

Renewable energy experience amongst large consumers of electricity : qualitative investigation results from Maharashtra

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ABSTRACT

Renewable energy penetration is on the rise in India, amidst a target to achieve 175 Gigawatt (GW) of renewable energy installation by 2020, of which 40 GW is to come from distributed solar power. However, the actual installations only stand at 5.44 GW. The objective of this study is to analyse the user experience of distributed solar power adoption amongst large consumers of electricity, in the state of Maharashtra. Data was collected through in-depth qualitative interviews with existing users of solar rooftops in the state. Responses were then transcribed and subsequently analysed. Findings reveal that users of rooftop solar models enjoy significant advantages, but benefits reaped are far outstripped by the difficulties/challenges faced. This research concludes by recommending policy interventions that rectify observed challenges faced by users, thereby accelerating the adoption rate of distributed green energy solutions in India.

Keywords

Renewable energy penetration, Distributed solar power, Transcribed, Policy Interventions

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Introduction

India confides its trust on fossil fuels for sustaining its Energy security. The country's more than 75% energy requirement comes from the fuels which are heavily imported and keeps India in debt. These fuels are not only expensive but also limited in nature. The reserves of fossil fuels are depleting at an alarming rate, these imported fossil fuels are used for the generation of electricity. During the process, various harmful gases are released into the atmosphere further causing Greenhouse effect and Global warming which leads to carbon footprint in India incrementing exponentially. The current power sector of India is incompetent filled with many inadequacies. The power generated is transmitted through grids, which cannot reach the remote locations of India because of inaccessible landscape. There are many dysfunctions related to grids such as Transmission and Distribution losses, the tariffs, the maintenance etc. Due to all these reasons, many households of India are still dwelling without proper access to electricity. These are severe implications faced each day by the Indian citizens.

India imports heavy amount of raw materials for thermal power generation. It pays a hefty amount for meeting the energy demand of the country. This dependency and bankruptcy of India can be mitigated if India responds actively to the renewable sources of energy. Owing to these factors, the government should think positively about the alternative resources which are renewable sources of energy. These resources are abundant in nature and can be replenished easily. The energy produced from these sources are pollution free and helps in reducing carbon footprint. India is taking various initiatives to boost this sector. It has aspired to produce 175GW of renewables by 2022. International Solar Alliance has been headquartered in Delhi seeing India's contribution in the sector. Similarly, there are

many policies and reforms promoting the growth of this sector and it is strictly complied with.

The renewables industry has started booming, significantly the solar sector. India being a tropical country receives uninterrupted solar light which makes India a huge solar energy market. One of the ambitious missions of India is to produce 100GW of solar power by 2022 of which 40GW is to come from distributed solar power. Various projects are going on to achieve this ambitious target. Solar power installations are escalating at a good rate. The investors, developers and consumers are optimistic about its future potential. All Indian states are an active participant in harnessing solar power. In correspondence with government and private parties, solar capacity is being incessantly increased. There are many projects undertaken by government in various aspects such as off-grids ,rooftops, commercial distributed power and many more like that. Government is providing subsidies and finances for solar panel installations in residential, commercial and industrial sectors.

The distributed solar technology been adopted in various parts of India not only in bulk but also for individual utilization. For instance, solar PVs can be installed at any place where it receives good sunlight and generate their own electricity. This electricity can be transferred back to the grids known as on-grids or may be stored using batteries for personal use known as off-grid system. Many households which cannot access the electricity via grids, use off-grid renewable system. This has become widespread, even industries and commercial places are using them. It gives them a business if they want to sell their energy or else, they can consume it themselves. This captive production has become a trend in today's world.

The large-scale consumers comprise of industrial and commercial consumers. If this sect of consumers adopts renewable energy systems, it can be highly beneficial to them. The large-scale consumers have lots of activities

going on at a time which requires an uninterrupted power supply. They pay a hefty amount to the distributors for providing them such supply of electricity but if they adopt these renewable energy systems, they can produce their own power which can support the power supply, if not they can sell the produced power and make money. This adoption is beneficial to them in either way. However, the adoption process is not easy. It requires rigorous effort.

The adoption of renewable solar systems is not as easy as it looks. It's a cumbersome job with lots of intricacies. It involves technical expertise to implement it and it's expensive. There are lots of obstructions in the implementation of this process. Approval from the government, strong financial viability, the adoption, the stakeholder's involvement and lack of capacity makes this business more formidable. These challenges discourage the adoption of renewable energy systems into the power, commercial and residential sector. These expostulations need strong planning to be eradicated from the roots in order to successfully implement the adoption of Renewable energy systems.

But apart from the barriers to its adoption, these systems if installed successfully will benefit the users in many potential ways.

- It will reduce consumer's dependency on the grids for transmission of electricity.
- It will reduce their electricity's bill.
- As these devices are using renewable systems for the energy generation, they don't cause any kind of pollution, they are completely green which makes it even attractive for the government sector and for the environment friendly sectors. They are an initiative for reducing the carbon footprint.
- They can be used in any buildings for providing electricity.
- They can be used in case of emergencies where electrical grids are unable to provide electricity.

It is important to record the experiences of distributed solar power amongst these large-scale consumers. There are many problems which comes in the process of adoption, this study will help other enterprises rectify those problems and can be useful for the policy makers to design any policy for this commercial sector. If the commercial sector of India starts reaping out the benefits of Renewable Energy Source (RES), the renewable sector can accomplish all its ambitious targets. The main objectives of this comprehensive study are to:

1. Document the experiences of distributed solar power with regards to adoption practices, problems faced and barriers to further adoption/expansion amongst large consumers of electricity in Maharashtra.
2. Identify the advantages reaped and barriers/deterrents faced by users of RES.

These objectives will help in formulating the research in a sequential manner. For the fulfilment of these objectives, it is important to collect data from these sectors. This data will decide the framework of the conclusions derived.

Maharashtra is one of the most prominent state of India and one of the highest consumers of electricity both residentially and commercially, hence data was collected from Maharashtra which added value to our analysis. This research was a qualitative investigation into the experience

of large electricity consumers in Maharashtra, using in-depth interview method.

Literature Review

Global warming is increasing at an alarming rate. If not controlled, it will cause disastrous effects. The level of pollution, carbon dioxide and other harmful gases in the atmosphere is burgeoning. The world as a whole should try to curb this havoc. The primary cause for this poisoning situation is the usage of fossil fuels for generating electricity.

Fossil fuels are limited in nature, it cannot be replenished. It takes millions of years to convert into the forms we use in our life. The rate at which it is depleting is very high, fossil fuel reserves are plummeting. This is the reason; entire world is penetrating into Renewable sector for its survival. The potential and utilization of these resources is increasing at a faster pace and if the coal consumed energy is replaced by 14% renewable energy, greenhouse gases can be reduced from 45% to 4%. There can be a huge positive change in the atmosphere if the world accepts it. [1]. Every country is not gifted with conventional energy reserves, they get it imported at substantial amount which is enough to make a country lose its denomination [2]. Jordan being of the example, imports 94% of fossil fuels for energy production. It is heavily dependent on the outside trade and spends billions of currencies in this. Jordan's energy demand is growing 3% annually which makes it necessary to switch to renewable resources. [3]. Another country suffering from heavy import expenses and lack of organized methodologies in the renewable sector is Nigeria, which aspiring to utilize the biofuels is still incapable owing to such factors [4]. India faces the same predicament and its Energy security is challenged time and again as 70% of the electricity comes from fossil fuels which is heavily imported [5].

Renewable energy's contribution in the primary energy mix will increase from 15% in 2015 to 63% in 2050 given it works with greater efficiency with technical, commercial, economical and innovative aspects falling into place [6]. Two key factors which is going to drive the future of Renewable energy are Innovation and Investment(both public and private) [7]. Energy sector of any country can sustain if it has both intact [8]. Solar energy, wind energy, biomass, biofuels and other renewable resources are making its way into the energy systems of the world. US is increasing its production in the Renewable sector. The country is trying to reduce its dependency on fossil fuels to achieve decarbonization and to improve socio-economic conditions of the country [9].

Similarly, India is also on the rise in renewable sector. The primary reasons for development of Renewable energy in India are accessibility of electricity to every household, socio-economic development and mitigating pollution. Due to these factors, implementation of Renewable energy projects is taking place at a faster rate. Ensuring affordable, reliable and economical energy to the Indian citizens is the primary objective of Indian Government, for that it has enacted many policies and reforms [10]. However, India faces other problems also, apart from the fossil fuel-based electricity generation. Transmission and Distribution losses, tariff rates, policy interventions and other inadequacies are

the inhibitors to electricity supply. Due to these reasons, 240 million people do not have proper and continuous access to electricity [11]. India having good prospects for renewable energy is moving incessant in this direction. Solar and wind energy are important components in India's energy mix. India is aspiring to gain position in this sector by heavily investing in such projects and targets to produce 175GW of renewable power by 2022 out of which 100GW is solar power [12]. Solar installations have gained momentum in India owing to the favoring solar landscape. [5]. Eradication of technological dysfunctionalities, heavy Government investments, policies, grid and tariff issues [13] can smoothen the process of Solar electricity development [14]. Solar electrification will enhance the economic, health, social conditions of the rural citizens but it also raises a question if the households will accept this change in their life, how well will installation and maintenance take place. These implications of Solar electrification will take some time to settle down but once it's done, Rural India can prosper [15]. Off grids being a boon to rural electrification are the future of the Power sector, this inculcated into the systems will provide electricity to every household [16]. Not only rural India but also the residential, commercial and industrial sector of the urban area is moving incessantly in solar technology adoptions. Calgary in Alberta is one such example where solar heaters are an important part of routine and penetrating into the commercial sector. Many innovative solutions applied to Solar energy have been implemented in the region. Support from government and local people can further enhance the residential and commercial usage of Solar energy [17].

Wind energy, being a contributing component of energy mix has its own nuances. Needing a large land space, wind turbine installations faces cringe from the locals [18]. These installations affect the ecosystem and has ramifications [19]. Australia being one of the resilient prima facie [20].

Renewable energy is a field which needs to be heavily backed-up by the government as it is a loss making industry but Government initiatives has made it lucrative using rebates, subsidies, taxations etc. [21], still the renewable sector of India is not as lucrative as it looks, it encompasses number of glitches. It is very cumbersome to utilise the complete potential of this sector because of lack of innovation and investments and also the pace at which this industry is growing is very slow [22]. Owing to less production of Renewable energy (Solar, wind and hydro energy) in India, organising this sector, studying about its commercial usage is very important. [16]. Government interventions, technological crunch and stakeholder's cooperation are the major shackles in this dimension. To eradicate such issues, flexibility in the policies, in the practices is extremely important. To incorporate large scale renewable energy system in Indian power system, a paradigm shift is needed in terms of policies, technical and other adoption methods [23]. The instance of Jammu and Kashmir illustrates this factually, among the Indian states, Jammu and Kashmir has the highest potential for solar energy, however it lags in harnessing it because of the lack of awareness, lack of local policies, the hazardous conflicts of J&K [24]. Caribbean, was studied and deciphered 5 underlying reasons behind the inert renewable development: Local people and entrepreneurs attitude, international

involvement, Electricity distributors and the other institutions. [25]

Stakeholder's cooperation is one big concern pertaining renewable energy adoption practices. Their diversified perception is an important fact in such adoptions. People are optimistic about the Renewable energy adoption but for expanding and taking it to heights, necessary local involvement is necessary. The cooperation of these local people is of prime importance as it smoothen the process without any barriers [26]. Their participation makes them feel valued to the owners and law makers and makes them part of the project which avoids any stakeholders' hindrance [27]. The transition of non-conventional resources to conventional resources has not only involved the policy makers, investors and other primary stakeholders but also the consumers. These passive consumers have transformed into active consumers known as prosumers. The prosumers active participation should be enforced by policies, reforms and good investments in order to increase their cooperation in all the processes. This will further enhance innovation which is necessary to keep up with the technological advancements [28]. Renewable energy adoption can be salubrious in rural zones providing best opportunity in the socio-economic development of a village [29]. A proper research and study on the adoption practices, the barriers in this path, the challenges and the advantages of having such renewable adoptions can prove to be to remunerative. This disquisition in the subject can help the stakeholders in making policies and taking actions which befits the scenario specially the large consumers of electricity owing to the fact, these commercial and industrial consumers' large consumption [16].

Methodology

The qualitative research methodology has been chosen for this study which is based upon grounded theory. Grounded theory helped in laying the foundation for strong data analysis by accumulating the data and coming to conclusion at last. This type of analysis gives a new perspective to the research, adding much value to it. Data assortment in this analysis is comprehensive and takes into account the concerned individual's knowledge and expertise which provides a good insight for the research. This analysis was structured in a sequential manner, first preparing the questionnaire which justifies the objective of research and then initiating first step towards data collection.

The questionnaire was designed in such a way, that it assists the thesis in gaining the essential information indispensable to the subject. The questions were composed in a comprehensive manner in order to accumulate information about the six main subjects of the research objective namely; factors that triggered the adoption of Rooftop Solar (RTS), processes followed to adopt RTS, advantages of adopting RTS, post-maintenance measures, barriers/problems encountered in RTS adoption and suggestive measures to enhance the adoption of RTS among Commercial and Industrial (C&I) consumers, these consumers being the highest consumers of electricity. These are the main propositions, giving the gist of the research analyzing the experience of the large-scale consumers.

The data collection was based on the consumers of Maharashtra, it being the commercial hub of India and one of the highest consumers of electricity. The sample from this state will approbate the analysis. Rooftop installations is increasing in the C&I sector owing to savings in bill and as a contribution in green energy. In the state of Maharashtra, total RTS installed capacity is 160MW in the commercial sector and 595MW in the industrial sector by December 2019. These number reinstate the fact, C&I sector being an active participant in the RTS adoption.

As the study is based on the large-scale commercial consumers of distributed solar installations, such commercial buildings were listed out with all the contact details and were further communicated with detailed conversation. When agreed upon, a formal invitation for a telephonic or online interview was sent out to the concerned consumer to be conducted at an appropriate timing.

All interviewees were the consumers from different commercial buildings from various districts of Maharashtra. A 45-60 mins interview was thoroughly conducted bringing in deep insights about the consumer perception among the C&I sector. Apart from the questionnaire, the interviewees shared various other instances depicting their experiences and

expertise. In total, 7 successful interviews were conducted (all 7 interviewee males) from heterogenous backgrounds. This helped in diversifying our findings.

After the successful completion of interviews, the recorded interview was converted into the transcripts in the form of answers of the questionnaire. All the interviews were similarly converted into such descriptive scripts. The next step being, turning the answers into small codes depicting the respondent's perception which would be easily understood. These small codes were segregated among the 6 main subjects of our research objective as discussed before. After segregation, each subject was discussed in detail keeping the extract of all the codes.

Findings and Analysis

Maharashtra. The main purpose behind this study is to record and document the experience of commercial consumers of electricity. The adoption of RTS encases lots of nuances which needs to be known among other consumers who are looking forward to such adoptions [16]. Apart from this, this dissertation will be helpful for the policy makers, they can form and amend regulations keeping the experiences of large consumers intact.

TABLE I. SOCIO-DEMOGRAPHIC PROFILE OF RESPONDENTS

Respondent's Number	Industry	Respondent's Designation
P1	Training Centre, Consultancy	Director
P2	Educational Institute	Campus Administrator
P3	Educational Institute	Administrator
P4	Consultancy	CEO

P5	Automobile plant	Deputy general Manager
P6	Educational Institute	Administrator
P7	IT solutions	GM-Admin

The above given table represents the social profile of each interviewee for better understanding.

The responses were recorded, converted into transcripts for the ease of analyzing. Further the transcripts were studied comprehensively to convert them into small codes for better learning purposes. These codes were well versed and written to be apprehended by the experts of the subject. Based on the 6 main subjects of this thesis, codes were written in separate tables which clarifies the objective. Each code was discussed further for better comprehension.

1. Factors that triggered the adoption of RTS

TABLE II. CODES DEPICTING FACTORS THAT TRIGGERED THE ADOPTION OF RTS

Coding from the Respondents transcripts
Cost reduction in electricity bills
Generation of Green Energy
Taking advantage from Government's subsidy and initiatives
Improvement of tail-end grid voltages and reduction in system congestion with higher self-consumption of solar electricity
Payback period of investment in just 3 to 4 years
Little impact of rising tariff of grid electricity
Depreciation on Capital Cost

P1: "Cost is the main reason, decreasing your expenses."

P3: ".....for saving of electricity bills by way of generating it through natural resources like solar energy."

P4: "Rising cost of electricity"

These are some of the instances of responses stating "saving in electricity bills" as the main trigger towards adoption.

The above given codings represent the overall evaluation of the responses, highlighting the major factors triggering an organization for the adoption of RTS. Cost reduction in electricity bills being the most common response among all respondents. C&I consumers pay hefty amount of electricity bills for the uninterrupted power supply, their need for RTS becomes ardent in order to save money. In the process, they will become an active participant in green energy initiative which is the government's main motive. Indian government is coming up with various schemes and reforms to subsidize such organizations coming forth to RTS adoption, this makes the adoption lucrative. Respondent P4 focused on the grid and tariff issue which is one of the major concerns these days. With the consumption of solar power from the installed RTS, the dependency on grid connection reduces and removes the voltage fluctuations by supplying solar power simultaneously with the grid electricity. The C&I sector pays higher tariff charge/unit for the electricity supply which is a major monthly expense and the tariff rate being uncertain and prone to inflation impacts the C&I consumers,

in such scenario RTS adoption soaks such deterrents in tariff change by reducing the cost incurred paving the way for more adoptions [13]. Also, after the payback period is over, the consumer can reap the benefits from RTS for 20-25 years which is a profitable transaction.

2. Process followed to adopt the RTS

TABLE III. CODES DEPICTING THE PROCESSES FOLLOWED TO ADOPT THE RTS

Coding from the Respondents Transcripts
Feasibility study, Prior study and research
Owing to financial and technical expertise, calling out vendors/Application to state government for on-grid RTS connection
Based on project’s criteria, tender is awarded to the deserving vendor

P5: “We first searched for developers based on their CRISIL ratings and then their financial stability.....18 vendors were there in the basket – then shortlisted to 9. Tender was issued – and finally 4 were considered for commercial bids – sealed bid approach was adopted. At the same time, technical rating of the developers was also developed.”

As respondent P5 clearly stated, this is the process followed for most of the adoptions. Developers are selected based on their ratings and their expertise.

The process followed for the adoption of RTS initiates from the feasibility study followed by detailed research by every C&I consumer looking forth. A plan of adoption along with specific criterion is jotted out, based on ratings; vendors and developers are called out.

The vendors fulfilling the financial and technical qualifications are selected and one among them wins the bid. This process is adopted for private vendors whereas state boards have separate applications and proceedings. According to the approval of senior management, the organizations make the choice for the service providers. The initial stage of deciding is crucial and requires dedicated efforts to go ahead.

3. Advantages of adopting RTS

TABLE IV. CODES DEPICTING THE ADVANTAGES OF RTS

Coding from the Respondents Transcripts
Cost saving in electricity bills
Green initiative
Government’s subsidy
Reduction in Carbon footprint
Using incessant natural resource, Solar energy
Good Return on Investment after the Payback period is over
Economic use of building’s terrace
Less dependency on Fossil fuels
Reduction of Voltage fluctuation

P2: “We are able to be a part in Clean environment.”

P3: “Reduction of Carbon in the environment.”

P4: “Green energy”

P5: “We have committed to green energy in all our European plants – by 2022, all the plants will be run on green energy. So, we will reduce our dependence on fossil energy and more focus will be on solar.”

According to most of the respondents as cited above, green energy generation is one of the major advantages of RTS adoption. This generation makes the organization, a major contributor towards curbing pollution [1].

Apart from savings in electricity bill, there are other benefits reaped from the RTS adoption. The respondents have clearly marked the green energy generation as profound implication of RTS adoption. Harnessing incessant solar radiations and abatement in carbon content is another important response from the interviewees. Reduction in carbon footprint motion is perpetually spreading worldwide, urging the government to initiate measures of subsidy and other helps in RTS adoption specially among the large consumers of electricity. From the financial viability part, after the payback period; the consumer can avail the advantages of RTS up to 20-25 years till the modules gets degraded. RTS adoption comes with the economic usage of terrace as per respondent P3 and P5, unused terrace finds a purpose and proves to be advantageous. The adoption of RTS also helps in stabilizing voltage fluctuations.

4. Post- maintenance measures

TABLE V. CODES DEPICTING THE POST- MAINTENANCE MEASURES

Coding from the Respondents Transcripts
Regular and periodic maintenance required
Dust accumulation reduces the efficiency of modules
Agreement with AMCs
Online monitoring by O&M- a good way to monitor the RTS

P6: “Post installation treatment/ service is required to get better generation..... The cleaning schedule should be maintained properly...If dust is there, and cleaning is not done properly, there is a 20% reduction in generation - and that is major.”

From the cited response, periodic maintenance is the key to modules operating efficiently. The codes transcribed from the other respondents also discuss the importance of maintenance.

Dust accumulation is the main factor responsible for decrease in module’s efficiency, this requires proper maintenance. Maintenance is the key to successful operation of RTS with consistent efficiency. All respondents emphasize on the value of periodic maintenance in thriving RTS adoption. Proper agreements with the O&M team should be made beforehand in order to avoid any technical difficulties. In current era of technological advancements [6], online monitoring option is available which eases the task of O&M people.

5. Barriers/Problems encountered in RTS adoption

TABLE VI. CODES DEPICTING THE PROBLEMS ENCOUNTERED IN RTS ADOPTION

Coding from the Respondents Transcripts

Liasoning with Government
Cost Intensive investment
Technical difficulty, due to lack of 3 rd party consultants
Lack of land space in big cities
Extensive clearance and procedural processes
Getting a commercial net meter is a cumbersome task
Shadow being a big factor, side-lined while adopting RTS
Lack of governments' subsidies
Lack of loan from financial institutions
Lot of uncertainty because of weather
No payments for excess generation, banked generation gets lapsed if not used
Stringent norms by the government
Zero salvage value of the modules
Taking permission of RTS adoption from higher management isn't easy.
Vendor issues- inefficient vendor supplies

P6: ".....but cost is a big issue - initially government was giving a capital subsidy, but now they have stopped."

P3: "it is felt that more financial schemes should be provided so that more people can install it."

P5: "smaller consumers will not be able to afford without any subsidies."

P7: "The biggest problem is that of high upfront costs. There is no bank that is ready to extend loans for RE investments."

According to most of the responses cited above, cost is the one of major impediment in RTS adoption. The sector needs heavy investment in form of loans or subsidies to ease the process of adoption.

The process of RTS adoption comes with obstacles as the path follows. The respondents observe government's involvement as the major impediment in the process of adoption. Liasoning, land acquisition, lengthy proceedings, lack of subsidies in the C&I sector, lack of investments, lack of proper regulations in the sector, overlooking the importance of a net meter and no permission to use the banked generation are the major problems encountered while dealing with RTS adoption. These stringent norms make the process more laborious and intensive. Government's anomaly deters the organizations in the RTS adoption. Apart from this, due to technical disability; some or the other factor may cause inefficiency in the generation process, like the shadow or uncertain weather factor which hasn't been considered while adoption due to lack of technical expertise or a consultant.

The other barrier is in the organization itself, getting approval for such adoption requires extra effort due to the requirement of heavy investment. The inappropriate selection of vendor without prior research leads to many technical difficulties.

The RTS is set up with heavy investment, but after the successful operation of modules, they are of no use with zero salvage value, left only for being discarded. These are the barriers faced by any C&I consumer which dismays the future adopters.

6. Suggestive measures to enhance the adoption of RTS among C&I consumers.

TABLE VII. CODES DEPICTING THE SUGGESTIVE MEASURES TO ENHANCE THE ADOPTION OF RTS AMONG C&I CONSUMERS

Coding from the Respondents Transcripts
Enhancement of govt. subsidies
More of flexibility from financial institutions
Legislating proper regulations
Reduction in initial investment
Awareness programs to be conducted among the C&I consumers Also, about RESCO models
Timely and ease of proceedings pertaining to liasoning, net metering, clearances and other processes.
Organizations using RTS, sharing their experience among other commercial users.

P2: "Maximum benefits should be given by Government to customers in terms of subsidy as well as tax benefits for commercial customers."

P3: "Govt. should offer subsidy to increase the use of solar in commercial and institutional sectors."

P7: ".... Also, financial assistance is not forthcoming - banks are not ready to give loans"

Financial benefits given by the government is the most important suggestible measures by the respondents which can enhance the adoption of distributed solar power among the C&I consumers.

Each respondent came out with certain measures to enhance the RTS adoption among the C&I consumers based on their experience and expertise, government's interventions being the most important measure to accentuate the adoption of RTS among the large consumers of electricity. Subsidies, initiatives, financial help and punctuality in proceedings needing prominent reformations. The flexibility in the regulations is a major step in the direction of future adoptions. The government should consider the deterrents and act accordingly.

Awareness programs to be made prevalent, programs comprehensively dealing with such adoptions should be organized. RESCO model, a zero-investment model where the investment is borne by a RESCO developer and the consumer only pays for the power generated. The information about this model to be made aware among the C&I consumers. This model is lucrative for the consumers as it initiates with zero upfront investment which is a major barrier in such adoptions. Also, the consumers successfully operating RTS should spread their experiences and benefits reaped among the sector. This will encourage the future adopters and will accelerate the process [26].

Discussions and Recommendations

payments. Reduction in the electricity bill is the most lucrative factor inducing the adoption among the consumers.

P5: "Even when we did the pilot, there was a subsidy scheme, but we were not sure of when we will get, so we passed it on to the developer, but unfortunately that subsidy never got paid to the developer."

Subsidy, an important part of any investment should be authorised under proper regulations and should be given

responsibly to the consumers. Proper subsidies will accelerate participation among the C&I consumers.

Apart from the savings, subsidies, ease in regulations and strong financial help triggers the adoption among these consumers. This adoption benefits both the consumer and the government by generating green energy.

P6: *“Getting a net meter for commercial purposes is a big problem nowadays”.*

Net metering, a profitable way of earning extra revenue by selling the excess power generated should be made readily available considering the organization’s sincerity and dedication. There are strict regulations in obtaining net metering facilities which should be eased. There are many advantages of net metering namely, benefits of extra revenue and credits if the capacity generated surpasses the consumption, decreases the use of any battery storages and cheap maintenance. These benefits can easily attract C&I consumers and can be a prominent factor in future adoptions.

P6: *“People should be made aware that such models exist”.*

RESCO or Renewable Energy Service Company/OPEX or Operating expenditure model, a great initiative in the development of renewable industry is an efficient model which is the most lucrative option for C&I consumers. In this model, the developer is responsible for all the investments, the consumer pays only for the electricity generated. All the procedures, approvals and O&M is handled by the developer itself. By opting for this model, the consumers can focus on their core businesses without the pressure for any investments, they can be independent towards any liability of RTS adoption. Widespread awareness programmes to be conducted for all large and small-scale C&I consumers to give them idea about such potent model. This will be a preminent step in diffusing such adoptions. RTS adoption is an area with much needed marketing, needing exquisite trigger.

Banking and other financial institutions should be flexible with granting funds for such adoptions seeing the necessity for such adoptions. With the help of RBI’s regulation, the interest rates for such debts can be reduced to empower the consumers opting for such adoptions.

P4: *“For all developers or organizations who intend to set up RTS, it completely new process for all. In such case, they take help of experts such as 3rd party consultants who help you to install RTS from beginning to the end.”*

In the initial phase of decision making, planning and designing the module installations, technical consultancy is must. There are many complexities in planning stage which any developer should consider, for successful implementation. A proper technical supervision and expertise can remove such obstacles.

The work is not only limited to adoption, periodic maintenance is necessary for its consistent performance and for its efficient working. Every organization should be proactive in calling out maintenance measures and should sign up an agreement to order to maintain periodicity.

P4: *“As the system is connected to web, online monitoring can be done by O & M partner and they can depute repair personnel as per requirement.”* Other important achievement in O&M is online monitoring, which can be adopted by consumers for surveillance and opting for maintenance when required. This saves time and money.

The process of RTS adoption is a big step for any organization, comes with its own pros and cons. The regulations, norms and the policies formulated by Indian government plays a prominent role in such adoptions. It has certain advantages and disadvantages. A comprehensive research which helps in designing the reforms with an ample amount of flexibility is the dire need of the sector [16].

The experiences of the experts shared in this research can help give good insights for any future decisions, the study can help ease the regulatory blocks which are major impediments in the adoption processes. This study encompassing expertise of the respondents will help the large-scale enterprises assimilate the facts and move further with optimistic mindset.

C&I consumers are facing deterrents as shared by the respondents, this dissertation will act as an aid in policy formulations which reinforces the adoptions. The consumers will perceive the experiences in an optimistic way and will encourage it further. However, the advantages reaped from such adoptions overcomes the barriers encountered [23]. These benefits will lay a strong foundation in future adoptions, taking a step forward in the GO Green initiative. This study analyses the respondent’s perception with suggestible policy interventions which will enhance the policy maker’s efficiency in formulating any policies and recommendations. Also, this thesis lays a foundation as a market trigger into promoting the future adoptions of RTS, incrementing the consumer base under C&I sector.

Conclusion

These are the information retrieved from the respondents which decided the course of our findings. From the detailed study, Government’s administration and regulation seems to have profound impact on the adoption of distributed solar installations. Advantages reaped, barriers encountered, maintenance measures and suggestive methods for enhancing the adoption among the C&I consumers were the titled experiences in this thesis. The responses have been dealt considering the intricacies of the adoption methods. Green energy initiatives, an important motive of Indian government and main tenet of the Industries present worldwide urges the C&I consumers to be an active participant in the generation of green energy. This is a step to curb pollution and reduce carbon footprint. C&I consumers spends a considerable amount of their revenue in electricity payments, decrement in these bills is an attractive offer for the consumers. This prominent factor is responsible for accelerating the RTS adoptions. Regulatory flexibilities, openness to new technologies and advancements, awareness among the consumers, driving on Go green mission and appealing cost savings in electricity bills are the most important perceptions of RTS among the consumers. This research will act as a market driver among the C&I consumers, creating awareness among the users to accelerate adoption.

Limitations

This study takes Rooftop Solar (RTS) adoption into consideration, leaving out other RES adoptions. Biomass, wind turbines etc. are other such installations among the

C&I consumers which are prevalent but RTS adoption being the preferred option among this sector has been incorporated for this research.

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