



Sustainable Electricity Access - Some Thoughts

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Dr.Ramarathnam was invited to join System Evaluation Group-4 for LVDC systems by International Electro-technical Commission, Geneva, Switzerland. Recently at the conference in Kenya he read a paper “Smart Micro Grid Rooftop Solar System with DC Appliances”. We are giving below his reflections on the conference.

I attended the recently concluded ‘LVDC Conference on Sustainable Electricity Access’ in Nairobi, Kenya on May 22 & 23, 2017. Apart from the opening ceremony there were four sessions, spread over the two days. These dealt with the following themes:

- Defining Electricity Access
- Financial Aspects of Electricity Access
- Project Implementation &
- Technological Solutions

India, having the largest population of people without electricity access and Africa where two out three people are without electricity access were the focus of the deliberations. That LVDC (Low Voltage DC) would be the key enabler in gaining access to electricity in these two regions was a key take away from the conference. There was also unanimous agreement that LVDC forum should learn from the high growth and deep penetration of Mobile Telephony and Internet.

I also noticed that most of the speakers in all the four sessions were focusing on efforts to the remote and un-served areas in an incremental manner. A graded Tier wise approach was in fact advocated by a speaker even in the technology session. Starting with a light or two in the homes (Huts) a graded approach from Tier 1 to 5 was being mentioned as the way to move ahead. Starting from a low power of about 10 Watts the plan is to upgrade to about a few hundred watts. Perhaps mine was the only speech which dealt with specific examples of higher power ratings, mostly for motorized loads. There was another speaker who gave examples of water pumps for agricultural & potable water schemes. Otherwise almost everyone was talking about incremental approach in enabling access to electricity for the populace.

On my flight from Nairobi to Mumbai, I was musing about the proceedings of the conference. I also felt that the approach to Electricity Access has to be much more aggressive and purposeful in order to usher the nearly 4 Billion people with limited or no access to electricity into a fast track mode towards progress. The incremental approach that was talked about would not be quick enough for this task and it will take many decades to improve their lot.

The conference correctly identified that we should learn from the quick progress of mobile telephony and Internet. In fact it is in these areas that millions of people in India & Africa leap frogged into a new era, quickly and seamlessly. Millions and millions of people who have not seen a telephone in the land line era are now proud owners of a mobile phone, mostly likely a smart phone. Similar observation for the Internet connectivity as well. Having rightly identified Mobile Telephony & Internet expansion as the role models, why not replicate the leap frog model for gaining electricity access as well. Any why the incremental approach? LVDC should be used as a springboard to leap frog and enable the billions with electric power and empower them.

There is an over emphasis on lighting & low power equipments with respect to electricity access. Instead I feel that focus should be on productive use of electricity for Water, Health, Food & Agriculture and Livelihood, in that priority. Unless the electricity access enables the billions, with little or no access now, to such productive uses, the access by itself would not be meaningful or transformational. During the conference the keynote speaker from Namibia touched every attendees' heart, when he depicted the typical picture of an African Woman. The description of a woman, carrying her child on her back and a stack of firewood on her head and two pails of water in both her hands, touched almost everyone at the conference! This depiction is equally valid for her Indian counterpart also. It is not uncommon to see such women in interior parts of India, like Marathwada, Telangana, AP, North Karnataka and Tamilnadu, some of the better developed states in the union. One need not talk of areas in UP, Bihar, MP, Chhattisgarh, Rajasthan, Jharkhand & Orissa not to talk of the neglected North Eastern region. Unless electricity access efforts address and eliminate this scenario, it will not be sustainable.

1. **Water:** Water must be the top priority as it is the lifeline of human beings and animals. Coupled with proper rainwater harvesting, creation & preservation of water bodies extraction and pumping forms a key requirement. Energy is required for pumping as well as purification of water. In fact we have a solar energy based solution for water pumping & purification. A prototype that we have built uses a 2 kW solar panel for handling 6000 Litres per day and giving an output of 1500 Litres of good water and 4500 Litres of waste water with sunshine of about 5 hours in a day. External grid power is not required normally. The waste water can be used for cleaning, flushing and other requirements. This system will easily handle the potable water needs of a hamlet with a population of about 150 people. The system can be expanded or downsized depending on the actual needs of the local site. Bigger pumps for water for agricultural needs also can be addressed by solar pumps. Such pumps could also serve a collection of farms in a village or community.
2. **Healthcare:** Another key area is the healthcare sector. Typically a primary health centre needs to store the medicines and vaccines for the local area. Normally a refrigerator with a freezer compartment can store such items. We have developed three sizes, 50, 170 & 300 Litre capacity units with 6, 16 & 60 Litre capacity freezer compartments. The power requirement of these LVDC models are so low and a battery backup for the night time is easily done. Thus a 24 x 7 storage solution is possible for such PHCs (Primary Health Centres).
3. **Cold Storage:** Cold storage finds another important application in food storage and processing units. Vegetables, Fruits, Milk, Meat and Fish need to be stored in cooled containers to enhance their shelf life. The temperature varies for around 10⁰ C for fruits and vegetables to sub-zero temperatures for meat and fish items. Provision of such holding facility considerably enhances the bargaining power of the poor farmer or fishermen. Cold storage plants using air conditioning, refrigeration and deep freeze units are available from our range. The LVDC powered refrigeration equipments consume very little power and energy and can easily be provided with back up batteries for a total solution. Such cold storage units will play a key role in reducing the wastage of such items and add significantly to farmers' yield, simultaneously increasing his competitiveness. By any estimation about 30% of the food articles are wasted from farm to the table of the end user.
4. **Livelihood:** Almost all governments face the bleak prospect of jobless growth, if at all there is growth. Provision of jobs to the teeming millions who are entering the job market every month & year is a formidable task faced by the governments all over the world, especially in South Asia and Africa. Hence it is inevitable that most of them would look for self employment. Whether it is agriculture, commerce, tourism or industry, energy is a key element of the process. Access to electricity should also focus and resolve this issue as well. Productive use of electric energy is reflective of the progress made by society as a whole. Many, if not all, implements require electric power in agriculture and industry. Thousands and thousands of

MSME (micro, small & medium enterprises) have to blossom in tackling the huge unemployment problem faced by developing countries. Distributed generation and local consumption with LVDC powered equipments could easily address this issue. Most of the implements would require power in fractional or small HP motors and provision of energy efficient DC motors would be handy in powering them. Many equipments like drill, lathe, grinder, air compressor, etc., could be powered directly from solar panels. At least one shift of production could be ensured without depending much on the power grid and even in remote places. This would guarantee at least a safe level of livelihood for these people. The list could be endless for use in small tools used in agriculture, artisans and micro industries. As these people are not burdened with historical baggage of AC powered equipments, a fresh start can be made.

In conclusion, LVDC systems with distributed generation using local renewable resources, a smart micro grid and super efficient DC appliances could be the way ahead to enable meaningful electricity access to the millions of the underprivileged in South Asia and Africa, the two areas where such access is limited or non-existing. Energy consumption, particularly the per capita

electricity consumption, is a pointer and is correlated with development of the society as a whole. LVDC systems could empower such populace in a swift and sure way on a path to sustainable development. The environment is also protected simultaneously as green energy is used. Solar cookers and thermal systems could be used for heating and cooking, another area where efforts are needed. There has to be a pro-active and aggressive approach to enable the leap frogging of these people into the modern era using LVDC as a springboard. Technology already exists for this. This approach would also ensure massive employment for the underprivileged simultaneously. The governments and local administration along with NGOs and Foundations should avoid the incremental approach and aggressively pursue this technology enabler.

One major advantage of our system is that as and when the grid power comes to the village or hamlet, the LVDC system is easily interfaced with it. This is done in a seamless manner. The battery backup can still be retained to give uninterrupted power for the select loads. Also due to the super efficiency of the DC appliances, the power requirement from the grid is drastically reduced. The near unity power factor will also hugely benefit the incoming grid. Besides the quality of power supplied by the LVDC Micro Grid will be superior in terms of input voltage fluctuations.

An incidental advantage is the huge employment potential made possible for selling, installation, commissioning and after sales servicing of the DC system. We have structured training courses for all these areas. Additionally local value addition is also possible with respect to sub systems and components of the system and appliances. We also envisage training disabled persons in all these aspects which will open betterment possibilities amongst the physically disabled people in line with recommendation of the UN CRPD (United Nations Convention on the Rights of Persons with Disabilities). Special training programmes can be devised for such people.

Thus this holistic approach combines several key parameters for the sustainable development of the underprivileged people on the face of the earth - Access to Quality Electric Power in the area of water, healthcare, cold storage and enhancement of their livelihood activities. By using mostly green energy it is environmentally friendly and it also opens up the possibility of a meaningful and focused deployment of the under privileged people and more so the disabled amongst them.

DC power distribution directly from PV to PC and LED

