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VIRTUAL POWER GENERATION IN THE RURAL SECTOR
Demand Side Management in Agriculture – Ag-DSM

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Abstract: A new approach is presented to tackle the old problem of improving the energy efficiency of agricultural pump sets. The farmer-consumer should install star rated high efficiency pump sets. The energy saved is like virtual power generated and can be purchased by the discom. The payment for this energy is sufficient to pay for the new pump sets and leave a cash surplus for the farmer to act as an incentive. The discom can sell the energy so purchased to other consumers and earn a profit, thus benefitting all parties.

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 often totally free of charge.

The result is huge wastage of power that is in short supply and a major drain on the national economy. The State Electricity Board (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.

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.

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 Reports 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 non-metered consumers there is a fixed charge, and in many cases power is supplied totally free. 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 the consumer to save energy.

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 if he saves energy. This is the only way to create a win-win situation that will benefit both 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.

The Government has for decades given subsidized power to farmers. If there is any saving in energy use because of the efforts of the farmer compared to his "present consumption", 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, can be purchased by the discom, such as MSEDCL, like any other power purchased from different vendors and 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.

CONCEPT

The following concept has been evolved keeping these factors in mind: Maharashtra data and tariffs are used as an illustration.

a) For the present power consumption, the present charge, (at heavily subsidized rate) should be retained. Nothing else would be acceptable for political reasons.

b) The farmer 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 the farmer at his own cost taking a bank loan at commercial rates.
c) The saving in energy, compared to the original power consumption, for the same amount of water pumped is virtual power generated.
d) The virtual power so generated should be purchased from the farmer by MSEDCL. MSEDCL purchases power from many sources; the largest quantum being from Mahagenco. It would be appropriate for MSEDCL to pay the farmer the same price for the virtual power generated as it pays to Mahagenco. This power is then available to the MSEDCL for sale to other consumers at regular commercial rates.
e) Financial analysis shows that the money received by the farmer from sale of the virtual power generated by him is sufficient for him to the pay the EMI (Equated Monthly Instalments) for the installation of the new high efficiency pumps and also pay for their maintenance. Since MSEDCL has to pay the farmer for the virtual power generated, it should deduct the EMI and pay it directly to the bank and pay the farmer only the balance amount.
f) Each consumer should be provided information on the improvement he can make to his system, its capital cost and the expected reduction in energy usage and explained the direct cash benefit that he is likely to receive. With this he will be motivated to go in for new high efficiency pumps and improve his system efficiency.
g) In exceptional cases, should any consumer exceed his "present energy consumption" for any reason, the additional consumption should be charged at the regular LT tariff of MSEDCL.

KEY REQUIREMENTS

To implement this system, the following key requirements should be in place:

a) Each consumer should be provided with a meter. This is already mandated by MERC order dated 16th August 2012.
b) The present consumption for each consumer, that will vary from season to season, can be averaged and based on this the "base consumption" should be fixed. The current amount billed by MSEDCL for this consumption will be the "base charge". This has to be done in a simple manner acceptable to all parties. Some suggestions on this are given in Appendix 2
c) Simple but robust energy audit software is required to compare the energy supplied by the Distribution Transformer with the aggregate of all consumers supplied from it. Payment to the farmer should be made only when there is no leakage. This is to ensure that there is no misuse. MSEDCL and most Discoms already have energy audit software that can be used for this purpose.

d) MSEDCL should agree to purchase the power saved by the farmer at least at the same rate as that paid to Mahagenco, if not higher. MERC should also give its approval to the scheme. This is absolutely clean pollution-free power.

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 where power is available for only 1640 hours/year, and the following assumptions:

a) The vast majority of agricultural pump sets are rated 5 HP and this size is used for the analysis.
b) 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.
c) 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.
d) MSEDCL should purchase the Virtual Power generated by the farmer at the price paid for purchase of power from Mahagenco. As per MERC order dated 26th August 2013, the rate is projected to be Rs 4.49/kWh for 2014-2015, and Rs 4.70/kWh for 2015-2016. For analysis, this is escalated conservatively at 5% per annum to Rs 4.94/kWh for 2016-2017, Rs 5.19/kWh for 2017-2018, Rs 5.45/kWh for 2018-2019 and Rs 5.72/kWh for 2019-2020.
e) The Virtual Power so purchased by MSEDCL can be sold to its regular consumers. The selling price is taken as the average cost of supply as projected by MSEDCL in the above MERC order. This is Rs 6.57/kWh for 2014-2015 and 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 8.82/kWh for 2019-2020.

FINANCIAL ANALYSIS - RESULTS

a) Use of high efficiency pump gives a saving of 2410 kWh/year. When this Virtual Power is purchased by MSEDCL at FY 2014-15 rate, the farmer will get Rs 10,821 out of which he can pay Rs 8,860 as EMI MSEDCL should pay this directly to the bank on his behalf) for the new pumps set (42 months @12% interest) leaving a surplus of Rs 1961 with him. Govt provides agricultural loans at a concessional rate of 7% and if this can be accessed the EMI will reduce with greater benefit to the farmer. When the EMI payments come to an end after 42 months, the farmer gets significant cash in hand from the sale of the Virtual Power (around Rs 13,000 per year per pump set) to act as a powerful incentive to maintain his system in good condition.
b) The Virtual Power purchased by MSEDCL can be sold to its other consumers for Rs 15,834 (at its average cost of supply) giving it a surplus of Rs 5,013. It may be noted that MSEDCL does not have to make any capital investment.
c) The scheme increases the system efficiency by reducing distribution losses, 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.
d) The working of the scheme is shown by the proposed Business Model in Appendix 4.

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. Against this, the present scheme puts the onus of improvement on the farmer and provides adequate financial incentives to him for this purpose. The Discom also benefits. It is thus a win-win situation for the consumer, the supplier and the power system.By paying attention to his energy usage, the farmer can save even more money, 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.Implementing this scheme on a large scale has the potential to dramatically improve the power distribution scenario in the country.

Acknowledgement:

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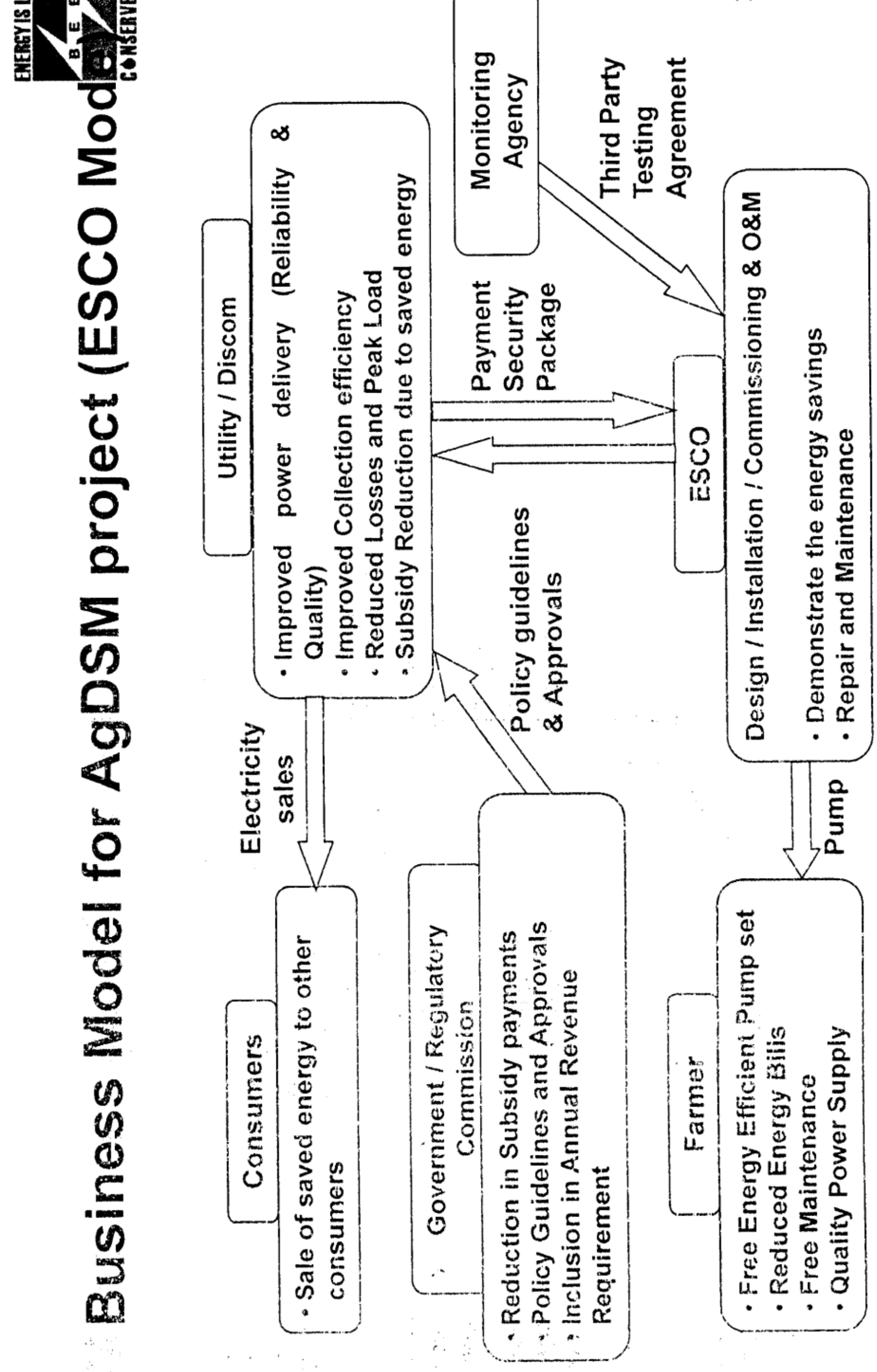
References:

Appendix 1: Business Model for Ag-DSM – ESCO mode
Appendix 2: Deciding the Present Consumption
Appendix 3: Financial Analysis
Appendix 4: Proposed Business Model

Appendix 1


Business Model for AgDSM project (ESCO Model)
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
Government / Regulatory Commission
• Reduction in Subsidy payments
• Policy Guidelines and Approvals
• Inclusion in Annual Revenue Requirement
Policy guidelines & Approvals
Payment Security Package
Monitoring Agency
Third Party Testing Agreement
ESCO
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

DECIDING THE PRESENT CONSUMPTION

The "present consumption" of each consumer is a key parameter on which the whole scheme is based. It is affected by the season and differs from month to month. It is therefore necessary to take an average.

Where there are meters installed for each consumer, the monthly consumption for the last 3 years should be tabulated and the month by month average calculated over this period. The quarterly consumption based on this can be taken as the "present" or the "base consumption" for a particular quarter of the year. The amount payable to the Discom for this is the "base charge". For the purposes of the scheme it is adequate to take quarterly consumption as the basis, and hence manual reading of meters will be adequate and automatic meter reading can be avoided. This will also mean that the present meter reading and billing system of the Discom can be used.

Where there are no meters, Discoms have established a basis for consumption based on the horse power of the pump installed and they use this for billing. This can also be used to decide the "base consumption" and the billed amount as the "base charge".

The "base consumption" should be determined in a transparent manner acceptable to the Discom and the consumers.

Appendix 3

VIRTUAL POWER GENERATION IN THE RURAL SECTOR - Ag DSM
FINANCIAL ANALYSIS

Old 5HP subpersible motor at full load will typically take		4.90	kW
Annual power consumption of each motor (power available for 1640 hrs only)		8,036	kWh/year
By replacing this with 3 HP high efficiency star rated pump set 30% annual energy saving is possible. This is virtual power generated		2,410	kWh/year
Sale price of this power to MSEDCL @ Rs 4.49 per kWh in 2014-2015		10,821	Rs/year
Cost of new 3HP high efficiency star rated pump set including excise duty, taxes and transportation.		18,235	Rs
Cost of dismantling old pumpset and installing new one	4,250		
Replacement of pipes and fittings expected in 20% cases	3,255		
Testing	2,600		
		10,105	Rs
Total Cost		28,340	Rs
EMI for Rs 28,340 @ 12% interest for 42 months (3.5 years)		832	Rs/month or Rs 8860 per year

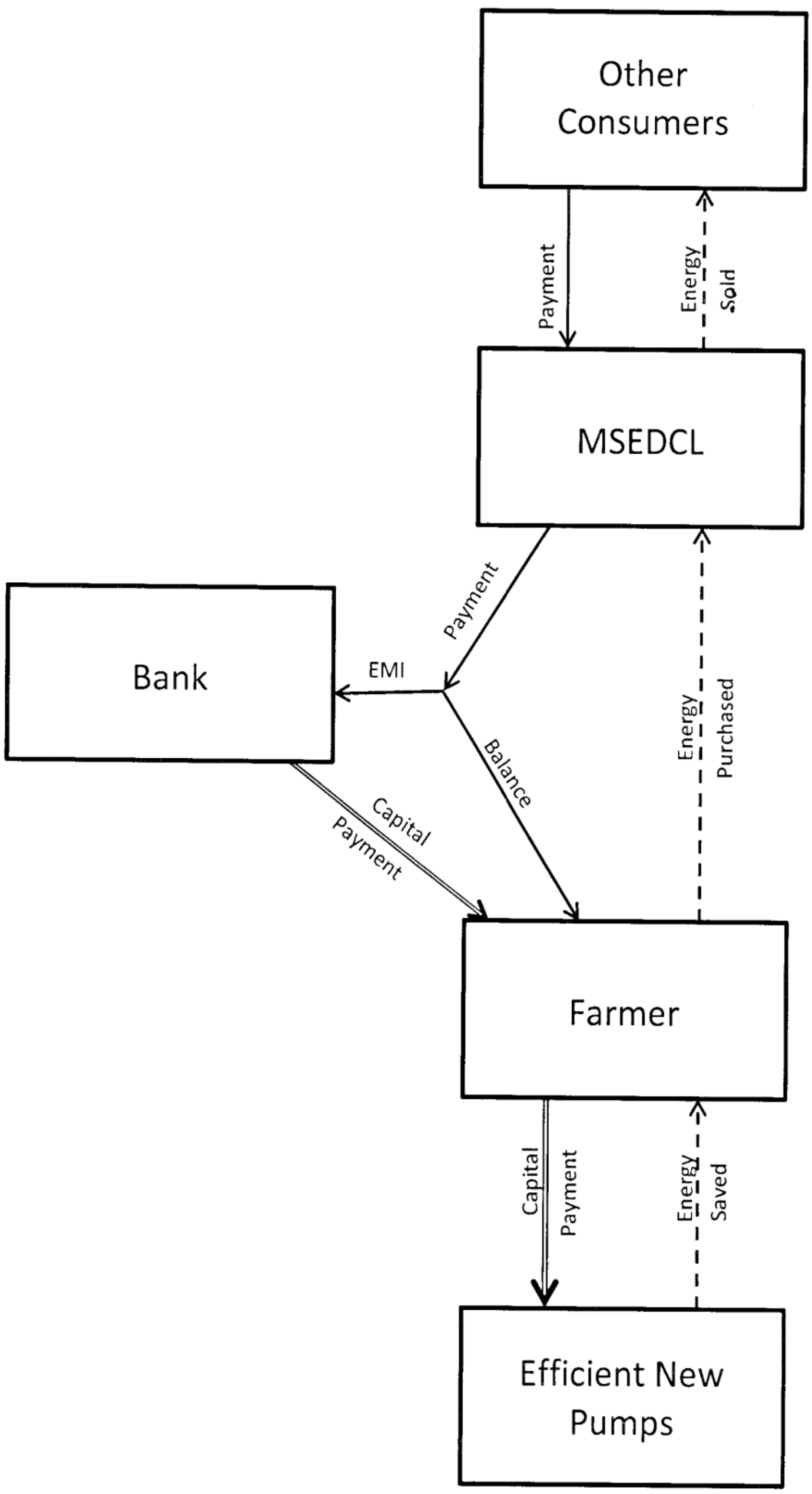
	Year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Sale price of Virtural Generation to MSEDCL	Rs/kWh	4.49	4.70	4.94	5.19	5.45	5.72
Amount to be credited to the farmer by MSEDCL for 2,410 kWh/year of Virtual Energy generated	Rs/year	10,821	11,327	11,905	12,508	13,135	13,785
less EMI for 28340 @ 12% interest for 42 months	Rs/year	8,860	8,860	8,860	4,430	-	-
Net amount to be paid to the farmer	Rs/year	1,961	2,467	3,045	8,078	13,135	13,785

Note: from the net amount received by the farmer he has to pay the Discom for the base energy consumption, that will be very small or in some cases zero.

		2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
The energy (2,410 kWh) purchased by MSEDCL can be sold to other consumers of MSEDCL at its average average cost of supply, which is	Rs/kWh	6.57	6.84	7.18	7.54	7.92	8.32
Revenue from sale of 2,410 kWh virtual power	Rs/year	15,834	16,484	17,304	18,171	19,087	20,051
MSEDCL's profit	Rs/year	5,013	5,157	5,398	5,664	5,953	6,266

vnm/June2014

Appendix 4



Proposed Business Model