INNOVATION IN THE ELECTRICITY INDUSTRY: FOCUS ON DISTRIBUTED RENEWABLE ELECTRICITY GENERATION

INSIGHTS INTO CUSTOMER ADOPTION

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Driven by growing concern for the environment and the rising price of electricity, customers are looking for options for consuming electricity in an eco-friendly and cost-effective manner. The availability of more affordable technologies, marketing activities from renewable energy companies, and government incentive programs have led to an increased interest in distributed renewable energy generation (DREG). Some customers, with innovator characteristics, have already engaged in DREG through programs such as net metering, micro FIT (feed-in-tariff), and FIT programs. These innovative renewable energy solutions have enabled customers to better manage their electricity usage and control their costs.

This report, the second of the series, examines customer adoption of DREG through the perspective of diffusion of innovation theory (Rogers 2003). This perspective suggests that understanding actual and future customers requires an examination of their profiles, motivations, decision-making process, concerns, and needs. Furthermore, the theory focuses on exploring how social systems and communication channels help and hinder the adoption of innovations.

Research Method

We collected the data during fifty-seven semi-structured interviews with sixty-five participants located in North America from June 2017 to October 2018. Thirteen of the interviews involved utilities; twenty were with third-party suppliers such as renewable energy providers, solar system installers or contractors; seventeen involved other stakeholders such as regulators, industry associations, and cities; and six were with DREG customers.

The interviews were conducted in person where possible, otherwise by telephone, and each lasted approximately 60 minutes in duration. Where permission was granted, the interviews were audio-recorded and transcribed verbatim. In other cases, notes were taken by the researcher and approved for accuracy by the participant.

Following the interviews, the data were analyzed qualitatively by identifying key themes that emerged from the interviews in relation to Rogers' diffusion of innovation theory. These are synthesized and reported in the Findings.

SUMMARY OF FINDINGS

- Current renewable energy customers are very characteristic of 'innovators', having a high willingness to accept risks.
- Diffusion of DREG is limited by a fragmented social system, the perceived complexity of the innovation, attributes that reduce its trialability and observability, and limited communication channels
- Strong motivations, good financial condition, and related expertise are the three main factors that enable customers to participate in renewable energy programs.
- To increase DREG adoption, we recommend integrating communications channels, improving the trialability of the innovation, and re-imagining the social system around electricity generation and distribution.

INNOVATION OF DIFFUSION THEORY

Diffusion of Innovation is a seminal theory for studying how innovations spread through a specific population or social system. The innovation might be an idea, product, or information technology (IT) solution that is perceived as new. The social system is "a set of interrelated units engaged in joint problem solving to accomplish a common goal" and it identifies the boundary in which the diffusion of innovations occurs (Rogers 2003). Diffusion is the process by which information about the innovation flows from one person to another over time, with the final result being adoption of the innovation (Rogers 2003).

Four main determinants of an innovation's successful diffusion are the communication channels, the attributes of the innovation, the characteristics of the adopters, and the social systems. Communication channels mean the media and methods through which people acquire information of the innovation and perceive its effectiveness. Attributes of an innovation include relative advantage, compatibility, complexity, trialability and observability (Rogers 2003). Our analysis suggests the last three attributes are most relevant to DREG. Complexity refers to the degree to which an innovation is perceived to be difficult to understand and use. Trialability is the ability of an innovation to be tested or adopted with minimal investment. Observability is the extent to which the benefits of an innovation are visible to people. An innovation with higher trialability, lower complexity, and higher visibility of benefits is likely to be adopted more quickly (Rogers 2003).

Potential customers of an innovation can be grouped into five types based on their attitudes and reactions towards an innovation. The five types of adopters, their characteristics, and the applicable targeting strategies are summarized in Table 1.

Table 1: Characteristics Five Adopter Categories and Strategies for Promoting Adoption (Rogers 2003; LaMorte 2018)

Adopter category	Percentage of population	Characteristics	Strategies
Innovators	2.5%	▪ Want to be the first to try the innovation. ▪ Are interested in new ideas and willing to take risks.	▪ Very little needs to be done to attract this population.
Early Adopters	13.5%	▪ Represent opinion leaders. ▪ Comfort with changes and adoption of new ideas.	▪ Provide how-to manuals and information package of implementation. ▪ Do not need to convince them.
Early Majority	34%	▪ Need to see evidence and proven benefits before adopting an innovation.	▪ Provide success stories and evidence of the effectiveness of the innovation.
Late Majority	34%	▪ Afraid of changes and risks ▪ Only adopt an innovation after the majority have adopted it	▪ Need detailed information on how many other people have tried the innovation. ▪ Prove the successful results after the adoption.
Laggards	16%	▪ Very conservative and traditional ▪ Very skeptical of changes and risks	▪ Include statistics approval of successful adoption of other people. ▪ Need pressure and push strategy.

Findings

Across North America, the diffusion of DREG is still in its early stages. Current renewable energy customers are 'innovators' based on the percentage of the population. These customers have better energy efficiency awareness, usually participating actively in the energy efficiency programs offered by utilities before adopting DREG. Most importantly, these customers are willing to tolerate inconveniences and risks associated with implementing a new technology.

Our two main findings, presented below, highlight influences on diffusion originating from the context and the characteristics of the customers.

1. A more rapid diffusion of DREG is limited by a fragmented social system, the perceived complexity of the innovation and attributes that reduce its trialability and observability, and limited communication channels.

Characteristics of the Social System

- The social system is fragmented or in transition, which creates challenges to the diffusion of information. There are various incentives or rebates programs issued from different levels of governments, but rules and programs vary from one jurisdiction to another. The traditional utility-customer relationship is being disturbed by new entrants, and solar system providers are trying to gain a foothold.
- Both customers and solar vendors need more education and support from the social system to cope with their needs, challenges and concerns in the adoption and implementation of DREG innovation.
- Some cities control their own utilities or cooperate with utilities within their territory to realize the objective of green energy and sustainability of electricity.

Attributes of the DREG as an Innovation

- Investing in DREG is a long-term commitment, with low trialability. However, government rebates and incentive programs help to facilitate the implementation of renewable energy by reducing the cost of upfront investment or payback period.
- Some potential customers require the loans and funding to engage in DREG innovation.
- For customers, renewable energy is a relatively unknown technology with perceived complexity. However, during the sign up process, solar vendors (in collaboration with utilities) can reduce this complexity by providing relevant information and making the process much easier to the customers.
- A key dimension of observability relates to the financial benefits of DG system. To increase observability, these benefits (savings and payback) are visible and predicable for the customers.

Communications Channels

- Governments' advertisements of rebates and incentive programs help drive interest in DREG.
- Solar vendors have adopted push marketing strategy through social media and view 'word-of-mouth' as an effective strategy to engage new customers.
- Customers like to share their experience with their neighbours, friends and others.
- Some cities take an active role in promoting renewable energy programs by installing solar systems and organizing social activities to transmit the information to their residents.
- Industry associations provide information and support to the solar vendors as they cope with the changing market. Associations may also actively promote renewable energy policies and adoption.

2. Strong motivations, good financial condition, and related expertise are the three main factors that enable customers to participate in renewable energy programs

There are two main phases of the customer decision-making process. In the first phase, customers get information about renewable energy from government advertisements of incentives and rebate programs, the solar vendors' marketing, social media, utilities' websites, and recommendation of neighbours or friends. Based on these informational resources, customers develop the initial willingness and interest to consider adopting DREG.

The main motivation for customers to engage in DREG is to save or make (in the case of FIT programs) money. Rebates and incentives programs facilitate adoption by decreasing the initial investment in a system. Concerns for the environment and climate change and desires to go greener in the production of electricity are also key, but secondary, elements that drive the innovators' interests for DREG. Another motivation for customers to adopt this innovation is their interest in new technologies, such as roof-top solar systems and net metering. Within the commercial customer segment, some manufacturers of solar equipment and cities (or other institutions) install solar panels for own educational and promotion purposes. For residential customers, the investment is sometimes about increasing the value of the property.

During the second phase of the decision-making process, under the guidance and support primarily of solar vendors, customers investigate more fully the feasibility of achieving their goals by examining the incentive details, physical properties of their location, and the financial benefits such as payback and potential savings. In another words, customers evaluate the trialability, observability, and complexity of the DREG innovation. If these elements can meet their expectations or requirements, customers make the decision to adopt.

Two main concerns influence customers' adoption decision. First, customers need to understand easily the terms and conditions, requirements and benefits of the DREG program. To date, solar vendors have done the largest part of the job of educating potential customers. However, customers require different sources to get information if the innovation is to diffuse to other innovator categories. Second, many potential customers can still not afford the initial investment of a solar system without external financing sources. As economic considerations are the main motivation for customers, the availability, complexity, and terms of financing for DREG investments has a major influence on adoption and diffusion.

Recommendations

With the aim of increasing DREG adoption, we make three recommendations to industry leaders.

1. ENHANCE AND INTEGRATE COMMUNICATION CHANNELS

Considering the approaches that appeal to different innovation adopter categories, we recommend increasing the informational value of the content provided to potential customers and integrating diverse communication channels. This strategy will help to enhance the communication effectiveness and attract more potential customers.

Instead of each party (utility, municipal government, regulators, vendors) developing their own content and marketing activities to introduce DREG, it would be more effective for them to collaborate to create standardized informational resources. Specific examples of content could include how-to manuals, information on DREG program implementation, success stories of previous customers, and factual, objective evidence of the effectiveness of the innovation to meet various objectives (financial as well as environmental benefits). Although there are differences in DREG programs from one jurisdiction to another, our research suggests that there are enough common elements that would allow for the creation of a suite of standard introductory materials. If created and offered through a creative commons license, each organization could then build on or customize the documents according to their particular stakeholder needs.

To improve the communication process, a variety of stakeholders (city, utility and solar vendors) could co-develop activities and an informational platform – including mobile applications - to allow existing DREG customers to demonstrate the effectiveness of the innovation and share their successful experiences with other potential customers. This would have multiple benefits for organizations. For example, solar vendors could share their success (and failure) stories to reduce distrust create realistic expectations (e.g., financial payback). Utilities could interact with customers through this platform to bring more direct live experience and information needed for customers' decision-making. With Improved information and more integrated communications between industry stakeholders, customers' perceptions of the complexity of DREG should diminish, thus enabling its diffusion beyond the innovators to early adopters and early majority, and so on.

2. INCREASE THE TRAILABILITY OF DISTRIBUTED RENEWABLE ENERGY

Clearly, buying a solar system for one's home or business is not like buying a vehicle. Although the price may be similar (or less even for a solar system), a potential customer cannot 'test drive' the system and the system is hard to remove and resell if the owner is unsatisfied or if the needs change. Still, to increase adoption of DREG, the industry needs to find creative ways for potential customers to gain experience with the innovation and reduce the potential financial risks of adopting. As financial considerations play an important role in the decision-making process, the upfront and life-time costs for the customer need to be lowered. Third-party and other financing services for net metering programs would attract more potential customers to participate in DREG. This is already being done in some cities where there is a publicly-supported, low-interest, financing programs offered by the government or non-profit

organizations. To be effective such programs must also offer a streamlined process that does not add to the perceived complexity associated with DREG programs.

Besides financing, both physical and information technologies should be used in innovative ways to improve trialability. The cost of solar has come down in recent years due to engineering improvement and efficiencies. Now, as DREG has gained a foothold, engineering design and manufacturing companies may want to explore how to make the physical system more 'plug-and-play' allowing for easier relocation or reuse if the initial conditions change. On the IT side, during the decision-making process, virtual and augmented reality could be used to help customers visualize how a solar system would look and function on their property. Decision-support tools could provide the range of outcomes given different scenarios. Virtual net metering might be another good option for increasing the possibility for more potential customers to participate in DREG. Such technological innovations must be accompanied by innovation within the policy and regulatory domain that removes constraints while still protecting societal and customer interests.

3. REIMAGINE AND BUILD AN IDEAL SOCIAL SYSTEM

The structure and interactions of a social system greatly affects individuals' attitude toward an innovation and its ultimate diffusion across the entire population. The first issue in this series highlighted the changes in the utility-customer relationship that are occurring as a result of the introduction of DREG. The findings in this report reveal that the current social system is not homogeneous and consistent. These tensions and uncertainties are not, in our opinion, conducive to growing participation in DREG programs. If the end goal is to facilitate the diffusion of DREG innovation among commercial and residential customers, we recommend that leaders within the industry – from government to business – work to re-imagine and then rebuild a coherent social system that supports the transition to sustainable and renewable energy. Achieving this goal means demands a new approach where the starting point is not where the industry is today, but rather, where the industry wants and needs to be in 10 or 20 years. We reflect on this challenge and opportunity in the third issue of this series.

Conclusion

The diffusion of DREG is still in its early stages. Those who have adopted are innovators, motivated by financial and environmental benefits and willing to take risks. A fragmented social system, attributes of the innovation itself, and limited communication channels provide resistance to broader adoption. By implementing the three recommendations above, the attributes of DREG customers will change, as different categories of adopters (e.g., early adopters, early majority, etc.) sign on. Industry stakeholders are thus encouraged to continue to monitor the level of adoption and characteristics of the evolving customer base for DREG, and to adjust their strategies accordingly.

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