Memorandum

TO: RHODE ISLAND ENERGY EFFICIENCY AND RESOURCE MANAGEMENT COUNCIL

FROM: DOUG HURLEY

DATE: DECEMBER 23, 2016

RE: TECHNOLOGY ADOPTION FOR SMALL CUSTOMER DEMAND RESPONSE

Introduction and Background

In June 2016 Synapse presented a paper to interested Rhode Island parties entitled "State of Demand Response in Rhode Island." It detailed the amount of Demand Response (DR) located in Rhode Island that is participating in the ISO New England wholesale markets, and gave a description of timely industry trends.

On June 9th, Synapse explained key concepts necessary to extend DR to Residential and Small Commercial customers. Presentations were given to the Rhode Island Collaborative and the EERMC meetings that day.

Other related projects, including the Tiverton/Little Compton project, the Worcester AMI pilot by National Grid which has now completed a second summer of participation, and Docket 4600 ("Investigation into the Changing Electric Distribution System") are addressing similar issues: how to get the necessary technology and rate design in place to engage these customers.

With the technology available today, and the way it has been introduced to customers in various pilot programs, it appears that most advantageous rate design for this set of customers involves a combination of time-of-use rates with peak-time rebates during a small number of designated hours. The rate design offered to customers must change over time to maximize customer participation. The most effective rate design will change as the underlying technology improves and customers become more adept at managing their electric usage. It will also change as these customers increasingly adopt distributed generation such as rooftop photovoltaic systems, and on-site storage, whether stand-alone or as part of an electric vehicle.

To gain greater success with this set of customers, we must treat the rollout of new technology not so much the way we have treated traditional utility infrastructure, but more as a consumer technology product launch: We need to convince customers that they want to purchase and use an exciting new product. Using a technology adoption model, we should seek out innovators and early adopters first, get their feedback, and adapt the product. Then broaden the customer base, and repeat the feedback loop.

Technology Adoption Life Cycle Approach

Rhode Island is working on grid modernization, rate design, and advanced metering. Exploration of potential benefits, cost effectiveness, and measures of success are good and necessary parts of the discussion on these interrelated topics. Numerous pilots have been conducted in Rhode Island, in National Grid territory in nearby areas (e.g., Worcester, MA and soon in Clifton Park, NY) and around the country by other electric distribution companies. Each has tested a different design to assess potential, costs, customer acceptance of hourly rates, peak time charges or rewards, in-home technology, automatic and manual appliance usage control, and other technologies and approaches. Through all of these pilots we still have not yet figured out what electric customers will actually want to use.

Each pilot program, though, has approached the problem of engaging smaller customers[1] primarily as a utility infrastructure project. We propose a different approach. Instead, create a multi-year plan designed to grow a market for this technology and treat customer behavior as a technology adoption problem[2]. Think mobile phones, not advanced meters.

Nearly all studies and pilots in this area appropriately address costs and potential benefits. Some of the benefits are categorized as "grid-facing", such as awareness of outages and power quality detection, ease of meter reading, and perhaps integration of distributed generation such as rooftop photovoltaic systems. A large share of potential benefits comes from actual customer behavior, reducing demand during certain hours. These benefits have been extensively detailed in several places, and include direct customer savings, deferred transmission, distribution, and capacity costs; price effects in the wholesale energy and capacity markets; and reduced emissions costs. But all of these "customer-facing" benefits will <u>never</u> realize their full potential unless a large portion of actual customers are engaged with some new technology that allows them to easily change their behavior from current norms. This is neither quick nor easy, but it is necessary, and the potential benefits are enormous.

Instead of simply issuing advanced meters to customers, we must consider this a technology adoption problem, and follow the discoveries outlined by the technology industry as new companies compete to succeed in convincing customers to buy their products. Successful technology companies generally follow this model:

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[1] We refer to "smaller customers" as the Residential and Small Commercial sectors. Although the differences in motivating behavior are large, both groups share a common trait of relatively low potential reduction per utility account.

[2] These are ideas adapted to the context of utility small customer demand response from the book "Crossing the Chasm", by Geoffrey Moore (3rd edition, 2014).

Figure 1. The Revised Technology Adoption Life Cycle[3]
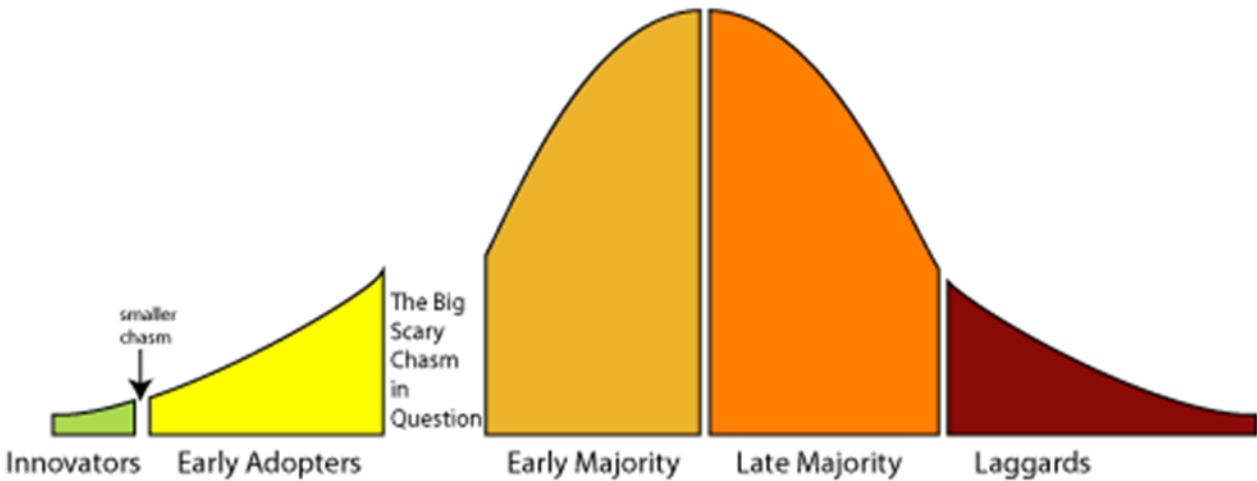
The focus of the book from which this graphic was taken, as can be seen in the diagram, is centered on the difference in adoption behavior between the second group - the Early Adopters - and the third group – the Early Majority. What can be instructive and perhaps revolutionary in our industry is to adopt the entire notion of these different customer segments and how we can evolve a pilot program over time to achieve a successful rollout with the right combination of technology, advanced metering, rate design, cost allocation, and other necessary factors. Let's begin with a quick description of each customer segment.

A. Innovators – *Technology Enthusiasts (~2% of the population)*

Technology enthusiasts, as the name implies, are a rare group who enjoy fiddling with the technology just for the sake of it. They don't need to see savings. These are the folks that wait in line for hours for the newest mobile phone even when the current one works fine, and they'll do so every year. They like to show off their technology to anyone who will listen, and therefore act as a voluntary marketing team to reach the second group. The best way to find them is in on-line technology forums, with direct descriptions of the technology, without gimmicks. It doesn't matter if the technology even works very well, yet, because they are happy to do the necessary integration to make it work with other products. Further, they're just as happy to give lots of feedback, and get a new version next year. There aren't very many of these customers, but their feedback on product design and viral marketing are crucial first steps to a wider audience.

B. Early Adopters – *Visionaries (14%)*

The visionaries want to see a clear benefit from the new product, which in this case is some form of technology that manages their electric usage, and perhaps on-site generation (e.g., PV) and even

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[3] "Crossing the Chasm", by Geoffrey Moore (3rd edition, 2014). Page 21.

storage (standalone or part of an electric vehicle). They look for a clear change in the ability to manage their electric costs or some aspect of their lives or businesses, perhaps as a jump on the competition, and they are willing to change their current behavior, using the technology to achieve this benefit. They will be motivated by reducing costs, saving time, or a passion for the environment. They will listen to the enthusiasts when everyone else is bored and trying to change the conversation, and they will figure out how they could apply this new technology in their home or small business. The actual product they use, and the design of the other pieces of the pilot (rate design, etc.) are now becoming important, will probably be different from what the enthusiasts first saw, and it will need to be. Although willing to do some integration on their own, the actual product they use needs to work.

The most successful approach will include several rounds of trial programs with both of these early groups, adapting the product and any related services based upon feedback from the customers. These customers are rare, and will not be geographically co-located, meaning that these pilot programs will not focus on particular towns, but rather will find these customers wherever they are in the state.

C.   Early Majority – *Pragmatists (34%)*

Unlike their more pioneering neighbors, the pragmatists will only adopt the new technology once several other folks they know and trust have tested it, and they have proof it will work. They are less willing to change their normal routine, and they require a product that works, right out of the box. There's no room for integration effort. Any reduction in usage by automatic means that does not disrupt their lives (what we hope to learn from the first two groups) is better. By this point the electric distribution company is considering the jump from a pilot program to full rollout, and all of the other necessary systems are in place. Contracts with vendors[4] who actually sell the technology and visit the customer site for installation have been signed. The adjacent products have interoperability standards in place, and there is a market of options available. The advanced meters themselves may have become more like a data platform, from which several competing applications can possibly retrieve data (noting security concerns). On-line support videos, a website with Frequently Asked Questions, and all the aspects of a mature technology product exist. The company is now expecting fully half the population of smaller customers to have all the necessary pieces, and they are ready to use them. They are unlikely to suffer major changes in technology with new versions or updates, and will consider that effort a hassle.

D.   Late Majority – *Conservatives (34%)*

Once we are reaching the Conservatives we are in full rollout mode, and all back-office systems are in place to handle participation by the entire section of the population who will ever participate. They want the technology to act like an appliance: plug it in and it works. There must be a full

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[4] In the consumer technology industry, these vendors are called Value Added Resellers, with the crossover acronym VARs.

network of installation and service available to them, and even then they are using it for fear of falling behind. At this point nearly everyone else they know is saving money by managing their electric usage, and it is time they caught up.

E.   Laggards – *Technology Skeptics (16%)*

The skeptics are uninterested in the technology at all, no matter how mature or well designed, and will probably never use it. These are folks who probably do not have mobile phones. In our context, they will have an advanced meter on their home, because all customers will at this point, but they probably don't even know it and won't use any in-home devices. There is little benefit in any effort spent to convert these customers.

If we revise the technology adoption figure to better reflect the timeframes proposed it might look like this:

Figure 2. Illustrative Smart Grid Technology Adoption Life Cycle
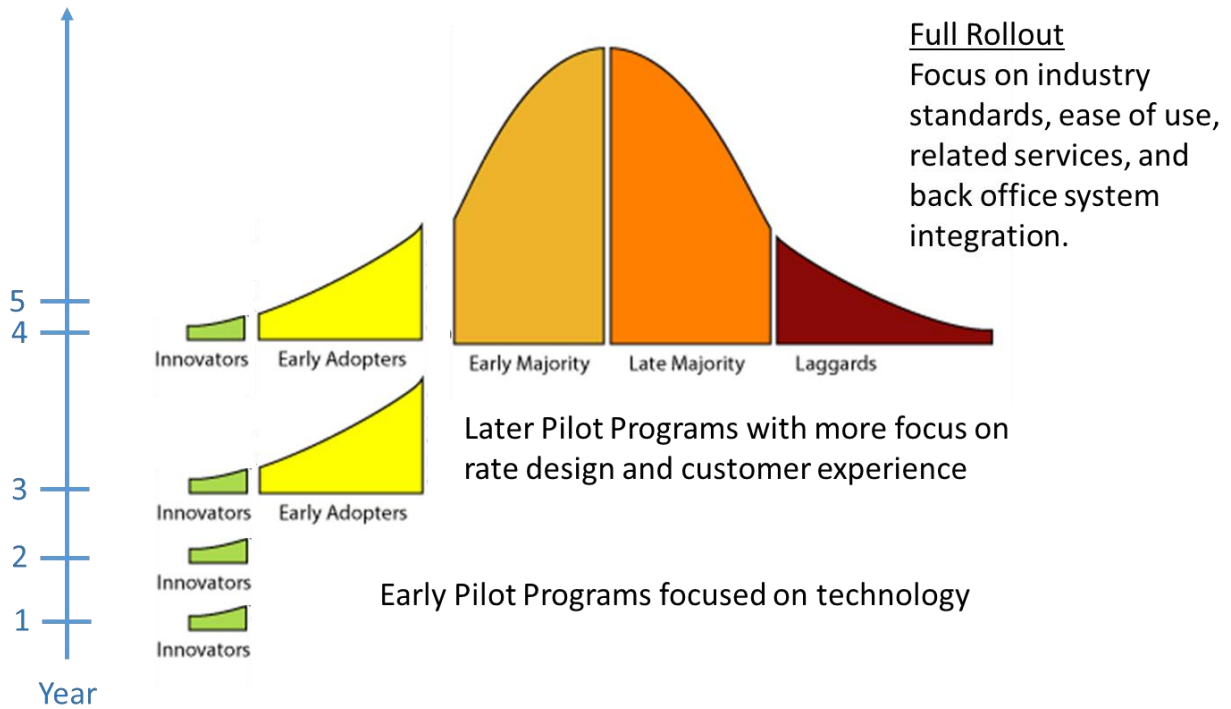
Cost Allocation

In the first several years, Rhode Island should consider the cost as a Research & Development project, much like pilot projects of other types. This will include marketing costs to entice the first customer groups. The overall cost should be low because initially this is a small number of customers. The customers should be asked to pay most of the cost of the meters and the technology, and this group will

pay it because it is either fun for them (Enthusiasts) or they see a value in adopting it early (Visionaries)[5]. The technology vendor may well offer their product at reduced prices, as they are also trying to encourage adoption of a new product, in hopes of bigger sales later.

In later stages, rollout will be broader, technology offerings and rate designs will be altered, and customer cost will probably be lower, enticing greater participation. The cost of the technology products will drop, and wider participation will create greater overall system benefits. Broader costs will also need to be undertaken, such as back-office system integration. At this point, a greater share of the cost of the program should be socialized.

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[5] A small number of customers in Green Mountain Power territory have shown a willingness to spend more than $6,000 to have a Tesla Power Wall unit installed at their home in an ongoing pilot program in Vermont.