. Within this time a project's developer will be required to gain the appropriate agreements, licenses and consents, design all aspects of the infrastructure, raise sufficient finance and then procure all of the necessary components and services under a carefully considered contracting regime. Understandably, there are many hurdles within this time and, hence, there are many elements that could prevent the project from progressing to a final investment decision. The construction phase is the most risky part of any project and issues experienced can quickly lead to large cost overruns and delays unless properly managed.

Once constructed and commissioned, a project can expect to operate for 20-25 years after which, some of its infrastructure will be decommissioned whilst other components could be reused and the site repowered.

Offshore wind development in India will, very likely, commence with an initial demonstration project, potentially funded by the state as an R&D project – as has been the case in most other countries with offshore wind industries. If the policy and support conditions are favorable, subsequent projects are likely to start being developed shortly afterwards and will begin to come online towards the late-2020s. Initially, these first commercial projects will tend to be close to shore, in regions of good wind resource and ideally in shallow water. These conditions will help to keep the development costs down and allow project developers to gain more experience and learn new lessons, thus further demonstrating the prospects for the industry.

ITP has been supporting the development of offshore wind in India since 2013, through three projects funded by the UK Government's FCO Prosperity Fund. This work has provided guidance and strategic advice to inform the creation of India's policy and regulatory framework. An early aspect of this was the development of a roadmap to illustrate how an offshore wind industry could evolve in India. The following graphic is an indication of the milestones, activities and capacity that could be added over the coming decades – following a trajectory currently being seen in Europe. *[Please get in touch for further information on these projects and their outputs.]*



The roadmap provided a series of recommendations to support the early development of India's offshore wind industry:

- To select sites and set targets for the project development, regional wind resource assessment programs should be commenced in Gujarat and Tamil Nadu (the two most energetic regions), by installing equipment and gathering data from long term, hub-height wind measurements at offshore sites.
- Develop a mechanism by which suitable offshore sites can be identified, allocated and leased by the government to project developers.
- Carry out initial Strategic Environmental Assessments (SEA) into the key regions of interest for offshore wind development and develop a sector plan.
- Ideally, establish a single window agency incorporating all Governmental authority responsible for offshore wind for the facilitation and issuance of project consents and licenses.
- Research suggests that, offshore wind energy projects can generate an average of 18 - 25 jobs (direct and indirect) per MW (for 1 year each) across the supply chain. For this reason, skilling Indian workforce and commitment to safe working practices are important for the industry to become a success in India.
- R & D strategy, into local issues, relevant to the needs of the industry will help to overcome barriers and challenges of this nascent industry, which may be unique to India's condition.

Consenting and financial support are two critical elements of policy that the Government should act on to ensure the success of the sector. Strong political will and leadership is key to driving the industry forward at the birth of the sector and the Government of India's active involvement has already sent positive messages to organizations interested in developing India's offshore wind industry.

Clean Energy & Climate Friendly Agriculture – Options for Northeast India

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The northeastern states in the Indian Republic comprise the Seven Sisters of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. The GB Pant Institute of Himalayan Environment & Development states that the North Eastern Region (NER) harbours the largest number of endemic and Schedule I species in India. Of late however, this fragile environment, hitherto protected by geographical and cultural isolation from rest of India's mainland, has come under threat from demands of unplanned economic development. Agriculture, the backbone of NER economies, is in need of innovative approaches and greater use of clean technologies and avoidance of chemical fertiliser and pesticide, in order to preserve their unique and diverse biodiversity.

The average size of farm holdings in northeast is 1.59ha, which is very close to the all-India average of 1.6ha. However as agriculture in NER is free from use of pesticide and chemical fertilisers, the productivity and profitability of agriculture is lower. To improve this, and arrive at a balance between farm size, inputs and productivity, innovative approaches to energy use could be a major driver. Especially, in terms of food processing and cold-chain development these innovations could make the sector become more viable by reducing losses in transport and processing. However the challenges are to ensure such energy efficient interventions are low-cost and thus affordable by the user.

Prominent applications of energy use in agriculture include drying, which can be carried out at various scales (small, medium and large), use of electricity and thermal energy in processing, and energising cold chains. Also, pumping solutions are encouraged that can solve demand for irrigation for dry months. Given high levels of erraticism in electricity supply, these solutions actually replace use of diesel generator sets and can have bankable returns on investment. More importantly, these promote rural enterprises, which is a vital development priority in the NER.

Some of the technologies that can provide innovative solutions to agriculture and rural development practices in NER are summarised below:

Ram Pump: The hydraulic ram pump (also called hydram) is a reliable, low maintenance and self-powering sustainable mechanical water-lifting device that uses kinetic energy of the water flowing through the driver pipe to pump water to higher elevation without using conventional energy. Potential for using ram pumps is high in mountainous NER, which provides the natural head required to utilise the ram pump. Can be used to provide a low cost solution to providing irrigation for fruits and vegetables in an environmentally sustainable manner.

Dryers: Dryers have a tremendous potential for impact in NER states, owing to the high market value of their products. Items like galangal, ginger, bambooshoot, wild apple, gooseberry, cardamom, pork, chillies and so on are valued highly in organic markets. However, dryer technologies have not penetrated to the extent needed. Some of the dryers that can be successfully introduced in NER are low-cost, and can be modified to be constructed entirely using locally available materials. These can use a solar collector and an array of trays. The collector collects the heat and transmits to the trays using thermal convection. The whole system cost can be lower than INR 6,000 (Indian rupees six thousand), or roughly USD 100.

Some of the other innovative technologies that can be applied to enhance efficiency of agriculture in NER include floating PV technology for sustainable fish-farming and electrification, especially in Assam. *Hydroger* is a locally made hydropower generator, made by Nagaland Empowerment of People through Energy Development (NEPeD), which can be used for fruit and food processing, and thermal energy storage systems that can be used for low cost preservation of crops, vegetables and flowers.

Figure 2. Ram Pump in operation in Nagaland. Image Courtesy – NEPeD, 2017

Figure 1. Solar Collector – dryer on display in Guwahati campus; image courtesy Assam Energy Development Agency

Table 1 gives some details:

	Technology	Description / Application	Remarks
1	Ram pump	Hydraulic pump that does not need any electricity, lifts water using natural gradient	Very useful for providing irrigation through drip and sprinklers for horticulture and floriculture
2	Hydroger	Low-cost, turbine for mini hydro (1 kW – 5 kW) designed in NER for NER applications	Can be extensively used for electrification and (micro) enterprise development
3	Floating PV	Uses state-of-the-art aerators for higher productivity of fish farms	Can be utilised with smart storage options for improving fish productivity
4	Dryers	Simplest options use solar convection, efficiencies can be improved using	Wide range of applications that can improve overall efficiency and reduce
5	Biomass gasifiers	Uses biomass for generation of energy	Can use excess biomass, usually burnt in the field, for generation of electricity and powering enterprises

Development of SEforALL Investment Prospectus for Guinea Bissau

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For reasons related to the availability of funding, political instability and weak institutional and human capacities, the efforts made in economic and social development are still far from achieving the targets for the eradication of poverty and socio-economic inequalities in Guinea Bissau. The need for modern energy services (electricity, motive power, modern fuels) are huge at all levels (productive, public and residential sectors) and, there is urgency for the implementation of actions to address the country's overall economic development delays.

As part of the GEF/UNIDO project "*Promoting Investments in Small to Medium Scale Renewable Energy Technologies in the Electricity Sector of Guinea Bissau*", in addition to contributing to the achievement of the ECOWAS Renewable Energy and Energy Efficiency policies' targets and goals for 2030 and the Sustainable Development Goal 7 (SDG-7: "Ensure access to affordable, reliable, sustainable and modern energy for all"), Guinea Bissau developed its National Renewable Energy Action Plan (NREAP), its National Energy Efficiency Action Plan (NEEAP) and its SEforALL Action Agenda (AA). According to these plans, the following targets were set for the country:

- At least 80% of the population will have access to electricity in 2030;
- By 2030 it is expected that at least 50% of on-grid electricity and 80% of the off-grid electricity generated from mini-grid and isolated systems, will come from renewable energy sources;
- At least 75% of the population will have access to modern sources of energy for cooking (e.g. cleaner cookstoves);
- Adoption of rational and efficient energy production and consumption practices.

To operationalize the actions proposed in the country SEforALL AA as well as the targets established in the NREAP and NEEAP, the SEforALL Country Action process foresees the development of the SEforALL Investment Prospectus (IP), which aims at identifying and integrating a pipeline of investment projects that will contribute to the achievement of those national targets and simultaneously attract possible project developers and financial institutions.

Since September 2016, ITPEnergised has been supporting the Ministry of Energy and Industry of Guinea Bissau in the development of the country's SEforALL Investment Prospectus as part of the GEF/UNIDO project above referred. The IP includes the description of more than 20 projects seeking financial and technical aid to be implemented in the country. The project kick-off meeting and two drafts of the IP have been developed and shared with the country stakeholders to collect feedback. ITPEnergised is now in the process of producing the final draft and presenting it at a workshop to be held in Bissau for final validation.

Electronic Waste Management in India and its Climatic Perspective

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Electronic waste or e-waste is the waste generated from discarded/end of life electronic items. In recent times with change in lifestyle of people all around the world, high demand of new and improved electronic items and technology obsolescence, generation of e-waste has seen a huge rise. With generation, comes the problem of proper management and handling. India is one of the leading producers of e-waste, being among the top five major e-waste producing countries in the world. India is experiencing rapidly increasing rates of consumption of electrical and electronic products and with government paving its way towards digitalization this rate is likely to go up.

The government, under E-waste (Management) Rules, 2016, has, for the first time, also brought under its purview, the management of the waste generated from disposal of Compact Fluorescent Lamp (CFL) and other mercury containing lamps. These items were not covered under the earlier rules, framed five years ago. Under the new set of rules the responsibility of manufacturers, refurbishers, dealers, state government and consumers have also been included. New economic instruments like `e-waste exchange' and `deposit refund scheme' will act as incentives for consumers to voluntarily adopt the system of waste management. The rules have been made stricter reflecting Indian government's commitment to environmental governance.

Today, dismantling of e-waste is mostly done in an unorganized and unscientific way. In India, 95% of e-waste is handled by the informal sector - unregulated and does not follow the prescribed environmental norms for handling hazardous substances. People are interested in getting precious metals like gold, silver, platinum etc. They take it out of the e-products by using primitive technologies like manual extraction, exterior burning and dumping in landfills. All these cause environmental degradation as well as health deterioration of the workers who are engaged in recycling without following any rules. To address these issues, the environmental community and government agencies have developed a collection of certifications to market correct recycling.

In India most of the formal recycling facilities have been registered with Central or State Pollution Control Board and the certifications which are widely prevalent are ISO 14001, OHSAS 18001, ISO 9001, ISO 14000 and R2/RIOS.

According to Global e-Sustainability Initiative (GeSI) and StEP e-Waste Academy co-hosted by the United Nations University, precious metal deposits in e-waste are 40 to 50 times richer than mines from where these ores are extracted but unfortunately only 15% of these precious metals are being recovered from e-waste, while the rest still lies in landfills. The term urban mining relates to mining for precious metals from discarded e-waste leading to a significantly lower carbon footprint as compared to mining precious metals directly from ores in the ground and processing them.

We developed a model to estimate based on clean development mechanism (CDM) methodology proposed by UNFCC, to estimate the emission reduction by extracting base metals, precious metals and plastics found in abundance in e-waste. Emission reduction can be estimated by calculating the difference between (i) the energy used for production of metals and plastics from virgin materials (baseline emission) and (ii) the production of the same metals and plastics from e-waste recycling (project activity emission). The sample items taken for this model in India for the year 2014 and 2015 were mobile phones, desktop and television since their market demand, rate of penetration and discarding is higher than rest of the products. The materials extracted from these e-wastes for this study model were aluminium, copper, silver, gold, tin, palladium and plastics (ABS - acrylonitrile butadiene styrene and HIPS - high impact polystyrene). The model gave the result that if we had extracted the materials from all those leading items contributing to e-waste volume in India in year 2014 and 2015, then the emission reduced would have been 1.78 $MtCO_2e$ which is quite an eye opener.

In conclusion, we say that thee-waste challenge in India can be converted into an opportunity by taking an integrated approach including technical aspects, policy level, implementation and most importantly mass awareness. This will also help us in setting standards of global environment and occupational health in the context of e-waste recycling.

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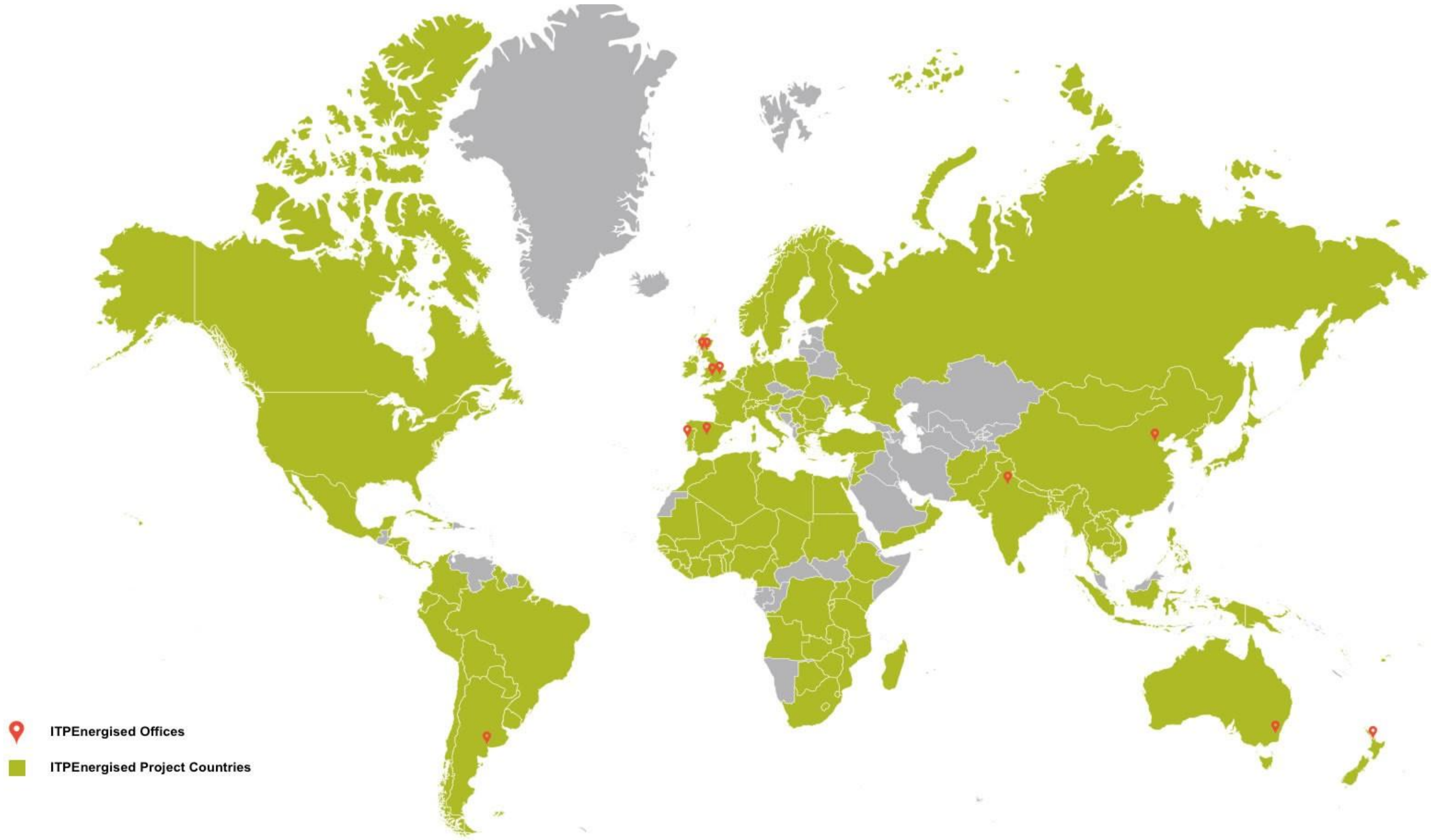

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