THE NATIONAL SOLAR ENERGY MISSION

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INTRODUCTION

Historically, solar technologies were propagated in India mainly for off-grid and electricity substitution applications. What is attempted here is the logic, imperatives, and vision behind the recent policy developments leading to multi-megawatt scale grid-connected application of solar photovoltaic and solar thermal technologies. In theory, one percent of India's land that is utilized for solar generation could supply all its electricity needs by 2030. However, if this potential of solar energy is to be achieved in practice, it should, in the long term, meet the three important thresholds of cost, availability, and reliability.

Firstly, the cost must be competitive, with at least the highest priced electricity produced coming from liquid fossil fuels. So the tariff should come down to around Rs. 10 per kWh. This price can also be supported with the argument of internalizing the cost of externalities of conventional power in its pricing. Solar power generation is emission free and hence the avoided cost can be considered to give a preferential tariff.

Secondly, solar power should be 'dispatchable,' which means power must be available when customers need it. Therefore energy storage will become critical for large-scale grid-connected development of solar power. Several new storage technologies are being developed and the potential for their deployment is significant; however, cost effectiveness of a solar generation project with storage would be important.

Thirdly, reliability can be ensured by judicious grid mixing of diverse renewable sources, like hydro, geothermal, and biomass based generation. Modern technologies for energy forecasting and dispatch management can also help.

The recent attempt in India to evolve a policy framework for grid-connected solar power, stems mainly from the global concerns about climate change and the need for future energy security. On 30th June, 2008 the Prime Minister's Council on Climate Change approved a 'National Action Plan on Climate Change' (NAPCC). The new outlook is best explained in the introductory paragraph of the NAPCC document: "India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change. This threat emanates from accumulated greenhouse gas emissions in the atmosphere, anthropogenically generated through long-term and intensive industrial growth and high consumption lifestyles in developed countries. While engaged with the international community to collectively and cooperatively deal with this threat, India needs a national strategy to firstly, adapt to climate change and secondly, to further enhance the ecological sustainability of India's development path. "

The NAPCC outlined its implementation strategy through the establishment of eight National Missions. Out of these, two were in the field of energy, viz, the National Solar Mission and the National Mission for Enhanced Energy Efficiency. Once effectively established, the National Solar Mission will have the greatest impact in greening our energy system. So the intent is to dwell on the concept, framework, organization structure, and expectations relating to this most vital initiative of the Government of India. But before

doing so, we need to look at the preparatory work undertaken to introduce a policy framework for grid-connected solar power in India.

PREPARATORY WORK

Several such actions were taken when this writer was working as Secretary to the Ministry of New and Renewable Energy, Government of India. Enough preparatory work was undertaken within the Ministry, and through outside consultants, to evolve a policy framework. The Ministry accelerated the work of preparation for the solar Radiation Atlas of the country. The Pune-based World Institute of Sustainable Energy (WISE) was appointed to prepare an important background study, viz, 'A Techno-Economic Evaluation of Solar Power Generation Technologies for Determination of Model Tariffs and Incentives in India.' Another important initiative was the introduction of the Generation Based Incentives (GBI) scheme for grid-connected solar projects.

The Techno-Economic Feasibility Study: The primary objective of the study was the techno-economic feasibility study for various solar power generation technologies and configurations for deployment in India. The following were the expected outputs:

- Estimation of costs for PV and CSP type of power projects for two sites in India.
- Estimation of annual energy generation at selected locations.
- Estimation of cost of generation and desirable tariff structure for both types of technologies.
- Suggestion of outlines for possible innovative financial mechanisms for support of these technologies other than capital subsidy.

Three main categories, viz, Solar PV, Solar CPV, and Solar CSP were studied in eleven different configurations. The summary of the simulation outputs from the techno-economic calculations are presented in the table below, in respect of the Jodhpur location:

Sr. No.	Site	Jodhpur		
	Type of System	Cost of Generation (Rs/kWh)	Tariff (Rs kWh)	Net specific energy yield (kWh/kWp)
1	CSP-Dish	6.79	10.60	2720
2	CSP-Fresnel + Storage	6.99	11.09	3840
3	CSP-Dish + Storage	7.18	11.08	3840
4	CSP-Fresnel	7.23	11.59	1600
5	CSP-Trough	7.89	12.31	2048
6	CSP-Trough + Storage	8.07	12.45	3840
7	CSP-Tower	8.97	13.80	2240
8	CSP-Tower + Storage	9.32	14.20	3840
9	HCPV	10.08	15.35	2190
10	PV-Fixed	12.31	19.21	1559
11	PV-Tracking	12.70	19.33	2062

These are broadly indicative figures. The above tariffs approximately result in a post tax return on equity of 14% and a post-tax project IRR of approximately 11.6% for each of the above configurations. It is clear that today CSP systems offer lower costs of electricity in comparison to PV systems; HCPV systems offer the lowest levelized cost of electricity from

amongst the three PV systems studied. Dish systems offer the lowest levelized cost of electricity from amongst the four **thermal** systems studied. However the lower indicated tariffs for Fresnel, dish and CSP systems with storage have yet to be commercially proven. A tariff of Rs. 12/kWh would suffice for most CSP configurations provided that these systems are installed with a large project scale of hundreds of MWs which will bring down per MW capital costs. The higher energy output from tracking PV systems do not add much value in terms of cost reduction since the additional tracking and O&M costs outweigh the added energy generation. This analysis would show that, till the technologies achieve grid parity (expected around 2015-17), it is imperative for the Government to put in place adequate incentive structures which would make investments in the sector attractive from the standpoint of project equity and loan, without putting undue burden on the state or the consumers.

THE NATIONAL SOLAR MISSION: THE CONCEPT

The Mission approach in programme implementation is not new to India. During the 1980s, India launched some important national missions. The Technology Mission on Drinking Water and related water management was launched in 1986. It was also called the National Drinking Water Mission (NDWM) and was one of the Societal Missions launched by the Government of India. The NDWM was renamed Rajiv Gandhi National Drinking Water Mission (RGNDWM) in 1991. Subsequently a few other programmes were also launched in the mission-mode. The Mission approach is adopted with the following objectives in mind:

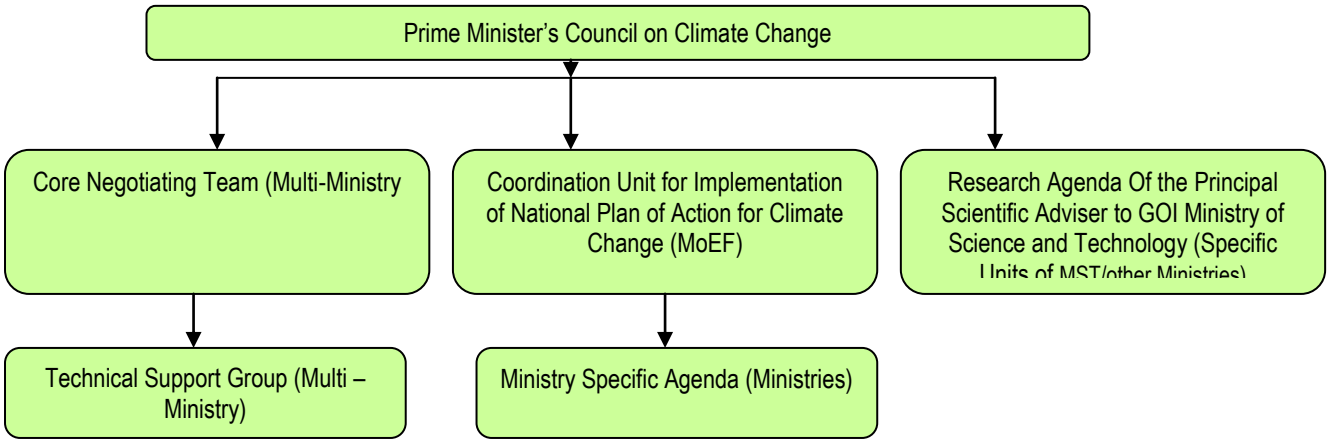
- To ensure maximum inflow of scientific and technical inputs into the relevant development programme.
- To ensure cost-effectiveness of the development programme.
- To facilitate performance improvements.
- To ensure accelerated and effective implementation within a defined time-frame.

The NAPCC document declares that a National Solar Mission will be launched "to significantly increase the share of solar energy in the total energy mix." It continues, "Solar energy…has great potential as a future energy source. It also has the advantage of permitting decentralized distribution of energy. Photovoltaic cells are becoming cheaper with new technology. There are newer, reflector-based technologies that could enable setting up megawatt scale solar power plants across the country. Another aspect of the Solar Mission would be to launch a major R&D programme, which could draw upon international cooperation, as well, to enable the creation of more affordable, more convenient solar power systems, and to promote innovations that enable the storage of solar power for sustained, long-term use."

The National Missions proposed in the NAPCC will be institutionalized by respective ministries and will be organized through inter-sectoral groups which include, in addition to related Ministries, the Ministry of Finance and the Planning Commission; and experts from industry, academia, and civil society. The institutional structure would depend on the task to be addressed by the Mission and will include providing the opportunity to compete on the best management model. A 'Comprehensive' Mission document, detailing objectives, strategies, plans of action, timelines, and monitoring and evaluation criteria, was expected to be developed and submitted to the Prime Minister's Council on Climate Change by December 2008 by the Ministry of New and Renewable Energy. The Council will also periodically review the progress of the Mission. The Mission will report publicly on its annual performance. The Mission will be tasked to evolve specific objectives spanning the

remaining years of the 11th and 12th Plan periods. Where the resource requirements of the Mission call for an enhancement of the allocation in the 11th Plan, it will be suitably considered, keeping in mind the overall resources position and the scope for re-prioritization.

In order to respond effectively to the challenge of climate change, the Government has created an Advisory Council on Climate Change, chaired by the Prime Minister. The Council has broad based representation from key stake-holders, including Government, industry and civil society, and sets out broad directions for national actions in respect of climate change. The Council will also provide guidance on matters relating to coordinated national action on the domestic agenda and review of the implementation of the National Action Plan on Climate Change, including its R&D agenda. The Council would also provide guidance on matters relating to international negotiations. including bilateral, multilateral programme for collaboration, research, and development. The organization chart of the institution arrangement is as follows:



Research and development of technologies would be an integral component of the Mission's objectives and activities. The proposed R&D activities, in respect of solar photovoltaic generation, for the near and medium term, would include improvement in solar cell efficiency to 15% at the commercial level; improvements in PV module technology with higher packing density and suitability for solar roofs; and development of lightweight modules for use in solar lanterns and similar applications.

Proposed R&D activities in respect of solar thermal power generation would cover design and development of concentrating solar thermal power systems, including parabolic troughs, central receiver systems, and dish/engine systems. The R&D effort should be directed mainly at reducing costs of production and maintenance, and include both production design and fabrication/assembly techniques. In addition, R&D should cover balance of systems issues, hybridization with biomass combustion based systems, and thermal storage.

The NAPCC document, while detailing the objectives of the Solar Mission recognizes the need for transfer and capacity building. The document says that, specifically, the National Solar Mission would be responsible for:

a) The deployment of commercial and near commercial solar technologies in the country.

b) Coordinating the various research, development, and demonstration activities being carried out in India, both in the public and private sector.
c) Realizing integrated private sector manufacturing capacity for solar material, equipment, cells, and modules.
d) Networking of Indian research efforts in international initiatives with a view to promoting collaborative research and acquiring technology, where necessary, and adapting the technology acquired to Indian conditions.
e) Providing funding support for the activities foreseen under (a) to (d) through government grants duly leveraged by funding available under global climate mechanisms, and earnings from deployment of research sponsored by the Mission.
f) Policy and Regulatory measures for promotion of solar technologies would also be enhanced as common to all renewables based technologies.

Over the 11th and 12th Plan periods (till 2017) the Mission would aim to deliver at least 80% coverage for all low temperature (<150^{0}C), and at least 60% coverage for medium temperature (<150^{0}C to <250^{0}C) applications of solar energy in all urban areas, industries, and commercial establishments. Rural solar thermal applications would also be pursued under public-private partnerships, where feasible. Commensurate local manufacturing capacity to meet this level of deployment, with necessary technology tie-ups, where desirable, would be established. Further, the Mission would aim for local photovoltaic (PV) production from integrated facilities at a level of 1000 MW/annum within this time frame. It would also aim to establish at least 1000 MW of Concentrating Solar Power (CSP) generation capacity, again, with such technical tie-ups as essential within the stated time frame.

In the long term, the Mission would aim to network Indian research efforts in solar technology with global initiatives in these areas, so as to enable delivery of solar solutions to India's energy needs in tandem with developments worldwide. In addition, in the long-term, the Mission would direct Indian solar research initiatives to deliver truly beneficial innovations that cut across more than one approach or technology. These include:

a) Getting the same electrical, optical, chemical and physical performance from cheap materials as that delivered by expensive materials.
b) Developing new paradigms for solar cell design that surpass current efficiency limits.
c) Finding catalysts that enable inexpensive, efficient conversion of solar energy into chemical fuel.
d) Identifying novel methods of self assembly of molecular components into functionally integrated systems.
e) Developing new materials for solar energy conversion infrastructure, such as robust, and inexpensive, thermal management materials.

As per the NAPCC, the ultimate objective of the Mission would be to develop a solar industry in India that is capable of delivering solar energy competitively against fossil options from the Kilowatt range of distributed solar thermal and solar PV to the Gigawatt scale of base load priced and dispatchable CSP within the next 20 – 25 years.

LAUNCHING THE SOLAR MISSION

When the National Action Plan for Climate Change (NAPCC) was announced on 30 June 2008, there was a great deal of excitement among various sections of society. It was a definite indication that the Union Government was determined to take positive initiatives for climate change mitigation. But there was considerable delay in setting up the eight Missions that

were announced. In the true style of government functioning, a lot of time was taken to crystallize the essentials of each Mission. Discussions were held with various ministries and departments even to arrive at the approach. The intervening elections also played a significant role in delaying matters further. Proponents of renewable energy have thus been kept waiting anxiously for the launching of one crucial mission in particular, the Solar Mission.

After a great deal of delay, the Mission was announced in November, 2009. The Mission came out with an ambitious target of having 22000MW of solar power in the country as a combination of grid-connected systems, roof-top tail end systems, tail end augmentation of the grids through solar power, and low-heat solar thermal systems to replace power consumption for heating applications. The target, no doubt, is laudable - ambitious as it is. But the strategy to achieve the target is still not clear. Given the clear thinking about solar power being in the domain of the private sector, there appears to be a great deal of confusion as to how to go about it. The Government seems to be shy of making budgetary commitments for supporting the sector, with the ingenious approach of getting a public sector power trading company to purchase the solar power that is generated, mix it with conventional coal based thermal power and then sell the mix to the utilities. Here again, the Government has limited such power to 1000MW by March, 2013. Thus there is no clarity or indication as to how the balance of the target would get supported in the years to come.

The trickiest constraint in the renewable power sector is created by the provisions in the Constitution of India that cannot be changed easily. Power - and naturally and logically renewable power- is a subject on the Concurrent List of the Constitution of India. In other words, both the Union Government and the State Governments have jurisdiction over the sector. The way in which the Mission has been announced and the logistics outlined by the Union Government in taking it forward has led to the feeling that the programme is that of the Union Government and that the cost has to be met by the same government. There appears to be a big disconnect between the Union and the State Governments.

Given the enthusiasm of the private sector – since applications have poured in to establish grid connected generation projects; the government appears to be toying with the idea of restricting the number of players in the sector in its apprehension of having to support a massive capacity in the private sector.

There is no doubt, whatsoever, that India is blessed with a great potential for utilizing solar energy which offers tremendous environmental and social benefits. But one has to simultaneously take into account past experiences in deploying solar energy systems, the reasons for the failure to scale it up so far, the criticism that solar energy is costly, efficiencies are low, the capacity utilization factor (CUF) of solar PV systems is low, etc. Unfortunately, deployment of solar energy systems in the past has been largely driven by government subsidy programmes. There has hardly been any commercial market for solar systems and products. Solar cell and module manufacturing capacity has always been higher than the domestic demand that was dependent only on government subsidies. In spite of production capacity having gone up recently, the demand levels still remain the same, mostly supported by the government. Almost 80% of the modules are exported to other countries that have a dynamic policy for supporting renewable energy.

Efforts in the past to take solar energy systems and products into the commercial mode have been half–hearted and poorly conceived. There have been new technological developments in the recent past that have reached the villages and the poor without any conscious effort

on the part of the government to extend subsidies to promote either the technology or the products. The growth of cell telephony in the recent past where the government played a very important role of being a policy maker, enabler and facilitator, with a robust regulatory system in place, is an example of such growth and the benefits reaching the rural areas. This proves that instead of adopting a 'hands-on' approach, the government needs to have only a clear policy for a stable period of time. This applies to commercialization of solar technologies also. However, consumer items like cell phones generated large volumes in a short period of time, thereby bringing down prices substantially. In the case of solar energy, globally, grid-parity is expected to be reached by 2015—17 and till then, some form of government support (e.g.: Generation Based Incentives), besides feed-in tariffs would need to be provided.

A CRITIQUE OF THE APPROACH

I will now attempt a constructive critique of the approach to the National Solar Mission, based on available information. At the outset, there appears to be excessive emphasis on electricity generation using Solar PV technology, ignoring the solar thermal route to a large extent. There is also a tendency to continue with small schemes that are driven by governmental subsidies but do not have any large–scale impact. The essential elements of any solar policy have to address issues in specific areas and work out appropriate strategies for each area. These are as follows:

Research & Development: As far as R&D is concerned, the work done in India in solar research has been limited. Neither the laboratories of the Council of Scientific and Industrial Research nor the academic institutions of excellence, like IITs, have devoted considerable time and effort in solar research. True, there have been claims of limited or isolated successes, but there has been no great achievement in terms of new innovations, increases in efficiencies, or commercialization of such technologies. Proposals for R&D in the past have been limited in ambition and led mostly to publication of papers in scientific journals. Funding was also not linked to deliverables in terms of technologies. Starved of funds as they are, the laboratories need to be linked to specific deliverables and commercialization of technologies. The private sector has not invested significantly in R&D efforts so far, nor have they shown any inclination to utilise the laboratories in the public sector. There needs to be a healthy relationship between the public sector laboratories and the private sector with a clear understanding on the sharing of the patents and Intellectual Property Rights. If the government is to fund research projects, the same has to be tied to deliverables, instead of to the routine funding of staff costs, equipment costs, and contingencies alone. Schemes need to be evolved for public-private partnership in a time-bound manner. Given the rather short time-frame for transitioning to a renewable energy economy, there should be an emphasis on adapting available technologies to Indian conditions, rather than trying to completely re-invent the wheel.

Manufacturing sector: The growth of the solar manufacturing sector in the past, unfortunately, had no dependence on, or even a relationship with government policies or domestic market demand. They have been, pure and simple, manufacturing industries based on cost advantages, mainly to meet the needs of export demand. In the recent past the government came out with an incentive policy for solar PV manufacturing, as part of the Semi–conductor Incentive Policy. This led to the increased interest of large Indian and foreign companies in making investments in solar manufacturing in the country. But, as ill luck would have it, the government took a very long time even to accord 'in-principle' approvals. The delay led to many applicants losing interest, with the intervening recession

making matters worse. We can only hope that these applicants come forward once again to get the projects started. There is also a need to have similar schemes in place for manufacture of the systems that need to be part of any solar PV project (BOS), like batteries, inverters, etc., that will be consumed only by the solar project developers. More importantly, there is a revival of interest in 'solar thermal' technologies and quite a few projects have been started in the recent past in many developed countries. Here again, any effort in our country has to depend upon imported equipment, components, spares, etc. It is estimated that the cost of these projects could come down by as much as 50%, if manufacturing facilities are started in India, given India's capability and cost advantages. A new package of incentives for the manufacture of solar thermal systems would help in deploying large capacities in generation. This can also help in opening up export markets in the sector.

Deployment Strategies: As far as deployment is concerned, there will be no progress at all unless the utilities and transmission companies evacuate power that is generated by the solar sector without raising unscientific objections about the nature of power being infirm, seasonal, etc. One has heard these objections in the wind sector where there have been numerous instances of the utilities refusing to permit 'shut-down' of wind turbines even for maintenance. On the other hand, some states have asked the wind power units to shut down so that they can utilise the cheap power from hydel sources. It is obvious that the ultimate issue is one of cost of power and their reluctance and resistance have nothing to do with technical issues; they are only used to camouflage their commercial concerns. One important issue that needs to be tackled is the cost of transmission of power from the generation point to the nearest evacuation point of the transmission company. There is a need to cap the distance over which the power has to be transmitted by the generator and prescribe the voltage at which the same has to be done. There could also be a cost sharing formula to be followed in financing these evacuation systems. When it comes to roof-top systems, the absolute need is one of 'net metering' so that the investor/house owner is certain of the savings/earnings. The pattern that has been adopted in Germany for a remunerative tariff to roof-top PV systems can follow once the net metering concept is accepted. To start with, the power that will be generated by the roof-top systems will be so negligible in the first few years that utilities are unlikely to offer any resistance to net metering. Time–of–the–Day (TOD) metering and differential tariffs for solar power could also be significant factors in pushing the sector forward.

Financing Issues: All renewable energy projects naturally require long–term finance at low interest rates. The financing costs necessarily have to be part of the cost of delivered power and thus needs to be brought down. This does not imply that the interest rates have to be concessional. The only requirement is that the project loans have to be long–term and the interest rates lower than the market rates. In the past, lending to renewables has been for regular amortization periods and at market rates. Such projects have been mostly in the wind sector. Existing companies with good balance sheets took advantage of the accelerated depreciation benefits and obtained loans based on their financial strength and not on the strength of project economics. The only institution that has built up the capacity to appraise renewable projects is IREDA and their access to funds is limited. They have to necessarily borrow from their competitors and add a small margin to service the loans. The government needs to support IREDA in obtaining long–term external lines of credit with government guarantees and allowing them to raise tax-free and capital gain bonds from the market. It is quite obvious that the government does not have to extend large budgetary support but only facilitate the financial resources for the sector. In due course, IREDA could also be asked to refinance commercial banks, if such a necessity arises.

Regulatory Issues: Regulators play a very important role in the determination of tariff. The inherent conflict in their role, in approving tariffs for the producer as well as the consumer, is an aspect that cannot be overcome easily. But the tendency of the regulators, to arbitrarily assume lower costs so as to fix tariffs at the lower scale, should not be applied to renewable power. Only a few regulators have been proactive in determining higher consumption tariffs for high profile uses like commercial hoardings, etc. This is an example that can be replicated by others as well. It is important to ensure that the regulators do not factor-in fiscal and other incentives offered by the Union Government and thereby reduce the tariff for solar power. It is heartening to note that the CERC has come out with a set of tariffs for both solar PV and solar thermal at which the public sector power trading company will purchase solar power from generating companies. The Forum of Regulators needs to co-ordinate this aspect of tariff determination. The regulators have to take into account solar insolation data of the specific states, while calculating the CUF and the resultant tariffs. After all, insolation in Gujarat and Assam has to be different, on any given day, and it would be a great mistake to assume uniform insolation throughout the country. Till such time that the producers and generating companies get together on a common platform to plead their cases before the regulators, the MNRE needs to be an interlocutor in all matters relating to solar energy. To start with, all regulators should be persuaded to fix RPS targets of 1% of electricity from solar power to be achieved by March 2011. This may appear to be too small against the 5% prescribed by the NAPCC by 2009-10. However, given the past growth and knowing the speed at which the government works, even this 1% is a tall order. There is no point in being over–ambitious initially and getting criticised later for failure to achieve the target. The government, having approved the framing of a Renewable Energy Law for India and the introduction of the Renewable Energy Certificate Mechanism, should give the powers of enforcing both these instruments to the CERC.

Fiscal Incentives: Treating both manufacturing and generation facilities as 'infrastructure projects' would aid in financing the projects. The 10-year income tax holiday that is now given for income generated through the sale of power to all power sector projects could be extended to 15 years for RE projects as a whole. There is a large requirement for import of capital goods for PV manufacturing facilities and even the spares and components for solar thermal facilities. These need to be exempted from Customs Duty for a period of ten years at least. A similar dispensation for exemption from Central Excise on solar manufacturing systems and products will help to bring costs down, resulting in lower tariffs. There could be a great deal of resistance from the tax administrators on the ground that these dispensations will reduce revenue and there would be a similar demand from other sectors as well. The argument of revenue loss is fallacious, since the perceived loss is a loss of revenue that never accrued. Secondly, the government will be well within its competence to accord special treatment to the solar sector which is important from the point of view of energy security, as well as climate change mitigation.

Budgetary Support: The strain on the governmental budgets is constant and will persist forever. There will be no plan period or year when the budget will not be under strain. Very often, ministries are told to assess the effectiveness of the expenditure vis-à-vis outputs and outcomes. It is in this context that there is a strong case for linking the incentives for solar projects directly to generation of power that is sold to the grid and utilities. This could be in the form of a feed-in tariff or additionality to the normal tariff in the form of an incentive. As far as solar power is concerned, this may be required for projects established up to 2015—17 i.e. till the technologies achieve grid parity. For these projects, feed-in tariffs and incentives may be paid for the amortization period. A conscious and concerted move away from the present system of capital subsidies to the Feed-In Tariff (FIT) would encourage the setting

up of solar power projects. The order of budgetary support will not be large in the initial years but may go up in future. But this will never run into 'lakhs of crores' as some people project or apprehend. Here again, the incentive may be tapered-off over the years for projects that are commissioned in future. This may be determined taking into account the technology/efficiency improvements and lowering of costs that are driven by economies of scale. The government need not, and should not, invest in setting up the facilities on its own. Considering that more than 98% of the investment in renewable energy has come from the private sector, the government's strategy should be to leverage such private investments with minimum budgetary support, rather than going in for huge investments. Even if it is perceived that the budget may not accommodate such large support, it should be possible to collect this amount by levying a minimal/nominal cess on power generated by coal–based power stations. This could be as low as a few paise. It may be similar to the 'Road Cess' that is levied on petroleum products. The essential pre-requisite is a robust policy of supporting the generation of solar–based power, rather than investing directly.

Support of States: It is learnt that the draft document does not even cursorily mention the 'state governments,' though the role of the regulatory commissions has been recognised. Given the fact that the subject is on the 'concurrent list,' it is absolutely essential to get the state governments on board. Unless the state governments facilitate the setting up of generation facilities, the Solar Mission will be a non-starter. Instances have been there where the states have utilised their discretionary power to issue directions under the 'Electricity Act' to do or undo the provisions of the Act and the policies. They also have arbitrary rates for sales tax, VAT, octroi, etc., that stifle the growth of the sector. The states are also not proactive in allotting lands on lease basis. There have been complaints of state governments demanding large sums as 'processing fees,' etc., for those who want to set up RE projects. Most importantly, many nodal agencies that have the mandate of facilitating RE projects are moribund. There is an urgent need to revamp these bodies through a capacity building process and provide them with appropriately qualified, trained staff, if the Solar Mission is to succeed. If need be, a performance–based incentive scheme needs to be worked out for the states, its agencies, and utilities.

Support of Local Self Government Institutions: A similar role should be played by the local self government institutions like municipal corporations, municipalities, panchayat bodies, etc. Many of the requirements of utilising solar power, solar thermal systems, etc., can be easily met by making their use mandatory through notifications, issued within their powers, without any need for the Union Government to issue statutory notifications. Similarly, these can be incentivised by them with appropriate measures like property tax breaks, penal measure for non-compliance, etc. But in practice, these institutions burden the investors by levying huge amounts as property tax, octroi, etc. One of the basic requirements to promote solar energy would be to ensure their full co–operation in the setting up of solar projects.

Support to Hybrid Systems: Whether we like it or not, the capacity utilisation factor of solar projects will remain low, since the utilisation will be only for a few hours each day. Unless there is a revolutionary breakthrough in power storage technologies, the situation will remain the same for a few years. It is in this context that generation of power through hybrid systems for constant supply to the grid and for ensuring 24x7 power to meet the basic requirements in the rural areas, needs to be encouraged. Naturally, certain conditions will have to be met and differential tariffs called for. It could be a minimum requirement of solar generation; utilisation of other renewable technologies in combination with solar power; storage of heat in solar thermal projects; maximum stipulation of conventional fuel utilised;

time–of–the-day tariffs; etc. For example, use of solar thermal power to pump the water back in pumped storage schemes will enable the systems to store energy in the form of water. All these issues need to be addressed in great detail so that the objective of ensuring power supply is achieved.

Critics could claim that a solar energy programme in a mission mode will call for phenomenal resources of the government, in terms of the budget. This argument is basically fallacious since the magnitude of funds is not likely to be as large as it is assumed. Criticism from the conventional power sector can also be expected on the ground that solar energy is available only for part of the day and not on a 24x7 basis. They would also question the need to set up transmission facilities for evacuation since power would be available only for a limited period. They will try to highlight the redundancy and cost factors to resist the investment needs of transmission. State governments and LSG institutions are likely to seek financial support for the sector from the Central Government. Ultimately, all such opposing views emanate due to purely commercial and financial reasons and technical or administrative reasons. There is a need to have a strong political will to take the Mission forward instead of lending credence to imaginary objections.

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