To
The Pay & Accounts Officer
Ministry of New and Renewable Energy
New Delhi-110003

Subject: Supplementary guidelines for implementation of “Solar Pumping Programme for Irrigation and Drinking Water under Off Grid and Decentralised Solar applications scheme.

Sir,

I am directed to convey the release of supplementary guidelines for installation of 1,00,000 SPV water Pumping System to meet the irrigation, drinking and other water requirements with an initial financial support of Rs. 400 crores (Rupees Four Hundred Crores only), during 2014-15 under “Solar Pumping Programme for Irrigation and Drinking Water”.

2. Ministry will implement the programme throughout India in coordination with Ministry of Agriculture through State Nodal Agencies, NABARD and Ministry of Drinking Water and Sanitation.

3. The detailed terms and conditions of supplementary guidelines, are indicated in Annexure-I. The provisions of this programme will be applicable only for installation of Installation of 1,00,000 SPV water Pumping System.

4. The concerned Implementing Agencies will submit annual accounts in the Standard format as required under GFR 209 (xiii), for the funds that would be released for the project. These accounts shall be open for inspection by the sanctioning authority and Audit, both by the Comptroller and Auditor General of India under the provision of C & AG’s (DPC) Act 1971 and internal Audit Party by the Principal Accounts Office of the Ministry whenever called upon to do so.

5. Concerned Implementing Agency will furnish the Utilization Certificate (UC) and audited Statement of Expenditure (SoE) for the released funds, in the prescribed formats given on website.

Contd…2/-
5. An Internal Review Committee of the Ministry will review the programme at an interval of **twelve months** and modification, if any, would be incorporated in the programme.

6. The implementing agencies has to follow procedure as prescribed under General Financing Rules.

7. Release of the CFA will be on advance/mile stone basis as prescribed in the guidelines No. 30/11/2012-13/NSM, dt 26.05.2014 and settlement of accounts on completion of the project and submission of completion documents..

8. The expenditure involved is debitable to Demand No. 69, Major Head 2810, New and Renewable Energy, Sub Major Head 00, Minor Head 101-Grid Interactive and Distributed Renewable Power, Sub Head 02,-Off Grid/Distributed and Decentralized Renewable Power, Detailed Head 04 Solar Power, Object Head 31-Grants-in-Aid during the year 2013-14 (Plan).

Yours faithfully,

(Tarun Singh)
Scientist B
Ph:24360707/Extn-2032

Copy to:

1. All State Nodal Agencies
2. JS(Agriculture), Ministry of Agriculture
3. Executive Director, NABARD
4. Principal Secretaries (Energy), All States & UT’s
5. The Principal Director of Audit, Scientific Department, DGCACR, New Delhi
6. PS to Chief Secretaries, All States and UT’s
7. PS to Addl. Chief Secretaries, All States & UT’s
8. PS to Minister, NRE / PSO to Secretary, MNRE
9. JS(TK)/DS (Fin)/Dir.(GP)/ PSO (SKS)
10. Dir. (NIC) to upload this on the MNRE website
11. Sanction file

(Tarun Singh)
Scientist B
Solar Pumping Programme for Irrigation and Drinking Water
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Solar Pumping Programme for Irrigation and Drinking Water

Supplementary guidelines (to be read with under Off Grid and Decentralised Solar applications Programme)

1. Introduction: Ministry of New & Renewable Energy (MNRE) has been promoting the Solar-Off Grid Programme since two decades. The programme size has increased many fold with the advent of Solar Mission, giving much impetus to various components of the programme in which solar pumping is one of the major component.

Solar Pumping Programme was first started by MNRE in the year 1992. From 1992 to 2014, 13964 no. of solar pumps have been installed in the country. This number is minuscule, if we compare with the pumps in agricultural sector. High costs of solar modules during these years resulted in low penetration of solar pumps. However, in recent times the module costs have started decreasing and are presently hovering around one fourth of the price in those days. As a result, the programme has become more viable and scalable.

2. Name of the programme: “Solar Pumping Programme for Irrigation and Drinking Water”.

3. Background: A large percentage of population in the country is dependent on agriculture for livelihood. The canal based irrigation system is limited to some areas only. As a result, farmers in most part of country are dependent upon pumps sets for irrigation.

The Ministry has conducted a study with the help of Shakti Sustainable Energy Foundation on the deployment of solar pump sets for irrigation in the country. As per the Shakti Sustainable Energy Foundation’s study conducted by KPMG, there are about 18 million pumps in the country which are connected with grid power. In addition there are about 7 million pumps running with diesel. The power consumed by agriculture sector is nearly 20% of installed power generation capacity in the country. More than 4 billion litre of diesel and 85 million tons of coal are thus consumed per annum to support water pumping for irrigation. Despite the power shortages, coal shortages and increasing trade deficit, the country cannot ignore this important sector in the view of food security. Saving of 9.4 billion liter of diesel over the life cycle of solar pumps is possible if 1 million diesel pumps are replaced with Solar Pumps.

4. Objectives of the scheme: The scheme broadly outlines the key aspects of the programme with respect to proposed targets, implementing agencies, integration of schemes, potential implementation options, funding sources, key stakeholders, modes of communication, Monitoring and Evaluation of the programme, technical specifications of the programme etc.

Key Objectives are as follows:

1. Development of models that will foster solar power deployment for pumping in rural areas in a scalable manner.
2. Exploring prospects of solar pump programs to address and support rural development-related aspects, over and above the basic service of water.

3. Improvement in energy access.

5. **Duration:** The duration of the programme will be five years starting from 2014-15.

6. **Targets:** It is proposed to sanction one lakh pumps for 2014-15 and it is expected that by the year 2020-2021, at least ten lakhs (1 Million) solar pumps will be deployed for irrigation and drinking water purpose in the country.

   The states shall identify the potential solar pump targets considering some of the factors like water resource availability in various districts considering the pump size under this program, cropping patterns, affordability of beneficiaries, availability of state funds from various sources etc. while determining the target number of pumps replaceable under the programme.

7. **Types of Solar Pumping Systems and Applications:**

   A solar pumping system consists of an array of Photovoltaic (PV) panels mounted on a fixed or tracking mounting structure, connected to an Alternating Current (AC) or a Direct Current (DC) motor, suction and delivery pipes and electrical switchgears. A DC pump could be driven by a brushed or brushless permanent magnet DC motor. In case of an AC motor, an inverter or a Variable Frequency Drive (VFD) is used to convert DC power from the solar array to AC power required by the pump.

   The versatility and robustness of solar pumps make them suitable for practically all types of conventional pumping applications. Thus besides irrigation solar pumping systems can be used in urban and rural municipal services, residential applications amongst various other applications.

   a. **Grid Connected Pumping**

      In many places, solar pumps can be installed where pump is being driven by electricity grid. Irrigation needs are intermittent, between 200 to 250 days in a year, leaving most of the days with additional power available. In collaboration with electricity authorities and local utilities, it could be encouraged to connect solar pumps to feed surplus power back in the grid.

   b. **Solar Pump Mini Grid**

      There is current trend in rural electricity grid to separate irrigation pumping from rural residential homes. A dedicated transformer is connected to a cluster of irrigation pumps supplying power for fixed number of hours. This has created an opportunity to introduce high efficiency electric pumps coupled to a transformer based solar PV plants. Each transformer could have PV plant ranging from 25 KWp to 500 KWp jointly in a people, public and private ownership. The PV plant will feed power to the cluster of pumps. In case surplus power is available, PV plant will feedback power to the grid. Pumps could act as reliable anchor loads in case of off-grid mini grids.
c. Diesel Pumps

In many areas that are not grid connected or if the power supply is not reliable, farmers are incurring high cost for diesel pump and recurring costs for diesel, making small and marginal farming economically unviable. Additionally, most of these diesel pumps are highly inefficient. A programme that replaces diesel pumps with solar PV pumps would also help in reducing pollution besides immensely benefiting the farmer.

d. Community Solar Pumps or Water as a Service

In some states, farmers with electricity/diesel connection also sell or barter water with neighbouring farmers who do not have a pumping system. In these situations, either solar pump (along with panels) needs to be portable or water as a service needs to be encouraged. The pumps would thus be owned by large farmers or community and the service of providing water to other farmers shall be provided. This could help to develop local enterprises increasing local employment opportunities.

e. Micro Solar Pumps

In some cases, farmers grow vegetables on a very small size plot largely using manual irrigation methods like swing bucket, hand pumps or treadle pumps. A small micro solar pump with less than 75 Wp to 500 Wp with 0.1 HP to 0.5 HP pump of power needed could do a similar function as a manually operated pump. Most of these farmers have no access to electricity. There are applications of micro solar pumps even in rural schools, health centres and drinking water.

8. Implementation of the Programme

The funding for the programme is through Government of India (GOI) budget to be provided in the budget every year. The states can identify various implementation models by leveraging the subsidy provided under this programme. Some of the models outlined below are based on integration of various schemes, tapping other sources of funds, financing in order to create a sustainable and scalable programme.

a. Potential Implementation Models for the programme

I. Through State Governments

State Nodal agency will implement the programme in the state and carry out work of solar pumping in the long run with dedicated and trained team. It would be advantageous if the State Nodal Agency has field presence.

Some of the possible models for implementation can be:

- Conventional Model

This model has already been implemented in many parts of the country. The funding pattern under this model could be:

- MNRE can provide Central Financial Assistance to the extent of 30% of the benchmark cost.
- Beneficiaries contribution to the extent of existing conventional pump cost (Beneficiaries' contribution may increase over a period of time as the benefits from scheme integration are realised i.e. yield improvement, high value crops etc.)

- Balance contribution shall be by the State Government through funds from various sources such as leveraging subsidy from various agriculture /water schemes, state budget, inter-department sources etc.

The State Nodal agency may integrate Solar Pumps with water harvesting and drip irrigation, rural electrification or any other relevant schemes as may be the requirement in the area. Currently, a number of programs and schemes are being implemented by the government to benefit farmers. Integration of relevant schemes (like on water harvesting, micro-irrigation among others) with the solar program could be considered as a possible end-to-end solution to challenges around irrigation, also encouraging overall efficiency in agricultural activities. The integration will provide a means to leverage subsidy and funds from other schemes to the solar program. This approach can facilitate the solar pump installation and increase energy access for farmers. This can also provide farmers opportunity to diversify to remunerative high-value crops, increase productivity and also improve the livelihood.

- Financing from lending agencies

State Government could borrow from Multilateral/bilateral agencies/ other sources offering long term loans with suitable interest rates. The loan could be repaid by utilizing the savings that would accrue owing to reduction in consumption of subsidized power. The funding pattern under this model could be:

- MNRE can provide Central Financial Assistance to the extent of 30% of the benchmark cost

*Note :: *absolute value – subsidy is fixed in Rupees per horse power (hp) of pump capacity. Therefore there is no need to go in to the calculation of cost as subsidy will be given in Rupees per hp without going in to price calculation.

- Beneficiaries contribution to the extent of existing conventional pump cost (Beneficiaries’ contribution may increase over a period of time as the benefits from scheme integration are realised i.e yield improvement, high value crops etc.)

- Certain percentage of contribution by the State Government through funds from various sources such as leveraging subsidy from integration of schemes, state budget, inter-department sources etc.

- Balance contribution as loan from Multilateral/bilateral agencies.

This model would help in reduction of the state subsidy as it is utilizing savings power subsidy for repayment of loan. Some of the safeguards that could be explored to ensure power subsidy savings could be possibilities of metering the agricultural consumers, surrendering of the electric pumps, removing the beneficiaries from queue of grid connection in subsequent years etc.
Government can also open this to RESCO’s (Renewable Energy Service Companies) who may bring in funds as equity or loan and cover the cost other than GOI and State Govt. subsidies

- **Water as a service model**

Business models that offer ‘water as a service’ could also be explored. The shared pumping infrastructure improves utilization of the pumps and hence the affordability to pay (either upfront or gradually).

The states may be flexible to look at any of the possible implementation models. The State Nodal agency will also select the beneficiaries through a transparent process. For procurement of solar pumps, the State Nodal agency will short list suppliers meeting MNRE norms through e-tender. These agencies will be responsible for supply, installations and maintenance. The shortlisted suppliers have to install workshops in the states for repair and maintenance. The beneficiary will have choice of the suppliers among the shortlisted. The rates may be different as per manufacturer or kept common as may be decided by the respective state State Nodal Agency.

**II. Through NABARD and banks like RRBs:** For this component, MNRE will place funds with NABARD to finance the pumps through RRBs/ Commercial Banks. State Govt. may fund some portion of the project cost as their share or any other mechanism appropriate to State Govt. MNRE subsidy in this case will be 40% of the benchmark cost (in absolute value). The beneficiary will be free to go to any of the implementing bank’s branches and avail subsidy along with loan for the remaining amount as per terms and conditions of the participating bank.

In this case, if the State Government wants to further subsidize, they may place a portion of the subsidy with the participating bank or NABARD. Ideally, this may be more suitable for replacement of diesel pumps since the savings of the beneficiaries on account of diesel expenditure are substantial.

State Government may also come up with a scheme to subsidize the repayment of the loan by the beneficiary by using the savings that the distribution company will have because of the saving in highly subsidized power for the agriculture sector. With this the State Government can reduce the burden on the farmer. MNRE specifications and standards will have to be followed in this case also. MNRE will empanel suppliers through a transparent process. E-tendering at the national level in collaboration with NABARD may be considered if required at some point of time among the shortlisted and empanelled manufacturers. In that case beneficiaries will get pumps from the suppliers shortlisted through e-tendering and the price arrived through the process of e-tendering. The price at which the farmer/user gets the pump will be result of competition amongst suppliers in free market and choice of customer.

**III. Through and along with Other Ministries of Government of India**

Certain other Ministries engaged in water management or water usage may like to use solar pumps instead of conventional pumps. MNRE may provide subsidy directly
to these Ministries through its existing scheme and at rates admissible in the scheme for covering the solar pump portion. One example here is drinking water scheme being implemented by the Ministry of Drinking Water and Sanitation. In such cases, procurement etc. will be managed by the concerned Ministry and MNRE will provide the necessary support required for the solar pump portion. Solar pumps could also be integrated with the energy efficient programme of BUREAU OF ENERGY EFFICIENCY (BEE) and electric utilities, as well as star rated pump sets or parts.

b. Key Stakeholders

(I) Government of India

- Ministry of New & Renewable Energy
- Ministry of Agriculture
- Ministry of Drinking Water & Sanitation
- NABARD

(II) State Governments

- State Nodal Agency looking after Renewable Energy
- Power / Energy Department including distribution companies
- Agriculture & Horticulture Department and organizations under them
- Renewable Energy Department in the State

(III) Others

- Banks like Regional Rural Banks (RRBs) and other Scheduled Commercial Banks (SCBs), who may be willing to lend to this sector
- Energy Service Companies
- Water service companies
- Technical support organizations, universities, IITs etc.
- Electrical Utilities as demand side management programme to manage peak power
- Multilateral / Bilateral or any other lending agencies that may be willing to provide grants/ funds for the sector

c. Technical Specifications, Standard/Quality of the solar pump system: The detailed specifications has been provided in Annexure 1 of this scheme. This Ministry will review these specifications from time to time in the interest of the users.

9. Monitoring and Evaluation: State Nodal Agencies will be responsible for 100% monitoring of the solar pumps installed in the field. The Monitoring and Evaluation mechanisms should be encompassing tracking of performance and benefits of the programme.
The key monitoring aspects that are crucial in this programme may be classified into two types depending on the evaluation characteristics: Quantitative aspects and Qualitative aspects.

The quantitative aspects of monitoring can include, measurement of power savings, generation of additional income of farmers (through yield improvement, high value crops etc.), pump performance (based on hours of usage, any issues faced etc.), water conservation, employment generation and other usages like lighting, charging etc. The qualitative aspects could possibly include, improvement in the livelihood of farmers, convenience and reliability, safety for farmers and Identification and traceability of pumps.

Various tools and technological interventions could be employed for monitoring and evaluation of the programme by State Nodal Agencies:

- Timely information from the field would help to evolve the programme and bring necessary changes based on data collected and feedback from the users. A MIS based information collection system would be put in place. This MIS system will act as end-to-end software for service delivery and monitoring.

- The agencies may also develop suitable mechanism to monitor the pumps through remote monitoring facility like the Supervisory Control and Data Acquisition (SCADA) monitoring system. Ministry may also develop suitable mechanism to monitor these pumps with remote monitoring. A GPRS based remote data logging system can be installed with all solar pumps above 0.5 HP. Smaller than 0.5 HP systems would be selectively monitored through third party surveyors and a small percentage would be fixed with data loggers for field data collection. A third party monitoring and evaluation protocol can be set by each implementing agency.

- For pumps promoted through NABARD, a status report by the empanelled manufacturers will have to submit on biannual basis.

- A social and technical audit would be conducted involving local universities and citizen bodies.

- Pumps can be metered to estimate the usage and gauge pump performance.

- State level helpline number, customer care centres and appropriate grievance redressal mechanism can also help in addressing to problems arising from unsatisfactory after-sales services, non-performance of the product and other programme implementation issues.

10. **Communication Strategy (Awareness and Training)**

The State Nodal agency will ensure that the programme is extensively communicated through various channels and a strong capacity building framework is provided for all stakeholders.

a. **Awareness**

The State Nodal Agency will need to conduct publicity campaigns so as to generate demand and spread awareness about the programme amongst all the key
stakeholders. The programme may engage with industry, academic institutions, bankers, retailers or farmers to enhance visibility of solar pumps. An awareness programme with a technical literature, demonstration pumps, pilot installations and training programme may be introduced in collaboration with existing agriculture universities in India.

An orientation and awareness programme targeted towards farmers and bankers is needed to be built in collaboration with solar pumping vendors and suppliers. A more detailed solar pumping training programme for vendors, bankers, individual farmers, associations and agriculture colleges may help in building the knowledge base for necessary acceleration.

The agency can develop a cohesive strategy to utilize media as a channel for effective dissemination of information on the programme. A generic radio and television advertisement campaign can be launched to generate interest among public at large. The agencies can also publicise the programme to the locals through word of mouth, street plays, and rural social marketing, national/state level workshops. The publicity need to be backed with state officials’ regular site visits to increase awareness. The State Nodal agencies could also work on implementing pilot solar agriculture pump schemes, working with suitable agencies to attain the objectives of bringing awareness. Active participation from empanelled pump suppliers / manufacturers is also envisaged in enhancing awareness.

b. Training and capacity building

A cohesive strategy to help build the capacity of various stakeholders needs to be formulated. Some of these can be:

- The trainings may be conducted at various levels on aspects of the programme such as proper use of the pumps, their maintenance and other aspects of reporting and monitoring.
- Capacity building for the involved implementing agencies can include organizing workshops/ stakeholder consultation sessions and providing supplementary training programs.
- Exposure programme for last mile conventional electric pump shop owners would help making them advocates for solar pumps.
- Retraining last mile pump technicians would develop a chain of ‘solar pump ministries’ (technicians) as close to farmer service providers.
- The pump manufacturers can be encouraged to develop product training modules and user guide for selection of right pump suitable to local cropping, soil and water needs for technical capacity enhancement at various levels. These product training modules can be designed exclusively for the beneficiaries and will be user-friendly and simple, multi-lingual, educative and visually descriptive, culturally sensitive and easily accessible.
- Training of technical staff in panchayat raj bodies and village level staff of other Govt. deptts/ agencies/ Power Distribution Companies (DISCOMs).
- Training and awareness of farmers and users through training/awareness camps.

11. Manufacturing: India has a thriving conventional electric pump manufacturing industry, catering to the needs of agriculture, domestic, public and industrial sector. This
was a spill over of the green revolution in 1960s. Same supply chain could be empowered to become engines of growth for developing solar pumping supply chain. The supply chain of conventional electric and diesel pumps is one of the most robust last mile linkage to the farmers in rural India, with a very strong and efficient manufacturing, sales and service network. There are about 400 pump manufacturers in the three manufacturing clusters in Gujarat, Tamil Nadu and Madhya Pradesh. Training and investment in new tools can help the existing conventional pump industry to manufacture and service solar PV pumps. A vendor development programme with investment in awareness and engineering would be part of the solar pumping programme to enable entrepreneurs in developing efficient supply chain for solar pumps. Manufacturing of good quality DC pumps in India may help in bring down costs. The low efficiency pumps already installed in several places or pumps made in unorganised sector can be replaced by efficient pumps if costs reduce due to manufacturing in India.

12. **Research and Development (R&D) and Product Development:** The key focus of research would be towards increasing the efficiency of pumps and reducing the cost of balance of systems. The product development research also need focus on how to make solar pumps portable. Farmers normally may not want to leave an expensive asset unattended in the farms. They also need power backup at home. Making solar and pump component portable would make it more accessible to the farmers and will open avenues for rent thereby encouraging beneficiaries to be a water service provider.

Research portfolio would also include cost reduction in solar panel tracking and mounting structures, lower cost Variable Frequency Drives (VFD), low cost electrical interconnects and mobile phone based remote smart metering payment systems. R&D could be also done for field prototyping of new developments like micro solar pumps, transformer based clustered solar pumps and ultra-high efficiency pumps etc. need to be field prototyped.

13. **Water and Energy Efficiency:** The aim of the programme is to discover and reward highest efficiency solar pumping system which delivers highest amount of water using least amount of solar panels. Along with solar pumps, efficiency of water usage, energy efficient pumps, solar tracking, low friction piping system and sufficient water storage are building blocks for an ideal solar pumping programme. Enhancing efficiencies of each component can significantly reduce the cost of the system and can deliver same results using a smaller solar array. To encourage development of higher efficiency system, a rating system which is similar to Star rating in conventional pumps, would be gradually introduced.

14. **Coordination Committee at GOI level**

A coordination committee will be setup at Government of India Level consists of Joint Secretaries of New & Renewable Energy (NRE), Agriculture and Drinking water and official of NABARD. The coordination committee will meet on quarterly basis to review the progress of the programme.

15. **Coordination Committee at State Level**
A Coordination Committee will be setup at State Level under the Chairmanship of Addl. Chief Secretary with representatives from the State Nodal Agency, State Agriculture Department, State Horticulture Department, Soil Conservation Department, Drinking Water Department and CGM of NABARD. The committee will meet on quarterly basis to review the progress of programme The States will constitute a Coordination Committee under the chairmanship of Additional Chief Secretary concerned for effective coordination among the various stakeholder departments /organizations and speedy implementation of the Solar pumping programme in the State. The Coordination Committee shall comprise the following members –

I. Additional Chief Secretary of any of the concerned Department Chairman
II. Secretary, Department of Agriculture Member
III. Secretary, Department of Horticulture Member
IV. Secretary, Department of Soil Conservation Member
V. Secretary, Department of Irrigation Member
VI. Secretary, Department of Power/Energy Member
VII. Secretary, Department of Renewable Energy Member
VIII. State Level Coordinator for banks Member
IX. Representatives of DISCOMs Member
X. Representative of NABARD Member
XI. Representatives from RRBs Member
XII. Representative from technical institutions identified for support Member
XIII. CEO/MD of State Nodal agency Convener

The terms of reference of this Committee will as follows:

a. The committee will ensure coordination between various departments to effectively implement the programme.
b. The Committee will ensure that the farmers in the identified areas of the State are duly covered under other available schemes for irrigation.
c. In case financial requirement is more than what the farmer can afford taking into account the Central financial assistance available, the Committee will ensure that the State Govt./other departments/other organisations reduce the financial burden through capital subsidy or interest subvention from the existing schemes or other provisions.
d. The Committee will invariably pursue the list of pending requests of the farmers with the distribution company/companies in the State so that the solar pumping scheme can benefit this class of farmers in case there is undue delay in getting their pump sets energised by the DISCOMs.
e. In case the farmer doesn’t need the pump for irrigation all-round the year, the farmer will be free to connect to the grid and supply power with net metering/ two way meters for which the farmer would be paid or given credit by the distribution company. The committee will ensure that the surplus power is either put into the grid or used effectively locally.
f. The Committee should ensure that the farmer gets a total package along with the
pump i.e water harvesting, drip irrigation and other forms of micro irrigation. Further
other inputs like seeds fertilizers etc are to be provided to get the maximum benefit
from irrigation.

g. Institutional financing in terms of agricultural loans/ or other form of soft credit may
be organised through various financial institutions and proper guidance provided to
the farmers.

h. The Committee will be responsible to ensure that the scheme is implemented on a
timely manner so that the State does not lose its subsidy because of delayed
implementation.

i. The Committee will ensure that service network is available for timely service and
repairs throughout the life of the pump.

j. The agencies will also be persuaded to offer insurance to the farmers against theft,
breakdown and other exigencies, if required.

k. The committee will explore the possibility of pumps using solar in allied agricultural
activities also.

16. The Coordination Committee should keep in view that the 13th State Finance
Commission has provisional Rs. 5000 crores to be given to the states under the following
criteria:

- 25 % of Rs. 5000 crore as incentive for achievement in installed capacity addition (over
  year period) relative to unachieved potential.
- 75% of Rs 5000 crore as incentive for achievement in installed capacity addition ( over a
  four period ) relative to the aggregate of installed capacity addition across all States.

Hence, Promoting Solar Pumps will not only help the farmers, but may also help the state
access to additional finance from the 14th State Finance Commission.
Annexure 1
Specifications of the proposed models of SPV pump for irrigation

1. Standards/Quality:

   A. PV ARRAY

   The SPV water pumping system for irrigation and domestic drinking water should be operated with a PV array capacity in the range of 75 Watts peak to 5000 Watts peak, measured under Standard Test Conditions (STC). In case of municipalities and rural drinking water installations than 5 KWp of array size would be considered. Sufficient number of modules in series and parallel could be used to obtain the required PV array power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 74 Watts peak, with adequate provision for measurement tolerances. Use of PV modules with higher power output is preferred.

   Indigenously produced PV module (s) containing mono/ multi crystalline silicon solar cells should be used in the PV array for the SPV Water Pumping systems.

   - Modules supplied with the SPV water pumping systems should have certificate as per IEC 61215 specifications or equivalent National or International/ Standards.
   - Modules must qualify to IEC 61730 Part I and II for safety qualification testing.
   - The efficiency of the PV modules should be minimum 14% and fill factor should be more than 70%.
   - The terminal box on the module should have a provision for “Opening” for replacing the cable, if required.

   B. MOTOR PUMP-SET

   The SPV water pumping systems may use any of the following types of motor pump sets:

   1. Surface mounted motor pump-set
   2. Submersible motor pump set
   3. Floating motor pump set
   4. Any other type of motor pump set after approval from Test Centres of the Ministry.

   The “Motor Pump Set” for irrigation and domestic drinking water should have a capacity in the range of 0.1 HP to 5 HP. Municipal and rural community applications could choose a higher capacity solar pump. In case of clustering of pumps in a solar pump micro grid each pump load should not exceed 5 HP. Solar Pumps should have the following features:

   - The mono block DC/ AC centrifugal motor pump set has its driving unit and impeller mounted on a common shaft, thereby giving it a perfect alignment. The pump should be provided with specially developed mechanical seals which ensure zero leakage.
   - The motor is of 0.1-5 HP having spring loaded carbon brushes in case of D.C. Motor Pump Sets. The suction and delivery head will depend on the site specific condition of the field.
- Submersible pumps could also be used according to the technical need of the particular case.
- The suction/delivery pipe (GI/HDPE), electric cables, floating assembly, civil work and other fittings required to install the system.
- The following details should be marked indelibly on the motor pump set
  a) Name of the Manufacturer or Distinctive Logo, model Number and serial Number.

C. MOUNTING STRUCTURES AND TRACKING SYSTEM.

The PV modules should be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour. The support structure used in the pumping system should be hot dip galvanized iron with minimum 80 micron thickness.

To enhance the performance of SPV water pumping systems above 0.5 HP, manual or passive or auto tracking system must be used. For manual tracking, arrangement for seasonal tilt angle adjustment and three times manual tracking in a day should be provided. For smaller pumping system, less than 0.5 HP a fixed mounting structure would be permitted. In areas where security of solar panels is a concern it would encouraged to mount solar pumps on movable trolley. A portable solar pumping system with mounting of solar panels on a movable trolley, with tracking for above 0.5 HP pump and without tracking for less than 0.5 HP pumps, would be allowed.

D. ELECTRONICS AND PROTECTIONS

- Maximum Power Point Tracker (MPPT) should be included to optimally use the Solar panel and maximize the water discharge.
- Inverter could be used, if required, to operate an A.C. Pump.
- Adequate protections should be incorporated against dry operation of motor pump set, lightning, hails and storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

E. ON/OFF SWITCH

A good reliable switch suitable for DC / AC use is to be provided with the motor pump set. Sufficient length of cable should be provided for inter-connection between the PV array and the motor pump set.

Testing: Following organisations will provide technical help and testing facilities. They will be strengthened with support from MNRE

  a. National Institute of Solar Energy (NISE) Gurgaon
  b. EQDC, Ahmadabad
  c. CPRI, Bangalore
  d. International Horticulture Innovation & Training Centre, Jaipur

2. Technical Specifications:
For D.C. Motor Pump Set with Brushes or Brushless D.C. (B.L.D.C.):

(i) 100 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 meters (Suction head, if applicable, minimum of 7 meters) and with the shut off head being at least 12 meters.

(ii) 55 liters of water per watt peak of PV array, from a Total Dynamic Head of 20 meters (Suction head, if applicable, up to a maximum of 7 meters) and with the shut off head being at least 25 meters.

(iii) 35 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 meters and the shut off head being at least 45 meters.

(iv) 21 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 meters and the shut off head being at least 70 meters.

(v) 14 liters of water per watt peak of PV array, from a Total Dynamic Head of 70 meters and the shut off head being at least 100 meters.

The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc.

Indicative performance specifications for the Shallow and Deep well SPV Water Pumping Systems are given in the Annexure I.

For A.C. Induction Motor Pump set with a suitable Inverter:

(i) 90 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 meters (Suction head, if applicable, minimum of 7 meters) and with the shut off head being at least 12 meters.

(ii) 50 liters of water per watt peak of PV array, from a Total Dynamic Head of 20 meters (Suction head, if applicable, up to a maximum of 7 meters) and with the shut off head being at least 25 meters.

(iii) 32 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 meters and the shut off head being at least 45 meters.

(iv) 19 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 meters and the shut off head being at least 70 meters.

(v) 13 liters of water per watt peak of PV array, from a Total Dynamic Head of 70 meters and the shut off head being at least 100 meters.