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VIRTUAL POWER GENERATION IN THE RURAL SECTOR

Demand Side Management in Agriculture – Ag-DSM
New Business Model

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Abstract: A new approach is presented to tackle the old problem of improving the energy efficiency of agricultural pump sets. It is proposed that the distribution company (discom) should replace the old pump sets with new high efficiency ones. The energy saved is like virtual power generated and can be sold by the discom to other consumers. The payment for this energy is sufficient to pay for the new pump sets and leave a cash surplus for the discom. The high efficiency of the pumps results in lower energy billing to the farmer who also benefits creating a win-win situation.

Keywords: Ag-DSM, pump sets, energy, efficiency Virtual power

1, BACKGROUND

In a previous paper (ref 1) it was shown for the first time, that the revenue earned from the sale of energy saved by replacing old pumps by high efficiency new ones is enough to pay the equated monthly installments (EMI) on the loan taken to purchase new pumps and also leave a surplus for the discom and at the same time benefit the farmer consumer. However, on a review it was felt that the business model proposed may have some difficulty in use particularly for unmetered consumers. Hence a new business model has now been proposed that is simple, straightforward and easy to implement. The paper has been revised accordingly.

2. INTRODUCTION

The rural distribution network in India is prone to huge losses partly because of poor design but mainly because of the use of inefficient pumping equipment, poor maintenance, wastage, unauthorized use of power and theft. In spite of the problem persisting for decades no workable solution has been found because of the political importance of the agricultural sector that is given power at highly subsidized rates and for unmetered consumers at a fixed charge.

The result is huge wastage of power that is in short supply and a major drain on the national economy. The State Electricity Boards (SEBs) / Distribution

Companies (Discoms) resort to power cuts and provide power for only 4-6 hours a day to save their losses.

While giving subsidized power to the agricultural sector is dictated by political considerations, even the political class would not agree to support the huge energy wastage occurring as a consequence. It is essential to find a way to separate the Government mandated electrical power subsidy to agriculture, from the resultant inefficiencies and wastage to find an acceptable technical solution to this major problem.

3. EXTENT OF THE PROBLEM

The Bureau of Energy Efficiency (BEE) of the Govt of India estimates that 40-45% saving in agricultural power consumption is practical with payback period of less than a year. For the 20 million pump sets in India, the annual saving is estimated at 60 billion units. At Rs 5 per unit this saving is valued at Rs 300 billion/year or Rs 30,000 crores/year. BEE has projected a total expenditure of Rs 15,000 crores to achieve this, indicating a payback period of 6 months.

4. GOVERNMENT INITIATIVES

The Rural Electrification Corporation (REC) have replaced many agricultural pump sets with new high efficiency ones and also replaced the foot valves and pipes with newer designs permitting smooth flow, thus increasing the efficiency of the installation resulting in lower power consumption for the same quantity of water pumped. However, these new installations soon deteriorated for lack of care as the farmer, who operates these pumps, does not see any benefit for himself and hence neglects carrying out regular maintenance to keep the pumps operating efficiently.

The Ministry of New and Renewable Energy (MNRE) gives loans at low interest rates to the distribution companies for replacing old pumping equipment with new ones of higher efficiency. While this facility has been used in some cases, this scheme has not made much headway.

Recently the Government of Madhya Pradesh has launched the “Atal Jyoti Abhiyan” to give 24 hour power supply to all village households and 10 hours power supply to farmers by separating the lines for the households and the agricultural pump sets, at a cost of Rs 6,262 crores. While this will provide for better availability of supply it entails high capital cost, and does not improve the efficiency of use in any way and the energy wastage remains.

The Bureau of Energy Efficiency of the Govt of India has given special attention to this problem and has proposed 3 different methods to tackle it - the DISCOM mode, the ESCO (Energy Services Company) mode, and the HYBRID mode. BEE has given a business model for each of these.

In the DISCOM mode, the distribution company finances and implements the project. In this mode, 15% of savings is shared with the State Govt and the balance 85% retained by the Discom.

In the ESCO mode, the project is financed and implemented through an Energy Services Company. The savings resulting from the project will be the source of revenue. In this mode, 95% of the savings are retained by the ESCO. The business model for this is given in Appendix 1. As is obvious, the business model is quite complex bringing with it its own complications in implementation.

In the HYBRID mode also, the project is financed and implemented through an ESCO, but 67% of the investment is by the Discom and 33% by the ESCO. In this case 55% of the saving is retained with the ESCO and the balance by the Discom.

BEE also invited tenders from contractors and pump manufacturers to undertake the work in line with the BEE project reports and business models for some areas in Maharashtra, Punjab and other States. However, the bidders have not found it worthwhile and most of the projects have not been completed. The expectations laid out in the Project Reports of BEE have not been realized in practice.

For example, the key postulate of the Project Report prepared by BEE for an area in Sholapur district (and also for other areas) states that:

> "The major benefit of the pump set efficiency improvement is to the farmer by way of increased water discharge output per unit of power consumed or same water discharge with lower power consumption"

While this may be the view of the project planners, the farmer does not see it this way. For him the water output is determined mainly by the availability of power, and the reduction in power consumption makes no difference to him, as the agricultural power tariff is very low. For unmetered consumers there is a fixed charge, and saving energy gives no benefit to the consumer. The farmer, who is the consumer, sees no direct benefit and is therefore indifferent to the proposals.

Hence, none of these schemes have worked as expected, as they were imposed on the farmer who saw no advantage for himself. Further it gave no incentive to him to save energy.

5. VIRTUAL POWER GENERATION

For any workable solution it is essential that the consumer has an incentive to use efficient equipment and properly maintain his system by getting some direct benefit for himself if he saves energy. This is the only way to create a win-win situation that will benefit the consumer, the discom and the national economy.

At the same time one has to accept that the present level of subsidized power, or in some cases free power, will continue because of political compulsions and it would be well-nigh impossible to change this. The challenge is to find a solution taking both these factors into account.

Use of high efficiency pump sets in place of the old pump sets saves energy and this saving is available for use by other consumers. The saving is really extra power available to the system, and is in the nature of virtual power generated and should be treated as such. The Virtual Power, so generated, is available to the discom, such as MSEDCL, like any other power purchased from different vendors, and can be sold to other consumers at their regular tariff. As is well known, capital expenditure required for energy saving is much less than the capital expenditure required for generating the same amount of energy.

The virtual power is not only pollution free but it actually reduces pollution and also reduces losses.in the distribution system.

6. CONCEPT

The discom, such as MSEDCL should replace the old agricultural pump sets with new high efficiency pump sets at the consumer's premises at its own cost and hand over the pump sets to the farmer for use. The farmer would be responsible for their proper maintenance and upkeep. The energy saved – Virtual Power - will be available to MSEDCL and can be sold to other consumers at their regular tariff. It is shown that the revenue so generated will be adequate to pay the equated monthly installments (EMI) for the loan taken to finance the pump sets over a 3½ year period allowing for 12% interest, and will also leave a surplus in the hands of MSEDCL.

At the same time the farmer consumer will benefit directly by lower energy bills because of the lower power consumption of the new high efficiency pump sets.

Both MSEDCL as well as the consumers benefit from this arrangement and should welcome the scheme.

7. NEW BUSINESS MODEL

A new business model has been evolved keeping these factors in mind. Maharashtra data and tariffs are used as an illustration. The model provides for the following:

a) The discom should replace old low efficiency pumps with new high efficiency pumps that give the same water flow under site conditions. This should be done by taking advantage of low interest funds provided by Government or by taking a bank loan at commercial rates.
b) The saving in energy, compared to the original power consumption, for the same amount of water pumped is virtual power generated.
c) The virtual power so generated is available to the discom and can be sold to other consumers at regular commercial rates.
d) MSEDCL must ensure that as part of the project the meters of metered consumers are checked and recalibrated and for unmetered consumers new calibrated meters are installed as mandated by MERC (Maharashtra Electricity Regulatory Commission) order dated 16th August 2012.
e) Financial analysis shows that the revenue from sale of the virtual power generated is sufficient to pay the EMI for the installation of the new high efficiency pump sets and also provide a surplus for the MSEDCL.
f) The high efficiency pump sets will reduce the energy bill for the farmer and this will be a direct incentive for him to support the scheme. Further, he will try and keep his equipment in good shape by proper maintenance, and also switch off the pumps when not in use as it will reduce his energy bills and benefit him directly.

The new business model is shown in Appendix 2.

8. FINANCIAL ANALYSIS - ASSUMPTIONS

A detailed financial analysis for a typical case to illustrate the working of this scheme is given in Appendix 3 and is based on data from Maharashtra and MSEDCL and the following assumptions:

a) Power for agricultural pump sets is available for only 1640 hours/year.

b) The vast majority of agricultural pump sets are rated 5 HP and this size is used for the analysis.

c) Actual field trials conducted by FICCI in Karnataka have shown that the old pump sets have efficiency in the range of 11–19%, while as the star rated high efficiency pumps installed as replacements show efficiency in the range of 29-36%. The field trials confirm an energy saving of 36-51% over the energy consumption of the old pump sets for the same water flow and head.
Similar field trials conducted by the Bureau of Energy Efficiency (BEE) in Maharashtra show an average efficiency of 28% for old pump sets and 48.9% for high efficiency new ones, indicating an energy saving potential of 42%.
On the basis of this data it is clear that an energy saving of around 40% is achievable.

d) As most of the existing pump sets are very old, it will be adequate to replace a 5 HP set with one rated 3 HP giving an energy saving of 40%. This will give water output equivalent to the old pump set. Where the old set is in reasonable condition, it needs to be replaced by a 5 HP new one. This will then pump more water than the original one. In this case, the farmer should be motivated to switch off the pump set after adequate water is pumped, to save money for himself. Taking these factors into consideration an overall energy saving of 30% or more should be achieved in practice, and this has been used in the analysis.

e) The Virtual Power is available to MSEDCL and can be sold to its other consumers at its regular tariff. This is taken as the average cost of supply as projected by MSEDCL (ref 2). This is Rs 6.84/kWh for 2015-2016. For analysis, this is escalated conservatively at 5% per annum to Rs 7.18/kWh for 2016-2017, Rs 7.54/kWh for 2017-2018, Rs 7.92/kWh for 2018-2019 and Rs 8.32/kWh for 2019-2020.

9. FINANCIAL ANALYSIS - RESULTS

a) Use of high efficiency pump gives a saving of 2410 kWh/year. This Virtual Power can be sold by MSEDCL to its other consumers for Rs 16,484/year (at its average cost of supply of Rs 6.84/kWh.) From this additional revenue, after paying the EMI of Rs 9,960, there will be a surplus of Rs 6,524 for MSEDCL. When the EMI payments come to an end after 42 months, surplus available to MSEDCL will be much more as shown in Appendix 3.

b) Based on MSEDCL's tariff for metered agricultural consumers (ref 3) with new pumps the farmer's bill will be reduced from Rs 21,932/year to Rs 15,235/year, giving him a saving of Rs 6,687/year,

c) For unmetered consumers with new pumps the farmer's bill will be reduced from Rs 21,932/year to Rs 15,235/year, giving him a saving of Rs 5,945/year.

d) There is a net positive cash flow for MSEDCL after paying the EMI and allowing for the reduction in revenue from the consumers because of their lower energy consumption. During the first 4 years the net positive cash flow for MSEDCL is estimated at Rs 2,274/year on an average. Thereafter, as the EMI ceases the cash flow is Rs 13,054/year. This is in the case of metered consumers while for unmetered consumers the cash flow for MSEDCL is a little higher as shown in Appendix 3.

In addition to this financial benefit, the lower consumption will reduce system losses and improve voltage profile of the distribution system.

e) For the consumers there is a direct saving in their energy bills because of the higher efficiency of the pump sets. In addition, they would get a new pump set with a longer life. The unmetered consumers would now have new meters and would be able to switch off their loads when not required or to install a drip irrigation system (for which generous financial assistance is available) to further save on their electricity bills. The consumer will thus have a direct incentive to use efficient equipment and to maintain it properly and try to save on electricity bills.

f) The scheme increases the system efficiency by reducing distribution losses, improving the voltage profile thus benefitting the whole power system and provides a surplus to the farmer and also to MSEDCL thus making it a win-win situation for all concerned and hence should be welcomed by all.

10. GENERAL

a) The project is viable using financing at commercial rates of interest. However, Govt is keen on improving the distribution system and have provided large funds under the R-APDRP and the National Electricity Fund (interest subsidy scheme). Accessing these funds will make the scheme even more financially profitable to the discom.

b) MSEDCL should use their energy audit system to make sure that there are no leakages in the system as is very common at present.

c) There is no need for any regulatory approvals for implementing the scheme and the discom can go ahead without any hurdles.

d) After 3½ years, when the EMI payments are over, the net surplus to MSEDCL will be Rs 13,054 per year per pump set. Thus, if MSEDCL replaces 1 lakh pump sets it will gain Rs 130 crores a year. Since Maharashtra has over 20 lakh pump sets, it is clear that the potential benefits are huge.

e) It may be mentioned that if, for any reason, some of the consumers do not wish to take advantage of the scheme, they can be left out without any problem in implementation.

11, CONCLUSION

The proposed scheme provides a practical and effective way to improve the efficiency of the agricultural pump sets in India that continue to remain woefully inefficient because of many constraints. Various attempts by the Government, the Discoms, the Bureau of Energy Efficiency, and Industry have failed to solve this problem, as they do not provide any incentive to the farmer to improve his system. In this scheme the farmer gets some immediate financial benefit and he can save even more money by paying attention to his energy usage e.g. by switching off the pumps when not required. He can also be motivated to install a drip irrigation system that requires much less water and also much less pumping energy and this will give him greater yield as well as further monetary benefits.

The New Business Model proposed in this paper and shown in Appendix 2, is simple, straightforward and easy to implement. It benefits the farmer, the discom and the distribution system as a whole thus creating a win-win situation. As India has over 200 lakh agricultural pump sets, the potential benefits are tremendous.

Implementing this scheme on a large scale has the potential to dramatically improve the power distribution scenario in the country.

12, ACKNOWLDGEMENT

Thanks are due to Kirloskar Brothers Ltd, Pune 411045 for providing the cost data for the financial analysis.

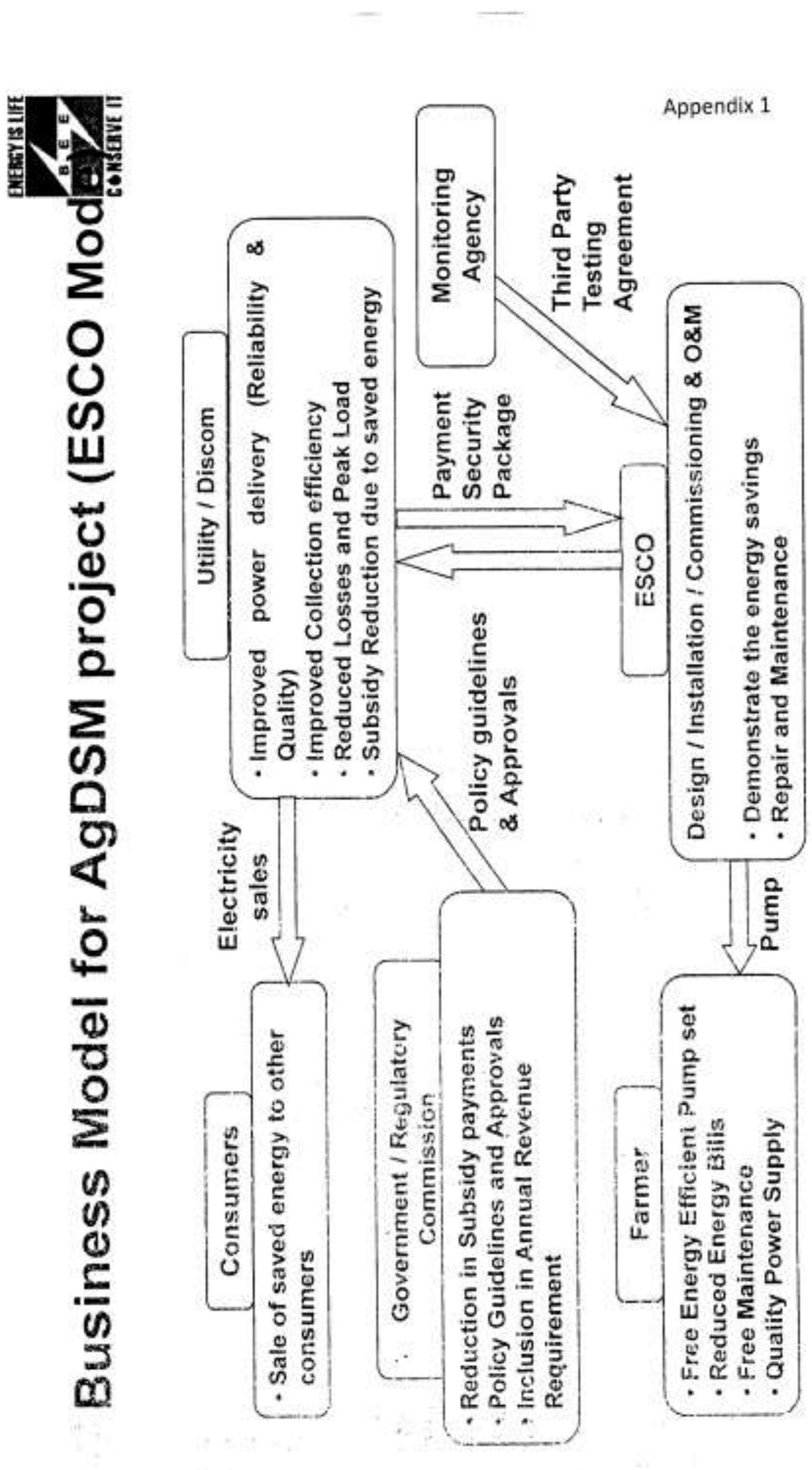
13. REFERENCES

1. Virtual power generation in the rural sector - Demand side management in agriculture – Ag-DSM by Vasant Manohar, International Journal of Combined Research & Development, December 2014 issue

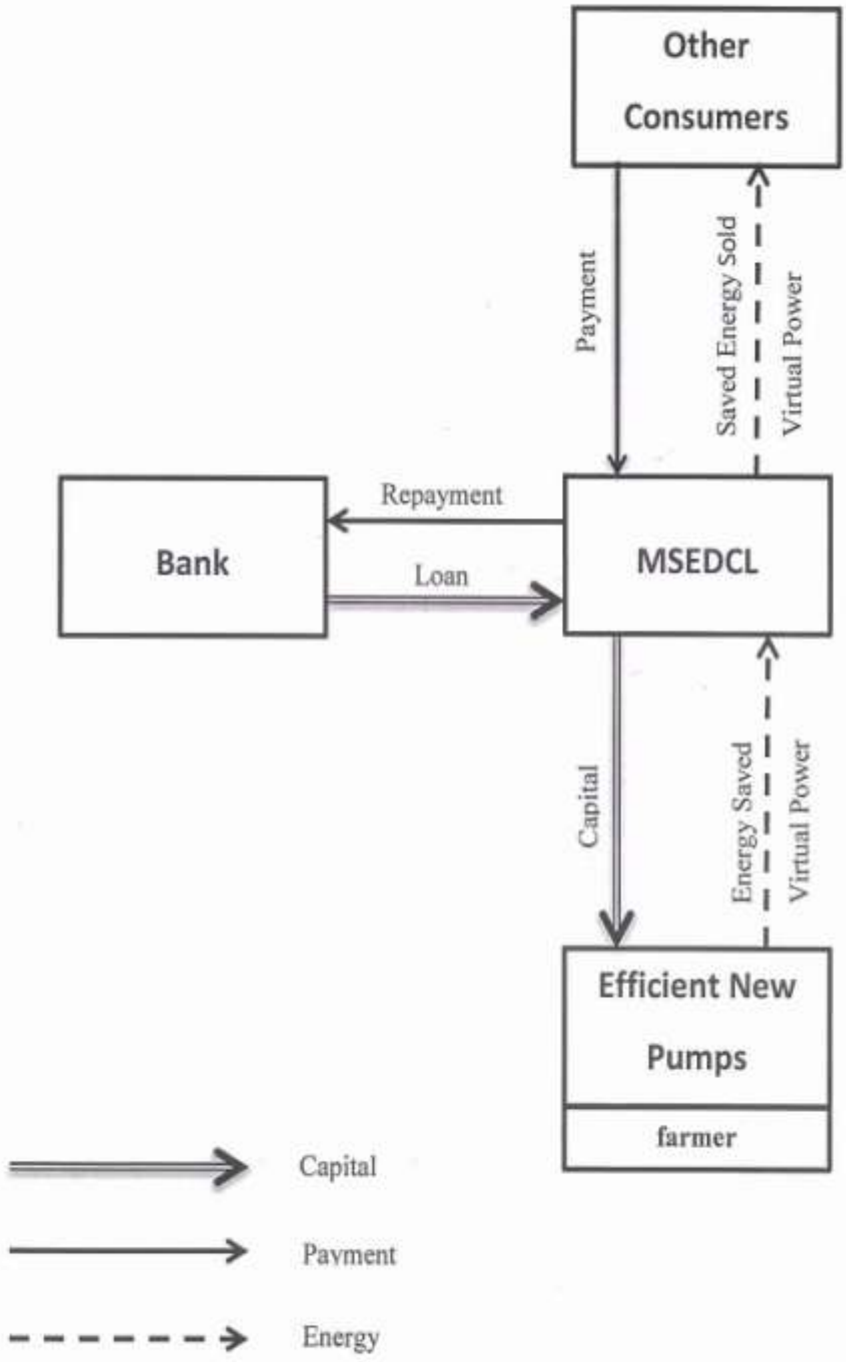
2. MERC Order dated 26th August 2013

3. MSEDCL multi year tariff for FY 12-13 to FY 15-16 issued in February 2015

Appendix 1: ESCO Model
Appendix 2: Revised Business Model
Appendix 3 : Financial Analysis


Business Model for AgDSM project (ESCO Model)
Appendix 1
Consumers
• Sale of saved energy to other consumers
Electricity sales
Utility / Discom
• Improved power delivery (Reliability & Quality)
• Improved Collection efficiency
• Reduced Losses and Peak Load
• Subsidy Reduction due to saved energy
Monitoring Agency
Third Party Testing Agreement
Payment Security Package
ESCO
Policy guidelines & Approvals
Government / Regulatory Commission
• Reduction in Subsidy payments
• Policy Guidelines and Approvals
• Inclusion in Annual Revenue Requirement
Design / Installation / Commissioning & O&M
• Demonstrate the energy savings
• Repair and Maintenance
Pump
Farmer
• Free Energy Efficient Pump set
• Reduced Energy Bills
• Free Maintenance
• Quality Power Supply

Appendix 2



New Business Model

Appendix 3

VIRTUAL POWER GENERATION IN THE RURAL SECTOR
Ag-DSM - New Business Model - FINANCIALS

Old 5HP subpersible motor having 76% efficiency at full load will take		4.90	kW
Annual power consumption (power available for 1640 hrs only)		8,036	kWh
30% saving in annual energy use (virtual power generated)		2,410	kWh/year
Estimated power consumption using 3 HP high efficiency pump sets		5,626	kWh/year
Cost of new 3HP pump set including installation testing etc.			
Basic price of pump set	16,275		
Excise duty @ 4.12%	670		
Sales tax @ 5%	847		
Transportation etc @ 2.5%	445		
		18,237	Rs
Cost of dismantling old pumpset and installing new	4,250		
Replacement of pipes and fittings 20% cases	3,255		
Testing	2,600		
		10,105	Rs
Total Cost		28,342	Rs
If this total cost is taken as a loan from a bank @ 12% interest, the equated monthly instalments (EMI) for a 42 month term will be Rs 830/month		9,960	Rs/year

	2015-16	2016-17	2017-18	2018-19	2019-20	
The virtual power of 2410 kWh can be sold by MSEDCL to their other consumers at their average cost of supply of (Refer Note 1)	6.84	7.18	7.54	7.92	8.32	Rs/kWh
giving MSEDCL a revenue of	16,484	17,304	18,171	19,087	20,051	Rs/year
Out of this EMI of Rs 9960/year would be payable	(9,960)	(9,960)	(9,960)	(4,980)	0	Rs/year
Surplus with MSEDCL after paying the EMI	6,524	7,344	8,211	14,107	20,051	Rs/year

Appendix 3 (contd)

BILLING TO CONSUMERS

With more efficient pumps the billing to consumers will reduce, based on MSEDCL tariff, as given below

for metered agricultural consumers:	Demand charge Rs 20/HP/month	5x20x12	1,200	Rs/year
	Energy charge Rs 2.58/kWh	8036x2.58	20,732	Rs/year
	Total billing		21,932	Rs/year
With new efficient pumps	Demand charge	3x20x12	720	Rs/year
	Energy charge for 5626 units	5626x2.58	14,515	Rs/year
	Total billing		15,235	Rs/year
Reduction in billing			6,697	Rs/year
for unmetered agricultural consumers:	Demand charge Rs 353/HP/montl	5x353x12	21,180	Rs/year
	Energy charge Nil		0	Rs/year
	Total billing		21,180	Rs/year
With new efficient pumps and meters installed				
	Demand charge Rs 20/HP/month	3x20x12	720	Rs/year
	Energy charge for 5626 units		14,515	Rs/year
	Total billing		15,235	Rs/year
Reduction in billing			5,945	Rs/year

Cash flow for MSEDCL:	Surplus with MSEDCL after payig EMI	6,524	7,344	8,211	14,107	20,051	Rs/year
metered consumers	less reduction in billing to farmer	(6,697)	(6,697)	(6,697)	(6,997)	(6,997)	Rs/year
	Net surplus with with MSEDCL in case of metered consume	(173)	647	1,514	7,110	13,054	Rs/year
Cash flow for MSEDCL:	Surplus with MSEDCL after paying EMI	6,524	7,344	8,211	14,107	20,051	Rs/year
unmetered consumers	less reduction in billing to farmer	(5,945)	(5,945)	(5,945)	(5,945)	(5,945)	Rs/year
	Net surplus with MSEDCL in case of unmetered consumers	579	1,399	2,266	8,162	14,106	Rs/year

Note 1: MERC's Order dated 26th August 2013 has projected the average cost of supply of MSEDCL as Rs 6.34/kWh for FY 2013-14, Rs 6.57/kWh for FY 2014-15 and Rs 6.84/kWh for FY 2015-16. Using this as a base the average cost of supply is escalated at 5% per annum to Rs 7.18/kWh for FY 2016-17 Rs7.54/kWh for FY 2017-18, Rs 7.92/kWh for FY 18-19 and Rs 8.32/kWh for FY 2019-20

Note 2: This is based on data for Maharashtra and the current MSEDCL tariff. Power is available only for 1640 hours per year..

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