Development of North East with Solar Energy

100% Renewable Energy Future for Northeast

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Background of North East

- NE has got one fourth of forest resource of India.

- Northeast India constitutes about 8% of India's size; roughly $\frac{3}{4}$th the size of the state of Maharashtra.

- Its population is approximately 40 million (2011 census), 3.1% of the total Indian population; roughly equal to that of Odisha.

- Still Energy shortfall is a concern for NE in terms of Electricity, grid connectivity and cooking Gas.
Over the period, erosion of Forest reserve is also concern as in over some period more than 500 Ha of forest reserve has been lost.

So, this presentation will seek solution towards Electrical Energy on Grid Connected, Off grid, Hybrid and micro and mini-grid basis and Cooking gas on individual and community basis even through pipeline network basis.
Solar Power

- Solar power in India is a fast developing industry

- Cumulative installed grid connected solar power capacity of 7565 MW as of 31 May 2016, with a proposed target of 100 000 MW by 2022.

- India is ranked number one in terms of solar electricity production per watt installed, with an irradiance of 4.5 to 7 Kwh (kilowatt hours).
India's solar resource
With about 300 clear, sunny days (in NE approx 260 to 280 days) in a year, India's theoretically calculated solar energy incidence on its land area alone is about 5000 trillion kilowatt-hours (kWh) per year (or 5 EWh/yr).

The solar energy available in a year exceeds the possible energy output of all fossil fuel energy reserves in India. The daily average solar power plant generation capacity over India is 0.20 kWh per m² of used land area, which is equivalent to about 1400–1800 peak (rated) capacity operating hours in a year with the available commercially-proven technologies.
<table>
<thead>
<tr>
<th>Electrification Levels</th>
<th>States/Union Territories</th>
</tr>
</thead>
<tbody>
<tr>
<td>90% and above</td>
<td>Himachal Pradesh (96.6%), Punjab (95.5%), Chandigarh (97.3%), NCT of Delhi (97.8%), Sikkim (90.2%), Daman &amp; Diu (98.3%), Andhra Pradesh (89.7%), Dadra &amp; Nagar Haveli (91.7%), Goa (95.6%), Lakshwadeep (99.8%), Tamil Nadu (90.8%), Kerala (92.1%) and Puducherry (95.8%)</td>
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<tr>
<td>Between 80-89%</td>
<td>Jammu &amp; Kashmir (80.7%), Uttarakhand (83.1%), Haryana (87.2%), Gujarat (85%) and Karnataka (86.7%)</td>
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<td>Between 70-79%</td>
<td>Nagaland (75.2%), Chhattisgarh (70%), Maharashtra (73.8%) and A&amp;N Islands (79.4%)</td>
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<td>Between 60-69%</td>
<td>Manipur (61.2%), Mizoram (68.8%) and Tripura (59.5%)</td>
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<td>Between 50-59%</td>
<td>Rajasthan (58.3%), Meghalaya (51.6%), Arunachal Pradesh (55.5%) and Madhya Pradesh (58.3%)</td>
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<tr>
<td>Between 40-49%</td>
<td>West Bengal (40.3%)</td>
</tr>
<tr>
<td>Less than 40%</td>
<td>Uttar Pradesh (23.8%), Bihar (10.4%), Jharkhand (32.3%), Assam (28.4%) and Odisha (35.6%)</td>
</tr>
</tbody>
</table>

Source: National Census 2011
So, in general NE is not blessed with good Electricity connectivity i.e. grid connectivity.

India has a 400 million energy poor population....

- Nearly 75 million rural households without grid connectivity nationally. NE % is further poor.

- The corresponding figure for urban households is 6.5 million.
Residents of off-grid villages resort to burning kerosene in basic lanterns to produce light at night in villages and tribal areas.

The average off-grid rural household in India spends Rs. 150 ($3) per month for 5 liters of kerosene for lighting.

Many electrified villages also face severe shortage of electricity 33% of the Indian population is estimated to be facing significant under-electrification-accessing less than 50 kWh of electricity per month/household.
Relevant RE Technologies

- MW Solar PV project ground mounted
- SPV Lighting and pumping system
- Solar Home Lights: Solar PV System
- Solar Street Lights
- Solar Lanterns
Roof Top Solar PV system

- Grid connected system with Net metering / without net metering
- Offgrid system (with battery back up)
- Mini grid system (upto 10 kw)
- Micro grid (more than 10 Kw)
- Solar Home Light (DC system)
Grid Connected PV System

- Rooftop solar PV is connected to the distribution system and ingestion of power is into a load center thereby avoiding transmission and distribution (T&D) losses
- This is a strong rationale for rooftop solar projects in India, where the national average of T&D losses hover at close to 30%
- Two types of Net metering model - Self owned net-metering model and other Third party owned Rooftop PV net metering model
- Generation Based Incentive (GBI) or capital subsidy or tax incentive may be adopted to bridge the difference between the higher cost of solar generation and applicable retail tariff for the consumer categories.
**Net Metering and FiT**

- **FiT**: Feed in Tariff is (advanced renewable tariff or renewable energy payments) is a policy mechanism designed to accelerate investment in renewable energy technologies. In Germany, Thailand, FiT was implemented in place of Net metering, that is why Roof Top Solar PV became so popular.

- In Net metering policy there are so many caps, if and buts, that is why in other countries with Grid connected Roof Top has not been so successful.

- MNRE, GoI has framed policy for both but DICOMs are in favor due to some obvious reasons.
Roof Top Solar PV system

Net Metering Policy is not available in the following states/Union Territories of North East:

- Arunanchal Pradesh
- Meghalaya
- Mizoram
- Tripura
- Nagaland

Due to paucity of demand, MNRE, Govt. of India has approved allocation for Roof top for the following states:

- Manipur – 8.4 MW
- Assam – 14 MW

As far as other states concern till date no demand has reach to MNRE (as per MNRE resources), Why?
No demand while grid system is considerably under-developed.

Gap in demand and supply.

Per capita electricity consumption is much low to national average.

Very high CFA i.e. 70% to 90%.

Still no demand of RE in NE, why:

- Low awareness
- Policy paralysis – no clarity on grid connected, off grid/mini grid/Hybrid systems
- Issues with SNAs
My solution for fast development of Roof Top PV System in India (Specially for NE):

- To start, FiT (or else Net metering) should be preferred along with Power Grid Stabilization Scheme.
- GoI should make a policy to encourage DISCOMs to adopt FiT.
- GoI should make a policy to encourage DISCOMs to adopt Power Grid Stabilization Scheme.
- In most of India (specially NE), power outage is a big fact & issue unlike developed world.
So In Indian context, Grid connected and Off grid cannot be separated. Both systems should be effected CFA

Hybrid Inverter should be encouraged

As you know that you are aware that when there is power outage, Grid tied inverters stop working (generating power) so in NE context actual power generation will be too less

Beneficiaries will not like to increase the capital cost of Roof top Solar PV project, so they should be allowed to use some part of Solar PV array installed to use as offgrid with battery to take care outage. This should be allowed with existing subsidy.
At present CFA process has been simplified to a great extent by MNRE, GoI:

- Government SPDs like Rajasthan Electronics & Instruments Ltd need not route through SNAs, they just apply MNRE online as per their allocation of CFA and CFA is approved online.

- Other SPDs to be routed through SNAs for approval of CFA and state subsidy (if any)

- This process is still with manual intervention in all cases, so it takes so much considerable time that beneficiaries/SPDs opts better to omit CFA
Solution to Roof Top PV (Specially for NE)

- It is a sad story as due to this benefit is not passed on of CFA and Roof top target of GoI will be difficult to achieve.

- The reasons for delay on part of SNAs or many: less manpower, lack of knowledge, lethargic attitude, delay tactics due to obvious reasons.

- In case it approved by SNAs, still they have to get its approval for allocation/reconciliation.

- So, for speedy approval of CFA and state subsidy, online process is must.

- The same process should be followed on BOM certification for exemption for Excise and Custom Duty on Solar projects as it is being done at MNRE level.
Solution to Roof Top PV (Specially for NE)

- Generation Based Incentive (GBI) or capital subsidy or tax incentive may be adopted to bridge the difference between the higher cost of solar generation and applicable retail tariff for the consumer categories.
- Third party Roof top system with net metering should be promoted.
- To promote Roof top Solar PV system and Solar PV system (MW scale) in NE, Wheeling Charges outside state should be nil.
- Similarly, Banking Charges should also be nil.
Solar power plants equipped with battery storage systems wherever net energy metering is implemented can use the stored electricity to feed electricity into the power grid when its frequency is below the rated parameter (50 Hz) and draw the excess cheap power from the grid when its frequency is above the rated parameter.

Every day, frequency excursions above and below the rated grid frequency are in the order of 100 times in a day.
The solar power plant owner under this scheme should get nearly double the price for the electricity sent into the grid compared to the electricity consumed from the grid if a frequency-based tariff is offered to rooftop solar power plants or solar power plants dedicated to a distribution substation.
A power purchase agreement (PPA) should not be needed for solar power plants with a battery storage system to effectively serve ancillary services operations and to transmit generated electricity for captive consumption utilizing an open access facility. Battery storage is already popular in India with more than 10 million households using batteries as back-up in case of load shedding. Battery storage systems are also used to improve the power factor.
Mini Grid

- Mini Grid has been implemented in UP with laid down approved policy way back but it is not successful, why? (1) In village, power is almost free or at very low cost due to political reasons (2) It is very difficult to collect monthly bills by SPD of Mini grid. No penalty may be imposed to consumers who do not pay bills (3) Theft of cables/evacuation system/ejection system

- In NE it is more non-practical as here houses/huts of villages are not close, so the project cost will be more and transmission losses will be more.

- Mini Grid may be successful in states with political will, dense population of villages, financially viable tariff in rural feeder and people are law fearing and disciplined like Kerala, Karnataka
So, what is the solution?:

- Stand alone/ Hybrid Solar Home light system with DC/AC option
- Subsidy should be applicable similar to Roof Top Solar PV system to households with a cap of Solar Home Light capacity to cater lighting, fan, TV, one Desktop PC, mobile charging
- Bangladesh whose grid infrastructure is too weak has shown very good progress with this model
- Banks should be advised and directed to effect loan for Roof top and Solar Home light in line with Home Loan. This guidelines has been issued by MNRE, RBI in January 2015 and most CMD of the banks have given acceptance on the policy but in ground reality it is not so.
Solar Home Light
Some matter of interest on Batteries

1. Life of battery is not based on year but on no of Cycle
2. Lithium Ion battery has very good life and now it is being cheaper
3. It’s cost is now hardly double the cost of Led Acid Batteries, so it may be more viable as it maintenance free and life is much more
4. For time being, Flow batteries are also popular in big size off grid system
5. Research and Invention on Sodium Ion, Lithium Oxygen and micro processor batteries are in full swing
Electric Vehicles and Fast Charging Stations

- At present in countries like Japan, China, USA, Electric Vehicles are in front seat. Japan has more Charging stations than Petrol pumps.
- China and USA selling more than 3 lacs Electric Cars in a year.
- India has also taken an initiative on this. Some models of small Electric Cars are available and even sedan model have been introduced this year in India market.
- GoI have started FLAME program for speedy development of Electric vehicles with new/Hybrid/Retrofitment and their charging station.
- Last year, 2 Electric bus very launched by Honorable PM for commutations of MPs.
Fast Charging Station
Electric Vehicles and Charging Stations for NE

- GoI has planned 2 lacs Electric buses during 2 years.
- GoI has planned and vision to replace all vehicles of Petrol/Diesel/CNG with Electric vehicles.
- Electric Vehicles have inherent advantage of zero emission, very low cost running and low maintenance.
- They may be charged easily with Solar PV system or with RE Hybrid system.
- This will preserve the rich flora & fauna of NE and save the environment from pollution of fossil fuels.
Solar Thermal Applications (Heating, Cooking and Drying)

- Solar Water Heater
- Solar based Purified water: Thermal/PV Based
Solar photovoltaic water pumping systems are used for irrigation and drinking water. The majority of the pumps are fitted with a 200–3000 watt motor powered with a 1800 Wp PV array which can deliver about 140,000 litres (37,000 US gal) of water per day from a total head of 10 metres (33 ft).

This is a plausible option in Assam and Manipur.

By 30 September 2006 a total of 7068 solar photovoltaic water pumping systems had been installed, and by March 2012, 7771 had been installed.
SPV Pumping System

- Solar Panel
- DC Power from Panel
- Electronic Pump Enhancer
- Water Tank
- Float Switch
- Stainless Steel Support Wire
- Bore Cap
- Outlet Pipe
- Bore Pump
- Bore
Energy policy of India § Solar energy

- We alternative is to use the water surface area available on canals, lakes, reservoirs and the sea for locating large capacity solar power plants. These water bodies can also provide the water needed for periodic cleaning of the solar panels.

- It is also possible to use highways and railways to avoid the excessive cost of land nearer to load centres and to minimize transmission line costs by installing solar power plants at a height of nearly 10 meters above the roads or rail tracks.
The solar power generated by using road area can also be used for in-motion charging of electric vehicles to bring down fuel costs. This practice would also protect the highways from damage from rain and intense summer heat and offer additional comfort to commuters.

The architecture best suited to most of India would be a highly distributed set of individual rooftop power generation systems, all connected via a local grid. However, erecting such an infrastructure, which does not enjoy the economies of scale possible in mass, utility-scale, solar panel deployment, needs the market price of solar technology deployment to substantially decline, so that it attracts the individual and average family size household consume.
That might be possible in the future, because photovoltaic is projected to continue its current cost reductions and become able to compete with fossil fuel. In the year 2016, the levelized tariff in US$ for solar electricity has fallen below 3 cents/kWh which is far cheaper than the fuel cost incurred by coal based power plants in India.

The Indian government has recently reduced the solar power purchase price from the maximum allowed levelized tariff of 5.79 Rs/KWh to 4.43 Rs/KWh to reflect the steep fall in the cost of solar power generation equipment. The applicable tariff is offered after applying either viability gap funding (VGF) or accelerated depreciation (AD) incentives.
Some noted think-tanks recommend that India should adopt a policy of developing solar power as a dominant component of the renewable energy mix, since its identity as a densely populated region in the sunny tropical belt of the subcontinent has the ideal combination of both high solar insolation and a high potential consumer base density.

In one of the analysed scenarios, India could make renewable resources such as solar the backbone of its economy by 2050, reining in its long-term carbon emissions without compromising its economic growth potential.
A recent study has suggested that 100 GW of solar power could be generated through a mix of utility-scale and rooftop solar, with the realizable potential for rooftop solar between 57 GW to 76 GW by 2024.

The Ministry of New and Renewable Energy provides a 70% subsidy on the installation cost of a solar photovoltaic power plant in North-East states and a 30% subsidy on other regions. The detailed outlay of the National Solar Mission highlights various targets set by the government to increase solar energy in the country's energy portfolio.
Government Incentives

As of the end of July 2015, the following are the five most prominent incentives:

1. Accelerated Depreciation: For profit making enterprises installing rooftop solar systems, 40% of the total investment can be claimed as depreciation in the first year. This will significantly decrease tax to be paid in Year 1 for profit making companies.

2. Capital Subsidies: Capital subsidies are applicable to rooftop (Grid connected) solar power plants. The original capital subsidy is 30% in general category states while in NE it is upto 70%.
3. Renewable Energy Certificates: Renewable Energy Certificates (RECs) are tradeable certificates that provide an incentive to those who generate green power by providing financial incentives for every unit of power they generate.

4. Net Metering Incentives: Net metering incentives depend on two aspects: a) whether the net meter is installed; and b) the incentive policy of the utility company. If there is a net metering incentive policy in our state and if there is a net meter on our rooftop, then we can get financial incentives for the power generated.
5. Assured Power Purchase Agreement (PPA): The power distribution and purchase companies owned by state and central governments guarantee the purchase of solar power as and when it is produced. The PPAs offer a high price equal to that of the peaking power on demand for the solar power which is secondary power or negative load and an intermittent energy source on daily basis.

6. Exemption of Excise and custom duty as per BOM certified by Empanelled Chartered Engineers of MNRE, GoI 7. Up to 90% subsidy for street light and Solar home light in NE.
Hybrid Solar Plants

- In India, solar power is often built to be complementary to wind power as it is generated mostly during the non-monsoon period in daytime. Solar power plants can be located in the inter-space between the towers of wind power plants or nearby areas with a common power evacuation facility.
- Hybrid model should also be explored with Hydro, Bio Mass, Bio Energy.
Hybrid Solar Plants

- It is also complementary to hydro electricity which is generated mainly during India's monsoon months. Solar power plants can be installed close to existing hydro power and pumped-storage hydroelectricity plants with the advantage of being able to utilise the existing power evacuation infrastructure jointly and store the surplus secondary power generated by the solar power plants.

- NE must pan in same direction for successful development of RE
Hybrid/Standlone Bio Digestors for Energy, all type of waste and Sanitation solution:

- Bio Gas, Electricity, Bio CNG, Cow milk, Phenoyl, medicines and other byproducts through Gau Grams and Gau Shala Corridors around the periphery of Cities

- Development of Gau gram near smart cities
- Integration of Gau shalas and Gau Gram to one Umralla
- Value addition and diversification of Quality and healthy Dairy and milk products
- Discouragement to Buffalos for milking
Hybrid/Standlone Bio Digestors for Energy, all type of waste and Sanitation solution

- Up skilling and skill Development in this sector
- Use of Bio Gas to Bio CNG and this for transportation of vehicles and Power generation through Micro turbine (more efficient than DG Set).
- Bio Fertilizer Promotion
- Organic Farming
- Above model is very financially viable as its IRR may be more than 30%
- We, ISECERE are ready to implement this hybrid model in Assam or any other NE state.
(1) Application
It is designed for medium and large farm, medium and large amount of waste water or medium and large size of MSW treatment.

(2) TECHNICAL DATA

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<th>Raw material</th>
<th>Waste capacity: For 260M3</th>
<th>Waste capacity: For 1380M3</th>
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<td>Pig manure</td>
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<td>Vegetable</td>
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Thanking you
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