Community Resilience
Board Learning Paper

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Energy Trust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020-2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. **These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.**

Introduction

Energy efficiency is the cleanest, cheapest and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering that resource. Communities face a growing number of stresses that pose risks to their energy systems, including aging infrastructure, natural disasters and severe weather events. To become resilient, many communities will need to develop concrete action plans that identify projects and initiatives tailored to local needs, strengths and vulnerabilities. As these plans are developed, energy efficiency and renewable energy investments are a strategy to enhance the resilience of energy systems in communities.

2017 was a historic year and broke records for the number of extreme weather events that occurred and the damages and costs that resulted.[i] According to FEMA, more than 25 million Americans (nearly 8 percent of the U.S. population) were affected by unprecedented disasters.[ii] Here in Oregon, residents experienced severe snow and ice storms, devastating wildfires and the hottest August on record.

Figure 1. Photo of the Eagle Creek Fire taken from the Washington side of the Bonneville Dam area on Monday, Sept. 4, 2017. (Photo by Tristan Fortsch)

In its 2014 report, the U.S. Global Change Research Program indicated that extreme weather linked to global climate change is already affecting every region of the country and is projected to worsen in the near and long term.[iii] This increasing frequency and severity of extreme weather and disasters highlights the need for individuals and municipalities to change the way they prepare for and mitigate against climate change and future hazards. Investing in mitigation activities *before* the next disaster or major heatwave is the key to becoming resilient.

Traditional disaster mitigation planning happens at the top (the state level) and trickles down until it finally reaches citizens at the individual level. But new thinking based on experiences with major disasters is driving new thinking about how individuals, cities and states should be making investments in resilience and, more specifically, bolstering "community resilience." [iv]

The concept of community resilience is relatively new to emergency preparedness, and there is no generally accepted or operationalized definition of community resilience.[v] Despite the lack of a formal definition, there are commonly held ideas about what makes for a resilient community.[vi] One good summary of these shared ideas comes from the City Club of Portland:

> "A resilient community, city or region understands its strengths and vulnerabilities and has developed capabilities to plan for and mitigate the impact of a major earthquake or other disaster, rapidly restore itself to a state of basic well-being, and rebuild to achieve even greater resilience."[vii]

The thing that may distinguish *community* resilience from broader definitions of disaster resilience efforts is the explicit focus on the risks, needs and resources specific to a given community. Community resilience also includes a focus on incorporating equity and social justice considerations in preparedness planning and response. From a planning perspective, community resilience planning is a bottom-up, rather than a top-down mode of thinking because priorities are likely to be very different when resilience is approached from the perspective of the impacted community as opposed to the state as a whole.[viii]

Energy concerns are a vital component of the community resilience equation, because energy powers communities, making modern life possible. Energy efficiency and distributed renewable energy are essential components of any resilience strategy because they aid emergency response and recovery, help with climate change adaptation and mitigation and provide social and economic benefits. They can also help protect communities from the impacts of emerging threats, such as politically motivated cyberattacks on power plants and electric systems.[ix] Whatever the threat, energy efficiency and distributed renewables help reduce vulnerability to the diverse hazards a community may face and increase the community's capacity to cope with the damage.

I. State-level Planning

In traditional resilience and hazard mitigation planning, community-level energy resilience mostly has been overlooked. Energy emergency planning at the state level is heavily focused on liquid fuels and petroleum, with some attention given to transmission-level electricity and natural gas. According to several experts interviewed for this paper, the conventional approach to local energy needs post-disaster has been almost totally reliant on generators and an expectation that "the national guard will fly in diesel when we need it."[x]

In Oregon, energy resilience planning at the state level is guided by two central documents: the Oregon State Energy Assurance Plan and the Oregon Resilience Plan.

A. Oregon State Energy Assurance Plan

Every state has an Energy Assurance Plan, which looks at the potential threats to critical energy infrastructure and identifies solutions for reducing risks and minimizing the impact of energy supply interruptions on health and safety. Oregon's Energy Assurance Plan was updated in 2012 and assesses an array of activities to prevent, prepare for and respond to any "energy emergency," which is defined as any disruption in fuel or electricity supply that extends over a wide area and lasts more than several hours. Under this definition, the plan looks at resilience in relation to more than severe weather and natural disasters. Energy infrastructure events (such as spikes in demand during peak energy use, unanticipated power plant or refinery shutdowns or transmission system congestion), acts of terrorism and cyber security breaches, political events (oil embargos or war) and even market anomalies (spike in energy prices) are also considered.[xi]

In Oregon, natural hazard mitigation and emergency response planning for liquid fuels falls under the purview of Oregon Department of Energy, while natural gas and electricity infrastructure and transmission fall to Oregon Public Utility Commission. Each agency has an action plan describing how distribution of energy or restoration of service is prioritized in the event of a disaster and is responsible for executing their plan during

an emergency. During an emergency, Oregon Emergency Management coordinates the work of these agencies and all other public and private organizations providing emergency services. The result is a top-down response that consolidates decision-making and directs the flow of resources through the various agencies and counties to critical services such as law enforcement, fire and medical teams, and then to essential service providers like utilities, telecommunications, public works, sanitation and public transit.

B. The Oregon Resilience Plan

The Oregon Resilience Plan was written to move Oregon beyond emergency preparedness into resilience, with a potential Cascadia earthquake and tsunami as the focal point. Commissioned by the legislature and written by the Oregon Seismic Safety Policy Advisory Commission, the Oregon Resilience Plan is more of a report than a plan.[xii] It highlights how different regions and communities likely will be impacted during and after an earthquake and paints a serious picture of how long certain communities may be isolated. The main message from the plan is clear, stated in bold as the opening sentence to the executive summary: “very large earthquakes will occur in Oregon’s future, and our state’s infrastructure will remain poorly prepared to meet the threat unless we take action now to start building the necessary resilience.”

Writer Kathryn Schulz pulled material from the Oregon Resilience Plan for “The Really Big One,” her Pulitzer Prize-winning article for *The New Yorker* on seismic risk in the Pacific Northwest.

> “Soon after that shaking begins, the electrical grid will fail, likely everywhere west of the Cascades and possibly well beyond,” Schulz describes memorably in her passages describing how a magnitude-9.0 Cascadia subduction zone earthquake might unfold, “If it happens at night, the ensuing catastrophe will unfold in darkness… in the I-5 corridor it will take between one and three months after the earthquake to restore electricity.” [xiii]

II. Communities at Risk

Disasters do not uniformly affect communities or residents. Risk is a difficult thing to define by a single metric. All communities are at risk from hazards of some kind, but what those hazards are and how they factor into the level of risk depend on a given community's geography, built environment, demographics and social systems.

Understanding how much a community is at risk from various threats is a complex undertaking. The likelihood of the hazards themselves must be weighed with the vulnerabilities of a particular community. Vulnerabilities can include physical infrastructure weaknesses and social and economic factors. Vulnerability to natural hazards is affected by a person's social and economic circumstances in everyday life. People who lack access to resources and information suffer most in a disaster.

As part of Oregon's state-level hazard mitigation planning, which is led by the Oregon Office of Emergency Management, the state has assessed the statewide risk from 11 natural hazards and predicted the impacts that climate change will have on each in the Oregon Natural Hazards Mitigation Plan. In addition to looking at the state as a whole, the plan analyzes eight regions in the state and assesses vulnerability by county. Figure 2 presents the local vulnerability rankings for each of Oregon's 11 hazards by county.

In addition to this statewide assessment, counties and some large cities in Oregon maintain their own hazard mitigation plans which identify their top hazards, vulnerabilities and mitigation priorities. Since they are local plans, the risks and recommended mitigation activities are more reflective of the local community's needs and other community-level planning efforts. For example, Portland's planning process applied an equity lens for the 2016 update to its Mitigation Action Plan to ensure that the process and outcomes benefit Portlanders who are most likely to be impacted by a natural hazard event.[xiv]

There have been efforts over the years to create a central repository for these local plans and catalogue and track all the actions from these plans. Unfortunately, there is no consistent funding or staff dedicated to the work.[xv]

County	Coastal Erosion	Tsunami	Drought	Dust Storm	Earthquake	Volcanic	Landslide	Wildfire	Flood	Wind Storm	Winter Storm
Baker			H	M	M	L	M	H	M	H	H
Benton			L		H	L	L	M	M	M	M
Clackamas			L		H	H	L	M	M	L	M
Clatsop	H	H	M		H	M	H	H	H	H	H
Columbia			L		M	M	M	M	H	H	H
Coos	M	H	M		H	M	M	M	H	H	H
Crook			H	L	L	H	L	M	H	M	M
Curry		H			H	H	L	H	H	H	
Deschutes			L		M	H		M	L	L	H
Douglas - central					M		M	H	H	M	H
Douglas - coastal	L	H			H		M	M	M	M	M
Gilliam			H		M	M	M	M	M	L	H
Grant			H		M	H	M	H	H	H	H
Harney			M		L	L	L	H	M	L	M
Hood River			H		M	L	M	M	M	H	H
Jackson			M		H	L	L	M	M	H	H
Jefferson			H		L	H	L	H	M		H
Josephine					H			M	M	H	H
Klamath			M		M	L		L	M		M
Lake			H		H	H	L	M	M	M	H
Lane - central			M		M	M	L	M	H	M	H
Lane - coastal		H			H		M	L	H	H	L
Lincoln		M	L		M	L		M	L	H	
Linn					H	H		M	H	M	H
Malheur			H	L	M	M	M	H	H	M	M
Marion					H	M		M	M	H	H
Morrow				M	H		M	M	H	M	H
Multnomah					H	H	M	M	H	H	H
Polk					H	M		M	H	H	
Sherman			M		L	L	M	M	M	M	M
Tillamook		H	L	L	H	M	H	H	H	H	H
Umatilla			H	H	M			H	M	H	H
Union			M	L	H	L	L	H	H	H	H
Wallowa			H		L	L	L	H	M	M	M
Wasco			H		M	L	M	M	L	H	H
Washington			M		H	H	L	M	H	H	H
Wheeler			H		H	M	H	H	H	M	H
Yamhill			M		H		M	L	H	M	H

Figure 2. Local vulnerability rankings by county, taken from local natural hazard mitigation plans. [xvi]

III. Community Resilience Planning

Across Oregon's vast and active landscape are urban, rural and deeply rural communities. Resources and capabilities to prepare for disasters varies. Community and energy resilience – a major emerging need – starts with developing resources and capabilities at the community level. Threats or hazards will always be part of the picture when it comes to discussing resilience, but many risks and dangers also come from just how well-prepared – or not – communities are when facing a range of threats. Impacts to homes, businesses, and infrastructure, in both the public and private sectors, are serious. Although this paper does not go into assessing impacts, some aspects of community-led and -supported resilience planning are included to illustrate some of the first steps toward resiliency in several communities.

Planning and prioritization factor greatly into resilience – or a community's ability to be resilient. Planning across a community's many needs is a great undertaking. Major systems such as energy, water, communications, health care, food security, to name a

few, require substantial planning to secure when disrupted. Access to energy, and electricity in particular, underpins all these critical systems. Following an emergency, there are two challenges that communities face: the time it takes to restore power and, when power is restored, the potential for reliability or capacity issues for a very extended period. Both can compromise recovery by undermining rebuilding and economic activity. On a positive note, communities can become more resilient by utilizing technologies available today.

Planning involves identifying needs and developing various ways to address the needs. From the perspective of urban planners and design professionals, a common phrase used is “design intent.” Utilizing technologies available today, strategies can be developed or applied to various needs to support a resilient design intent, or to maintain functionality when utility-supplied energy is constrained or unavailable. Solar electric systems are an example of a technology that can be enhanced with storage and other advanced technologies to be resilient. Other systems may need to be designed to fail safely or to activate or buffer in certain circumstances. Buildings with robust envelopes and smart controls can be designed to “coast” through fluctuations in available power, or drop non-critical energy loads, enabling the building to be livable or usable even under constrained power scenarios. Therefore, designing with resilience in mind is a way of strengthening existing strategies and technologies currently used today in providing energy efficient solutions and renewable energy solutions in homes and businesses.

IV. A Growing Movement

Natural disasters near and far have focused the attention of Oregonians on the need to create more resilience in our communities. Communities are learning from each other, sharing plans, knowledge and emerging best practices to accelerate this movement toward a more secure and resilient energy future.

Several Oregon communities are leading the way to develop secure, self-sustaining systems. Communities on the forefront of mitigating serious risks to their communities, business and commerce include:

- Central Lincoln PUD, serving Coos, Douglas, Lincoln and Lane counties,
- Eugene Water and Electric Board (EWEB),
- Beaverton School District

For example, Lincoln PUD led community support to relocate a substation out of a tsunami zone and build a new operations center on higher ground. These investments are the result of the community engagement to prioritize energy resilience investments essential to providing power.[xvii]

Additionally, EWEB and the City of Eugene are exploring locally-sourced power, supported by Oregon State University in a three-year study to explore how to use solar and waste-to-energy systems for generating local energy supplies. EWEB is preparing to provide power in Eugene through a microgrid in the event of an extended outage, which is just part of an overall Eugene community disaster readiness plan. The City of Eugene's community disaster readiness plan considers bolstering essential services such as emergency services, communications, health care and first responders.[xviii]

Beaverton School District was one of the first districts to develop a plan to upgrade schools to serve as community centers or emergency shelters. Its plan outlines various strategies to address back-up power, renewable generation and water storage. These lessons can be shared among other schools or community buildings planning to serve large populations seeking shelter and services.[xix]

A. Technologies

The pathway toward community resilience will require long-term planning, prioritization and leadership at the local level to procure technologies. Planning done locally places communities in a lead role when shaping priorities and needs and procuring resources.

As local infrastructure investments are made, resilience can be addressed in ways that bring value over the life of the investments, rather than just during a major event. For example, an investment in solar provides daily savings on power bills but can also be enhanced with advanced energy storage to provide back-up power to the occupants in the event of an emergency, as well as grid services to the utility, such as peak shaving.

An example of how controls can transform existing equipment into more flexible community assets is PGE's Dispatchable Standby Generation program, which puts commercial and industrial customers' standby generators to work when the local region has a critical need for power. In this program, PGE upgrades the customer's control system, installs new switchgear and pays for routine maintenance. In return, the utility can use the generator during non-outage times when there is a need for additional power.

Looking across many communities in Oregon, several types of technologies or renewable fuels can be incorporated for energy resilience, including:

- Biomass, like wood pellets, utilized as a primary fuel for space and water heat;
- Separation of critical and non-critical loads, with responsive controls;
- Solar plus storage to provide electricity to critical loads during outages;
- Electric vehicles as a multi-strategy solution for transportation and storage;
- Microgrids that combine various distributed energy systems and controls;
- Passive systems to allow for passive heating and cooling or ventilation;
- Daylighting to allow electric lighting to power-down or to cut lighting load; and
- Envelope enhancements to help moderate fluctuations with heating and cooling.

Currently, most homes and businesses are unable to disconnect safely from the grid to operate utilizing only on-site power. Microgrid capabilities are emerging as a solution for enabling grid-connected homes, businesses and communities looking to serve energy needs in times of a power outage, and can be developed into community energy resilience planning. Figure 3 illustrates various levels of microgrids.

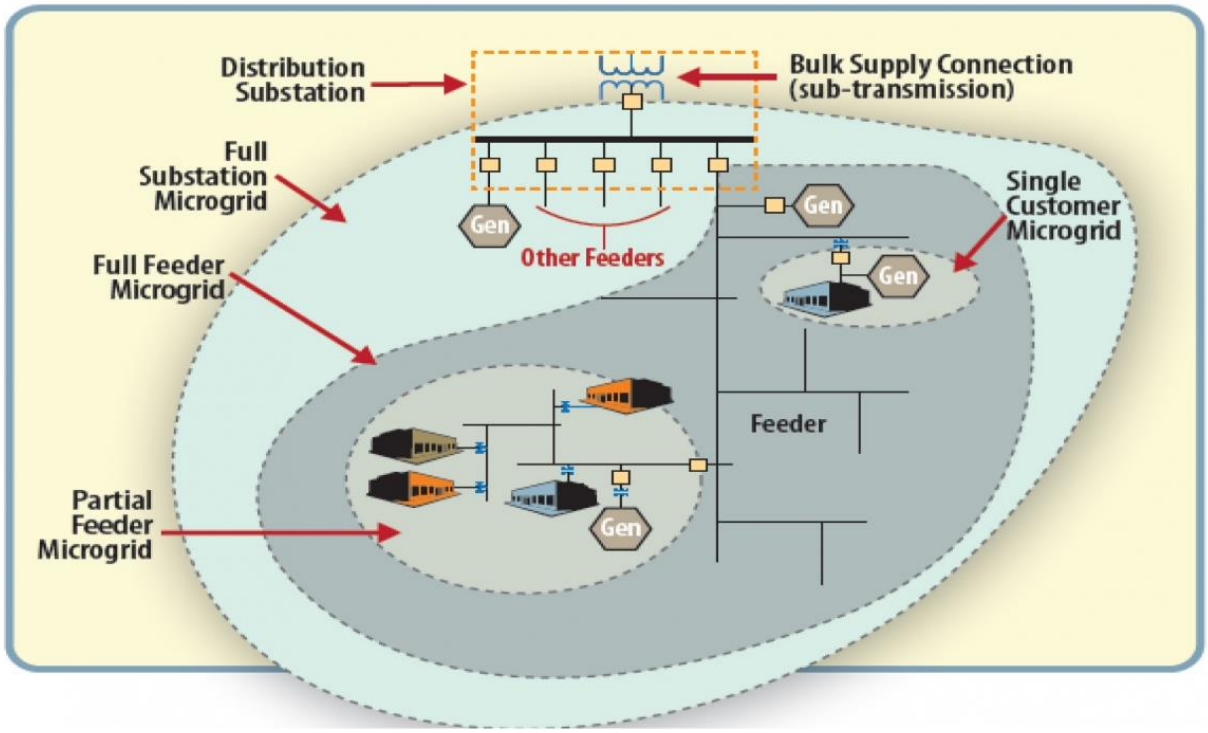

Figure 3. A microgrid is a group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode. (Illustration by U.S. DOE)[xx]

Most of the energy solutions used to create community energy resiliency are commercially available today. Opportunities are in packaging solutions, including smart controls and developing specific messaging and support to deploy these towards resilience. Energy Trust can build on the awareness already created in public and private sectors and help customers adopt *distributed and resilient* energy solutions.

Still relevant today is the 2007 point of view by the chairman of the Oregon Seismic Safety Policy Advisory Commission:

> "Without exception, everyone on the West Coast will be assuming more responsibility (public, private, personal), so the better informed and educated people are, the more responsive everyone will be when the need to help each other arises".[xxi]

Considerations for Energy Trust

The following are areas of opportunities for consideration by the board.

1. As cities and communities start to lead resilience efforts, or create new positions in government to lead resilience efforts, Energy Trust can engage with city staff leading resilience efforts that incorporate energy resilience planning. To do this more effectively, it may be helpful to **reposition efficiency and renewable energy as a resilience strategy**, with the objective of strengthening cities and communities to incorporate technical aspects of energy resilience.

2. Develop technical information and guidelines for **enhancing solar systems with new capabilities to deliver on-site energy when the grid is unavailable, a function known as "islanding."** (When the grid is down, most of the more than 12,000 distributed renewable energy systems that Energy Trust has funded will also be down because they lack islanding capability, and therefore unable to provide power to homes and businesses.) Investigate the costs and benefits of retrofitting existing solar electric systems to be capable of islanding.

3. **Target resources**, technologies and strategies for critical community locations to **power the delivery of essential resources** – water, electricity, food, health care, communications, and emergency shelter. Identify priority areas for critical facilities and communities with high needs/risks/vulnerabilities from widespread and prolonged power outages.

4. **Document emerging energy resilience assets** to provide transparency into which communities have plans and critical infrastructure so that gaps in local community infrastructure can be addressed.

5. **Develop public-private partnerships** and support community-based organizations in the delivery of resilience and identification of grant funding opportunities. Set goals at the county or a regional level to have energy resilience plans developed and in place. **Study Japan's recovery** and

restoration efforts to build local knowledge and capabilities to lead resilience integration across communities, as retrofits and those under construction today.

6. **Support more advanced-planning efforts and zero-net communities** where large-scale developments can be developed to behave more like a microgrid capable of supporting densely populated areas, mixed-use developments and critical infrastructure commonly part of large-scale developments. **Incorporate renewable energy into water-resource planning** and emergency communication planning to support local emergency responders.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

[i] (National Oceanic and Atmospheric Administration, 2018)
[ii] (Kaniewski, 2018)
[iii] (Melillo, 2014)
[iv] (Fritz, 2017)
[v] (Patel SS, 2017) and (Plough, 2013)
[vi] (Schultz, 2018), (Patel SS, 2017) and (Community & Regional Resilience Institute, 2018)
[vii] (City Club of Portland, 2017)
[viii] (Schultz, 2018)
[ix] (Sanger, 2018)
[x] (Hall, 2018)
[xi] (Oregon Department of Energy, Oregon Public Utility Commission, 2012)
[xii] (Oregon Seismic Safety Policy Advisory Committee, 2013)
[xiii] (Schulz, 2015)
[xiv] (City of Portland, Portland Bureau of Emergency management, 2016)
[xv] (Joseph Murray, 2018)
[xvi] (State Interagency Hazard Mitigation Team, 2015)
[xvii] (Wray, 2017)
[xviii] (Sayard Schultz, 2016)
[xix] (SEFT Consulting Group, 2015)
[xx] (U.S. Department of Energy, 2018)
[xxi] (The Oregon Resilience Plan – Energy – February 2013)

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Community Engagement
Board Learning Topic

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April 2018

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Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.

Introduction

Energy Trust provides comprehensive energy efficiency and renewable energy solutions for 1.6 million utility customers. Growing interest in energy among communities and municipalities and their members presents an opportunity for Energy Trust to leverage local efforts for greater energy savings and generation. When local governments, community organizations and neighborhoods take action to save or generate energy, they can create local jobs, stimulate business development, foster energy independence, realize environmental benefits or simply reflect the will and interest of residents and business owners. When communities are ready to act, Energy Trust programs can assist, achieving multiple benefits including acquisition of cost-effective energy savings and renewable energy generation.

While community engagement is a necessary and long-used strategy of Energy Trust, opportunities exist to evolve, customize, broaden and deepen community engagement to increase responsiveness and effectiveness, ensure ongoing relevance, provide more equitable support and increase impact.

This board learning topic explores community engagement in preparation for development of the 2020-2024 strategic plan. During the planning process, the board will assess strategies

and opportunities that could be leveraged to achieve organizational goals. As part of this exploration, the board may want to assess additional ways community engagement could be leveraged to achieve energy savings or generation goals.

I. Community Engagement – Definitions and Framework

A. What is Community?

Community is a fluid concept. Individuals identify with and participate in multiple communities. Community can be broadly defined as "a group of people united by at least one but perhaps more than one common characteristic, including geography, ethnicity, shared interests, values, experience or traditions."[1]

Others broaden the definition, describing community by the people, as well as the social relationships, ties and networks among those people, and the systems (natural, social, governmental, economic) in which they participate.[2] Whether highly integrated or loosely connected, these networks and systems function to meet, or fail to meet, community needs. As noted in a report by the National Association for Environmental Educators,[3] "understanding of the interlocking systems is a critical foundation for building people's capacity to create a healthy, sustainable and resilient future."

Culture is also key component of community. Culture "shapes, identifies and fosters notions of community, and it shapes how individuals and groups relate to each other, how meaning is created and how power is defined."[4] This has implications for effective engagement strategies.

Communities that Energy Trust might work with through an engagement strategy include:

- *Geographic and natural*: urban to rural, in a vast range of ecosystems. Of note, there are multiple ways to define rural that range from population under 50,000 to under 2,500, and that take into consideration proximity to an urban area, population density, land use, commuting patterns and other factors.[5]
- *Demographic and cultural*: people across age, economic status, education level, professional, religious/spiritual, racial and cultural identities.

- *Organizational*: community-based organizations and institutions in nonprofit, business and government sectors (city, county, regional, state, national) working in environment, energy, housing, workforce development, business development, education and more.
- *Social and political*: local or virtual networks whose interests intersect with Energy Trust.

Energy Trust has expressed a commitment to deeper engagement with low-income, rural and communities of color through its Diversity, Equity and Inclusion (DEI) Initiative. This initiative is an effort to understand gaps in participation, and identify opportunities to effectively engage diverse customers in energy efficiency and renewable energy programs. A successful engagement strategy might explore the intersections of these communities, as well as others described above, and seek to listen, build relationships and address barriers to engagement. Energy Trust may find it useful to closely integrate DEI planning with community engagement planning.

B. What is Community Engagement?

Definition: Community engagement has many definitions. It operates as both a process and an outcome.[6] This definition is adapted from the health field:

> The process by which individuals and organizations work collaboratively to identify community needs and priorities, build relationships, mobilize resources and catalyze change in structures, policies, programs and practices. Community engagement is a powerful vehicle for bringing about individual, organizational, community and systems changes aimed at improving the well-being of the community and its members.[7]

Framework: Community engagement and collaboration is best represented on a continuum. The International Association for Public Participation (IAP2) community engagement continuum[8] is commonly utilized to identify the level of engagement that aligns with the desired outcomes of the effort. Approaches will vary based on goals, phase or target of the engagement.

CONTINUUM OF ENGAGEMENT

	INFORM	***CONSULT***	***INVOLVE***	***COLLABORATE***	***EMPOWER***
ENGAGEMENT LEVEL IN ACTION	Some community involvement Communication flows one way; informing Provides community with information Entities share information	More community involvement Communication flows to community, then back; answer seeking Gathers information or feedback from the community Entities seek input from each other	Active community involvement Communication flows both ways; participatory Ensures community issues and concerns are understood and considered Entities coordinate with each other	Community leadership Communication flow is bidirectional; collaborative Establishes shared leadership on each aspect of project from development to solution Entities collaborate on common goals	Community ownership Final decision-making is with community; empowering Prioritizes community-driven solutions and shares power Entities form strong partnership structures with shared accountability
OUTCOMES	Communication channels established. Community is informed.	Connections expanded. Community is heard and better understood.	Cooperation is active. Community issues and concerns influence decisions and plans.	Increased trust. Decisions and plans are co-created.	Strong trust. Community owns and leads process and outcomes.

Increasing level of community engagement, communication flow, trust, and potential for impact

Figure 1: Continuum of Community Engagement (adapted from IAP2 and CDC frameworks)

A Bridgespan Group report on engagement[9] suggests starting with input and once comfortable with real input, experimenting with co-creation and ownership. It also emphasizes making an organization-wide commitment, being inclusive and continuously learning and adapting.

II. Community Engagement – Trends and Insights

A. Community Engagement Trends

Current trends in community engagement practices are driven by the recognition that social and environmental challenges are increasingly complex. Strategies to address those complex challenges must be collaborative, and lasting solutions must include and be led by those affected. Five intersecting key trends emerge in the literature:

1) **Systems-oriented**. Applying a systems perspective that explores the people, culture, structures and conditions of a community is considered best practice. Patrick McCarthy, president of the Annie E. Casey Foundation, made this point at a 2014 forum: "An inhospitable system will trump a good program—every time, all the time."[10]

5 Key Trends

1. Systems-oriented
2. Data-driven
3. Networked and collaborative
4. Inclusive and trust-based
5. Sustained, yet adaptive engagement

2) **Data-driven.** Collective Impact[11], a widely utilized framework for collaboration on complex social problems, focuses on gathering data and establishing shared metrics as central to aligning collaborative initiatives and achieving outcomes. Community engagement is core to successfully using data to drive action and accountability.[12]

3) **Networked and collaborative.** Successful engagement requires organizational, political and public leadership, networking and collaborating across sectors. Leaders who operate in this way are shifting historic roles and dynamics, building trust, growing strategic networks, fostering leadership and achieving significant impacts.[13] [14]

4) **Inclusive and trust-based.** Simply stated, change is more likely to be successful and sustainable when the individuals, community-based organizations and institutions it affects are involved in initiating and leading it.[15] [16] [17]

5) **Sustained, yet adaptive engagement.** Collaborating with communities to create change takes time and requires a commitment over the long haul. Sustained commitment means building local capacity and cultivating community leadership.[18] Sustained commitment does not mean static engagement, but rather continuous learning and adaptation.

B. Oregon Community Leader Interviews

In 2017, Energy Trust conducted a number of interviews with community leaders in Oregon to explore effective diversity, equity and inclusion engagement strategies. Interviewees offered general information on how Energy Trust could most effectively engage in communities, and reinforced much of what surfaced through external literature reviews on community engagement for this paper.

Diverse community leader interviewees were clear about the importance of investing in relationships with local leaders and community-based organizations working with the populations Energy Trust wants to serve. Many reinforced the value of having a local presence and connection to assist Energy Trust in building trust, establishing credibility, reinforcing messages, being visible and gaining access in local communities. One interviewee said, "Community outreach and engagement relies upon asking the right questions and listening to the answers. Acting upon what is said matters even more…" Feedback through these interviews on best community engagement strategies included these concepts:

- Establishing local connections and credibility;
- Leveraging communication strategies, channels and access points;
- Gaining access through community-based organizations, particularly housing groups; and
- Connecting through workforce development opportunities.

C. National Scan of Community-Based Education Efforts

A 2017 literature review by Grounded Research and Consulting for Energy Trust included a scan of successful programs delivering energy education. They found that community-based education efforts can be an effective investment option for driving participation in programs or behavior change. Community education efforts also can help organizations reach deeper into communities across diverse audiences. Models of community education efforts were identified, (Figure 2), which share similarities with the engagement continuum (Figure 1). While these models are related to energy education, they are relevant to deploying program services and energy-related offers.

Municipal champion-led model	A model that builds a stable network of municipal partnerships that can be leveraged year over year
Community-based organization-led bottom-up model	A small grants-based model for grassroots education by organizations with ties to the community
Implementer-led top-down model using "stacked activities" that include community organizations	Outreach through top-down model led by an implementer using "stacked activities" that include community organizations

Figure 2: Models of community engagement identified by Grounded Research

Their research identified numerous organizations using community-based education to drive engagement in energy efficiency and renewable energy programs. Figure 3 includes three examples from the research along a continuum, from inform to empower.

NATIONAL EXAMPLES ON THE CONTINUUM OF ENGAGEMENT

INFORM	***INVOLVE***	***EMPOWER***
Renew Boston (Mass.) Renew Boston targeted both residential and business customers in 2010-2011, with the goal of increased participation in existing audit and rebate programs. This effort was led by the City of Boston's Mayoral office. The effort engaged program administrators, implementation contractors and a network of community-based organizations. City of Boston representatives were responsible for developing marketing and outreach materials, maintaining the website and providing overall marketing and outreach coordination. *Renew Boston* dedicated staff who worked on-the-ground with community groups on managing and customizing outreach across the city of Boston and community partners.	**New York State Energy Research and Development Authority (N.Y.)** This model engages local organizations in specific regional economic development regions. NYSERDA's Community Energy Engagement Program recruits ten local organizations (one in each of 10 Economic Development Regions) through a competitive bid process to drive targeted low and moderate income customers to energy efficiency and renewable programs. NYSERDA tracks the amount of funding received by customers, the number of partnerships, the number of customers assisted with clean energy applications, the number of completed loans and the number of projects completed.	**Connecticut's Clean Energy Communities (Conn.)** This effort challenges cities and towns to make a 20 percent reduction in energy in municipal and board of education buildings. To date 158 of 169 Connecticut communities have pledged to reduce energy. Cities and towns receive grants based on residential and business participation. There is also a Sustainable-Energy Community level that towns can achieve when they continuously engage in outreach and energy-efficiency campaigns with their residents, community organizations and businesses; integrate *eesmarts*™ curriculums into the schools; and have achieved 30 percent residential-program participation as well as 20 percent commercial-program participation, among other requirements.

Increasing level of community engagement, communication flow, trust, and potential for impact

Figure 3: Examples on the Continuum of Community Engagement

III. Community Priorities in Oregon

For this paper, Energy Trust leveraged expertise at Association of Oregon Counties (AOC) to understand community priorities at the county level. Energy is not necessarily the top priority

for many Oregon communities, but understanding local needs and areas of focus highlights how energy can be incorporated and Energy Trust can engage most effectively.

A. Summary of Economic Development Priorities in Oregon Counties

To outline common economic development priorities around the state, AOC drew from recent research commissioned by the Oregon Rural Development Council.[19] This research examined several economic development agendas established by:

- Oregon's Economic Development Districts' through their Comprehensive Development Strategies (CEDS) reports. These reports are the result of locally-based, regionally driven planning processes required of districts funded by the U.S. Economic Development Administration;
- The regional Advisory Committees of Regional Solutions, an intergovernmental coordination program in the Governor's office that focuses on advancing economic development policies and projects at the local level; and
- County Commissioners and county staff through a survey conducted by AOC.

The diverse economic development priorities called out predominately fell into one of four categories:

I. **The need to augment general approaches to economic development in Oregon**, which included topics such as improving incentives for business recruitment and expansion, increasing access to capital so companies can grow, identifying new export opportunities and confronting regulatory challenges;

II. **Focusing on strategies that support business and job growth** such as revitalizing downtowns and strengthening community amenities, expanding support services for entrepreneurs and emerging businesses and developing alternative energy sources or new tourism attractions;

III. **Addressing infrastructure and land base issues** such as the affordability of housing, the quality of public infrastructure including roads, bridges, public transit systems, ports, airports and water/sewer systems, and improving access to industrial lands; and

IV. **Developing Oregon's workforce** by expanding vocational training opportunities, and further aligning career and technical education programs from primary school through higher education.

Although the individual context for each community is unique and important, there are several cross-cutting economic development priorities called out throughout the state. They include:

- Emphasizing and investing in recruitment, retention and expansion of businesses;
- Improving the quantity, quality and affordability of housing, particularly for middle- and low-income working families;
- Expanding vocational training so Oregonians are prepared for the jobs in their communities;
- Improving access to “shovel-ready” industrial lands;
- Addressing permitting and regulatory barriers;
- Developing support services for entrepreneurs and emerging businesses;
- Maintaining and modernizing our road network infrastructure and improving access to public transit options; and
- Ensuring broadband is available in every community.

These priorities continually lead to unique ideas and initiatives throughout the state. In turn, they present complementary opportunities for Energy Trust to build partnerships and engage Oregonians in saving energy and generating renewable energy. Most specific to Energy Trust, many regions called out the development of alternative energy sources as an economic development priority, including South Central Oregon (Klamath and Lake Counties), the Southern Willamette Valley & Mid-coast region (Benton, Lane, Lincoln and Linn Counties), the Mid-Columbia Gorge (Hood River, Sherman and Wasco Counties), as well as Umatilla and Coos Counties.

B. County-Based Case Studies

See Appendix for Association of Oregon Counties case studies on energy-related engagement opportunities in three counties, Douglas and Jackson Counties (energy focus), and Clackamas County (housing development focus).

IV. Current State – Energy Trust Activities, Benefits and Challenges

A. Highlights of Energy Trust Community Engagement Activities and Initiatives

To achieve energy saving and generation goals, Energy Trust engages communities across its service territory. It also partners with utilities and other organizations to extend its reach. These engagement approaches are reflected on the continuum and are critical to meeting annual goals and maintaining awareness of offers and services.

Range of current engagement efforts. Community engagement objectives and activities utilized at Energy Trust are primarily designed to reach energy saving and generation goals. The activities are listed here from lower to higher on the continuum of engagement, though each could be adapted or scaled to shift the level of engagement:

- Community awareness: presentations, marketing, sponsorships, events;
- Community outreach: presentation of services or offers at a community level;
- Community capacity-building: interns, training, tools and materials;
- Community-based staff: staff embedded in or serving specific communities;
- Community-blitz: community offers provided for a sustained period;
- Community planning and implementation support: providing data, content on programs and other services, as well as supporting community planning efforts;
- Community delivery: leveraging local organizations with access to members, resources, communications; delivering services and outreach in communities.

Examples of Energy Trust efforts driven or sustained by communities. In addition to efforts led by Energy Trust to reach customers across its service territory, Energy Trust has engaged in efforts driven or sustained by communities. Highlights of some of those efforts include:

- **Corvallis Energy Challenge**: a yearlong community-wide effort to foster energy efficiency and renewable energy in Corvallis with evaluated results (2008-2009).
- **Making Energy Work for Rural Oregon**: a workshop series led by Sustainable Northwest to engage participating communities and local governments in energy planning and opportunities to save and generate energy (2015-current).

- **Resource Assistance for Rural Environments (RARE) AmeriCorps interns**: support for interns with an energy focus placed in communities in Energy Trust service territory, which is similar to capacity building programs provided by supporting interns placed at businesses (2015-current).

- **Energy planning or policy development**: upon request, Energy Trust provides communities with expertise, data and information to assist their planning, as resources allow. Ongoing, Energy Trust responds to requests for information from stakeholders working on local energy policies. Examples include City of Portland Home Energy Score and City of Portland Benchmarking, and Hood River Energy Plan.

- **Georgetown Energy Prize cities (Bend and Corvallis)**: support in the form of program staff engagement, data and incentive offerings. Additionally, similar challenge efforts in other communities have been supported by Energy Trust in the past (2014-2016).

- **Solarize**: an effort to help residents overcome the financial and logistical hurdles of installing solar power through bulk purchasing at the neighborhood or community level (2010-ongoing as initiated by communities or contractors).

- **Living Cully Community Energy Plan:** Living Cully is a collaboration formed in 2010 between four community-based organizations to leverage resources and create greater impact for residents of the Cully neighborhood in Northeast Portland. Living Cully engaged Energy Trust as a technical expert and community partner in 2017 to develop an energy plan.

Assessing the value and challenges of community engagement is important for Energy Trust or other organizations leveraging these approaches, particularly given cost and policy constraints associated with public purpose charge dollars.

B. Value and Benefits of Community Engagement

Maintaining credibility, trust and relevance across customers, stakeholders and the energy industry is critical to Energy Trust's mission. Community engagement often leverages the joint assets of multiple stakeholders and creates and/or maximizes opportunities for mission impact.

Key Benefits

- Increase participation across diverse audiences
- Leverage other resources
- Adapt to community
- Generate momentum
- Grow credibility and trust
- Ensure relevance
- Maximize opportunities for impact

In addition to benefits already outlined in this paper, the 2017 Grounded Research effort identified additional benefits of community-based efforts:

- **Increased program participation**. Community-based efforts have been shown to be very effective in increasing participation in programs and reaching new and diverse audiences.
- **Leverage non-program resources.** When partnering with community organizations, those organizations often lend their networks, staff or other sources of funding to the effort.
- **Adapt to community.** Statewide efforts do not always take the specific needs of a community into account. However, by approaching outreach on a smaller scale, the effort can be tailored to reach each community in the most relevant ways.
- **Generate momentum.** By aligning interests and taking mutually reinforcing action, community engagement and collaboration can generate momentum beyond what an entity can do on its own.

D. Challenges of Community Engagement Activities

Grounded Research also identified challenges of community-based education efforts.

- **Community-based efforts can be costly in terms of staff resources and efforts**, especially if not well-designed. In addition, past efforts point out the importance of having a thoughtful tracking system to understand what is happening in the community.

- **Ramp-up time can be an issue**. Often community based efforts take time to ramp up, but the program cycle is not long enough to allow for program success.
- **Not all communities are a good fit**. The best organizations have knowledge of the community they are planning to serve. Past efforts have been required to shift tactics when they developed a program model first and then tried to apply it to a particular community, rather than first understanding the community's needs and then using the available resources to develop an appropriate program.[20]

Key Challenges

- Can be costly in staff time
- Ramp up time
- Not all communities are a fit
- Can be difficult to measure
- Community interests may not align with Energy Trust offers
- Best methods of engagement may not align with current Energy Trust structure

Additional challenges observed by Energy Trust staff include:

- **Some efforts are difficult to measure, evaluate or establish attribution**. Not all community engagement efforts result in direct Energy Trust program savings or generation. Responding to data or information requests as communities consider policy changes or take on energy planning may increase Energy Trust program engagement, but it may not be clear how to value our involvement or attribute benefits.
- **Community interests may not align with current Energy Trust offers**. Based on the need or interest of a community, the energy offer they seek to promote may not be available or designed in a way that the community members will take advantage of, or in a way that the community can easily promote.
- **The best method of engaging the community may not align with Energy Trust's current structure**. Programs that have been designed to effectively serve particular market segments may not be well designed to serve communities. Similarly, delivery channels that have been optimized for cost-effectiveness may not be optimized for community engagement.

V. Planning for the Future – Considerations for Energy Trust

A. Potential to Expand Community Engagement Activities

Communities and municipalities increasingly have expressed interest in energy and climate issues, and have engaged Energy Trust to explore opportunities for participation in programs and services. Recent requests by communities seeking Energy Trust engagement fall in six categories:

1. Provide data for various uses (e.g. strategy, education, funding proposals, energy plans, advocacy);
2. Participate in community events and challenges;
3. Package Energy Trust offers to be presented to community members, and potentially by community-based organizations;
4. Participate in energy planning efforts;
5. Serve as a connector to resources and networks, and help navigate across entities;
6. Develop an ongoing partnership model with clear points of contact and sustained support.

Energy Trust can continue supporting these community requests at the level it does today. Alternately, opportunities exist for the organization to choose a greater degree of investment with potential for greater outcomes over the long-term. Energy Trust can consider approaches across the continuum, from inform to empower. Going beyond traditional “inform and educate” approaches would require building relationships and partnerships of trust and mutual interest that shift some degree of resource allocation decisions and leadership to the hands of communities.

B. How Might Energy Trust Prioritize Opportunities and Approaches?

Energy Trust is currently guided by energy saving and generation goals to determine community engagement approaches and investment levels. In addition to this goal, there are additional criteria that could be considered for prioritizing certain community engagement opportunities. Criteria include:

- Community and Energy Trust strategic goals are aligned and mutually reinforcing.
- The community initiative will advance DEI and other strategic priorities and values.

- The effort will leverage and strengthen local assets, plans and resources to help reach mutual goals.
- The community's civic culture is strong and supportive.
- Local leadership commitment and capacity exists in the community.
- Potential exists to further grow benefits to community and Energy Trust.

C. How Might Energy Trust Measure Impact of Community Engagement Strategies?

If Energy Trust sought to measure effectiveness of community engagement efforts beyond acquisition of energy savings and generation, there are some potential qualitative and quantitative metrics to consider:

- Growth in number of communities, collaborators, customers engaged with Energy Trust;
- Growth in number of Energy Trust programs and services communities access;
- Greater speed, scope and quality of responsiveness to communities;
- Increasingly positive perceptions of Energy Trust where engaged;
- Increased strength (e.g. trust, shared leadership, mutual support) of collaborations;
- Growth in number of energy projects underway in communities;
- Growth in number of communities with energy plans referencing energy efficiency and renewable energy and intentions to access Energy Trust services;
- Shifts in how communities think about and value energy savings.

D. Key Questions and Next Steps

Energy Trust's mission, vision, values and annual energy savings and generation goals will drive the goals of community engagement. As such, here are key questions for consideration in advance of Energy Trust's next strategic plan:

1. What additional community engagement approaches, beyond what is done today, would help meet energy saving and renewable energy generation goals now or in the future?
2. What is the appropriate level of investment in these approaches? What people, processes and structures are needed to deliver on that investment? What funding limitations will Energy Trust need to consider?
3. What is the scope of the appetite/interest among communities for increased Energy Trust engagement? What are the criteria, and therefore best opportunities?

4. What is Energy Trust's best role in community energy planning and implementation?
5. To what extent is Energy Trust open to community engagement approaches that yield some of the investment decisions to the community? Is this something Energy Trust can foresee in the future?
6. How can community engagement work specifically advance Energy Trust's diversity initiative and other strategic goals and values?
7. What are priority metrics for success for community engagement?

If the Energy Trust Board identifies that community engagement can be further leveraged as a strategy to meet goals, Energy Trust is in a solid position to build on current engagement efforts and extend its credibility, trust, reach and mission impact.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

Appendix

AOC developed county profiles that highlight local priorities and plans around energy efficiency and renewable energy. One such county profile focuses on Douglas and Jackson Counties. Another profile identifies housing in Clackamas County. Note: percent rural is based on Census urban-rural classifications.[21]

A. Clackamas County – Opportunities in Housing

Population: 413,000

Percent rural: ~19%

Top priorities: economic priorities in Clackamas County and the metro region focus on:

1. Increasing economic opportunity for local residents by addressing housing availability and affordability,
2. Growing and recruiting businesses and pioneering innovation,
3. Strengthening transportation infrastructure,
4. Increasing access to employment and industrial lands, and
5. Developing and advancing the region's talent.

Current engagement in energy efforts: Through its 2008 *Action Plan for a Sustainable Clackamas County*, the Clackamas County Board of Commissioners established specific energy-related goals, including becoming carbon neutral by 2050 and reducing the county's energy use by 5 percent from 2014 levels by 2020.

Current and future plans: Clackamas County's Comprehensive Plan calls out the need to conserve energy and promote efficiency through alternative energy resource development, recycling, land use and transportation circulation patterning, site planning, building design and public education. It calls for exploring geothermal resources in the Cascades and working with the state to evaluate potential for wind and solar energy. The plan also stresses the importance of publicizing energy conservation and available weatherization programs, serving as a forum for addressing energy-related issues and working with community partners to develop an education program around energy efficiency. Additionally, the county's Performance Clackamas strategic plan outlines goals for the development of various county facilities, which will present opportunities for conservation and use of renewables.

Since the end of the 2008 recession, population growth and in-migration have significantly increased housing prices in Oregon, particularly in Clackamas County since it is closely connected to the Portland housing market. While construction of single and multifamily housing has also increased, it has not kept pace with demand, resulting in a shortage that falls heavily on low- and moderate-income residents.

To address this shortage, Clackamas County has established an aggressive goal to develop 2,000 new homes affordable for low- and moderate-income families in the next ten years. Also in the preliminary stages, the county is initiating an extensive analysis of housing needs. This analysis is guided by the Clackamas County Coordinating Committee (C4), which is made up of representatives from the county, cities, unincorporated communities and transit, sewer, water and safety district. This committee has hired a consultant to lead the effort and is committed to funding at least 50 percent of the analysis, with the goal of local cities committing the other half. The outcome of the plan will be an in-depth analysis of the current and future needs of affordable, workforce and other housing options in the county; a set of quantifiable recommendations to bridge identified gaps; and information necessary to comply with Oregon's Statewide Planning Goals & Guidelines Goal 10.

The Clackamas County Housing Authority is also undertaking an aggressive redevelopment plan to quadruple its 545 public housing units, which are currently located primarily in four housing parks in Milwaukie and Oregon City. This process already has involved outreach to residents, cities and other local stakeholders. There will be many more opportunities for community engagement as the Oregon City Manor, Milwaukie Hillside Park and Milwaukie Hillside Manor projects advance.

The county also hired a broker to identify additional property to purchase. Evaluations of building and development codes are underway to assure codes do not create any obstacles to affordable housing. Several municipalities in the county have begun similar evaluations. Although this redevelopment will likely take more than ten years to complete, the county sees the value of having a pipeline of projects that will expand housing options over time. It remains optimistic that the timeline will be shorter if voters approve Metro's housing bond in November.

B. Southern Oregon – Opportunities in Energy Efficiency and Renewable Energy

Douglas County

Population: 110,395

Percent rural: ~41%

Top priorities: Economic priorities in Douglas County and the region include:

1. Expanding training opportunities,
2. Building a talent pipeline,
3. Addressing land use and housing availability and affordability,
4. Diversifying the economy,
5. Growing value-added employment in the natural resource sector, and
6. Developing tourism products, alternative energies, broadband and transportation infrastructure.

Plans: Douglas County's Comprehensive Plan identifies energy conservation as an objective. It encourages consideration of conservation and solar energy use during location and design stages of residential and commercial construction, and promotes new development in areas with access to winter sun. Finally, the plan encourages the exploration of two rivers, Elk and Calapooya, for potential hydroelectric power generation as well as geothermal and woody biomass as minor energy sources. Entities such as Douglas County Electric Cooperative, United Community Action Network, Neighborworks Umpqua and others are involved and engaging community members in issues related to renewable energy and energy conservation.

Jackson County

Population: 213,765

Percent rural: ~20%

Top priorities: Economic priorities in Jackson County and the region include:

1. Workforce development,
2. Improving the availability and affordability of housing,
3. Supporting the agricultural and recreational sectors,
4. Strengthening transportation and water/wastewater infrastructure, and
5. Identifying additional resources for infrastructure projects and economic development initiatives.

Plans: Jackson County's Comprehensive Plan details a number of very specific action items for the county. One action item is to establish an energy advisory committee to assist in a variety of efforts, such as public education and engagement, developing an energy conservation package and incentive program and an action-oriented plan for developing energy supplies from renewable resources. Many other organizations are engaged in energy-related work in Southern Oregon, including the Southern Oregon Hybrid-Electric Vehicle Association, ACCESS, Rogue Climate, Southern Oregon Climate Action Now (SOCAN), Geos Institute, Energize Rogue and Spark Northwest to name a few.

Over the last several years, two citizen-led initiatives have gained momentum in Southern Oregon. Located in the Roseburg area, Douglas County Smart Energy is a project that has grown out of the efforts of the Douglas County Global Warming Coalition, a broad-based citizen group focused on promoting a healthy climate. As the coalition broke into subcommittees to focus on specific issues related to climate, energy efficiency and renewable energy became a clear priority for the group. Thus, DC Smart Energy was born. Today, the project includes a broad spectrum of interests including community members, local businesses and representatives from Douglas Electric, Avista Utilities, Pacific Power, Energy Trust, United Community Action Network and Neighborworks Umpqua. These organizations meet regularly to pool knowledge and resources to provide energy efficiency tips and incentives in a way that is easy to access and understand.

Each month, DC Smart Energy volunteers submit a column to the local newspaper regarding efficiency and renewable energy related opportunities, such as programs that provide energy assistance for low-income households, electric cars, creating a greener home for energy savings and more. The DC Smart Energy "Energize" campaign, which is staffed by an AmeriCorps RARE intern partially supported by Energy Trust, has included a series of town halls with Douglas Electric Cooperative and Energy Trust to highlight ways to save energy and money. In partnership with nonprofit Spark Northwest, it has also recently led a series of three workshops about ductless heat pumps. In addition to educating over 200 attendees, it was able to extend a group-purchase discount to participants and help them access additional tax credits and rebates to help cover the cost of installation.

In collaboration with Sustainable Northwest, DC Smart Energy also joined three other rural communities across Oregon to apply for a Federal Department of Energy SunShot grant. This grant offers funding and technical assistance for the development of solar energy in rural communities. It was awarded last year. DC Smart Energy is also working with Douglas County, the City of Roseburg and other landowners to identify potential sites for community solar, as well as long-term funding opportunities. Additionally, to take advantage of the growing trend toward electric cars, it has applied to Volkswagen for funding to install electric car charging stations in Roseburg.

Farther south in the city of Talent, a group of residents have come together over the past few years to create a clean energy plan for their community. Their hope was to develop a plan that would be adopted by city council and incorporated into the city's Comprehensive Plan. Their efforts were successful, and the plan is currently being adapted for inclusion in the city's COMP Plan with the help of a seven-member Citizen Advisory Committee.

As planning continues, Talent has also unveiled two electric vehicle charging stations in front of its community center, which was recently outfitted with a solar array to serve as its primary power source. Serving as the city's energy efficiency coordinator, an AmeriCorps RARE intern is working to further promote energy savings. This intern's position is jointly funded by the city of Talent and Rogue Climate. The intern tables at the public library once per week to inform citizens about energy efficiency programs, and his availability will soon double with an additional weekly session at the local coffee shop. His schedule is advertised in the local newspaper, which residents have confirmed as the reason for their visit to his table at the library. He also plans to publish a new page on the city's website devoted to energy efficiency, which will be available in English and Spanish

With the long-term goal of achieving net-zero consumption, Talent city leaders are also beginning to analyze total energy use across the city and identify potential sites for solar as a preliminary step toward developing a solar master plan. In the meantime, the city is working to identify immediate opportunities to save energy and is participating in Energy Trust's Strategic Energy Management program.

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Cost-Effectiveness
Board Learning Paper

Prepared by Fred Gordon
April 2018

Energy Trust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by the Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020-2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.

Overview

Energy efficiency is the cleanest, cheapest and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering that resource.

Cost-effectiveness is the investment test for ratepayer-funded energy efficiency. The basic question cost-effectiveness answers is whether an investment in efficiency lowers costs to ratepayers as a group, or in some states, to society. Regulators, utilities and Energy Trust express cost-effectiveness as a ratio of benefits to costs. If the ratio is greater than one, the investment passes the test. Many variations stem from this basic question, depending on (1) whose costs and benefits are included, (2) whose perspective is being considered, and (3) how difficult-to-estimate costs and benefits are handled. The level at which the test is applied is also important. For example, should the test be applied to measures, programs, or the entire portfolio of programs? Also, because benefits occur over the life of the efficiency

measures, which can be many years, the way that future costs and benefits are discounted influences the result. Increasingly, cost-effectiveness depends on how much energy the measure or program saves at times when there is the highest energy requirements (peak) on the gas or electric system. Additionally, Oregon utilities, the OPUC and Energy Trust are just beginning to assess how to value location-based savings that depend on the ability to avoid expensive local expansions of the grid.

This paper does not address renewable resource investment tests. The legislation that established the Public Purpose Charge, SB1149, provided a different set of investment criteria for renewable resources based on the above-market cost. While energy efficiency investments are justified by costing less than alternative resources, Energy Trust can offer incentives for renewable energy only to cover part of the cost that exceeds the cost of the same power from grid resources. This reflects the view that when the cost of renewable energy is at parity to the cost of grid power, utilities will buy them as a least-cost resource. By contrast, Energy Trust is the agent of Oregon utilities for purchasing energy efficiency that costs less than the comparable power purchase.

Some key takeaways from this paper are that:

- Cost-effectiveness is a pass/fail test for whether efficiency investments reduce costs to ratepayers in a utility system. In Oregon and Washington, the process does not consider other government policy objectives nor benefits that accrue to parties beyond program participants and the power system.
- In valuing energy efficiency programs, Oregon already considers the value of carbon, albeit in a limited way. Unless carbon market prices are very high, future carbon regulation is likely to have only modest impacts on Energy Trust's program cost-effectiveness.
- Peak energy savings are increasingly important to Oregon's power and gas system. Efficiency actions that save energy during peak times will become increasingly valuable, and actions that only save energy at other times will be less valuable. A process is underway to assess how much of the value from reducing peak electric use derives from reductions during the summer versus the

winter peak. That decision may influence Energy Trust's future program portfolio. The extent of these changes and their impact on efficiency value will become apparent over the coming year.

- Locational differences in the value of savings are likely to become more important over the next few years.

Oregon tries to achieve balance by considering similar types of costs and benefits, but it does so in a different way from many other states. Oregon evaluates difficult-to-quantify benefits by considering them as the basis for exceptions from strict cost-effectiveness calculations.

Governance

For Energy Trust, as well as investor-owned utilities throughout the U.S., cost-effectiveness rules are determined by each state utility commission. Because Energy Trust operates in both Oregon and Washington, it is subject to slightly different rules in each state. The varying rules have not resulted in huge program differences.

For consumer-owned utilities such as Oregon's co-ops, municipalities and Public Utility Districts, much of the conservation funding comes from the Bonneville Power Administration (BPA). Their cost-effectiveness criteria are determined under Federal law by the Northwest Power and Conservation Planning Council.

Each of the five utilities that fund Energy Trust in Oregon have different forecasts of avoided costs, which are the costs of purchasing and delivering energy. These costs are compared to the cost of reducing that energy use through efficiency. In their Integrated Resource Plans, which determine how much efficiency Energy Trust should deliver, each utility uses their own avoided cost forecast. However, in determining which measures to support, and in reporting on program and measure cost-effectiveness, Energy Trust uses a blend of the values from all the Oregon gas and all the electric utilities. This allows us to run an efficient program for all Oregon investor-owned utility service territories. Energy Trust uses different avoided costs in Washington.

The inconsistencies between values at different individual utilities versus the combined values used by Energy Trust usually result only in minor differences in outcomes, because most efficiency measures are highly cost-effective. However, if utilities forecast different peak periods (e.g., summer versus winter), utility values for various efficiency measures may differ more substantially. This possibility is under discussion in a current regulatory docket.

The Tests

The California Standard Practices Manual established the basic cost-effectiveness tests in 1983. Following are the questions each test answers.

Utility Cost Test (UCT): Sometimes called the Program Administrator Cost test. Are the benefits to ***the utility system*** in avoided generation, fuel, delivery and other costs greater than the costs paid by the utility?

Total Resource Cost Test (TRC): Are the benefits to ***the utility system and utility ratepayers combined*** greater than the costs paid by both?

Societal Test: Are the benefits to ***everyone*** greater than the costs paid by everyone? Different state policies may limit “everyone” to the state, or the country, or the planet. This test has no formal role in Oregon or Washington.

Rate Impact Test (RIM test): Does the investment reduce rates, not just utility costs, but the actual rate per unit of power or gas purchased? This is a much more restrictive test, because efficiency reduces power or gas sales. Most efficiency program portfolios reduce total utility costs, but rates may go up slightly due to lower sales volume. The reason is that a utility recovers fixed costs (e.g., pipes, lines, wires, billing and customer service) over fewer units of energy sold, so the cost per unit is higher. The RIM test tends to allow for demand reduction programs that shift the time of energy use but do

not reduce sales. In states where it is the primary test, there are very few efficiency programs.

Participant Cost Test (PCT): Are the benefits to the ***participant*** greater than the participant's costs?

Oregon and Washington commissions both focus primarily on the UCT and TRC tests, meaning the focus is on benefits exceeding costs for the utility system and for all ratepayers combined. In these states, the RIM test and PCT do not play significant roles. Benefits to the participant are considered in program design; if the participants do not benefit, there is no participation.

According to a 2017 Esource review of 29 states, the TRC test is most commonly employed, followed by the societal test and then the UCT. The RIM test and participant cost test are least frequently used (Figure 1).

Cost-Effectiveness Test	Number of States Using Test
Total Resource Cost Test	20
Societal Cost Test	14
Utility Cost Test	12
Ratepayer Impact Measure	11
Participant Cost Test	8

Figure 1: Number of states using each cost-effectiveness test

Do we apply the tests to measures? Programs? The portfolio?

Under Oregon commission rules, Energy Trust applies the cost-effectiveness rule to individual measures as well as to programs. There are details in the rule that govern

when measures should be combined for cost-effectiveness analysis because they are interdependent from a marketing or engineering perspective; the rationale is that combined they are worth more than the sum of the parts.

Washington focuses primarily on applying the TRC test at the portfolio level, but sometimes scrutinizes individual measures if a utility proposes to add them to the portfolio.

Regardless of which tests are required, based on the same Esource report, 70 percent of states require the program and/or the portfolio of programs to pass tests. Only 40 percent ask that the project pass the test, and only 30 percent of the states embrace Oregon's policy of focusing on individual measures.

Exceptions

Any economic calculation, including cost-effectiveness tests, provides a limited perspective, because not every consideration can be reliably turned into a number and added to the calculation. Thus, cost-effective thinking often is more than a simple ratio. If a measure passes the TRC test but does not pass the UCT, one possible solution is to reduce incentives, since this reduces the utility cost. Oregon's cost-effectiveness rule provides for a number of exceptions or circumstances where efficiency investments are appropriate even if the measure does not pass the TRC test.

In Oregon, exceptions provisions allow a measure to be considered if it does not pass the TRC if any of these conditions apply:

- There are significant benefits other than energy that are not included in the benefit cost calculation.
- Over time, lower costs are expected due to increased market acceptance, leading to the measure passing the test.
- The measure is included for consistency with other programs in the region. For many measures, consistency makes all programs in the region more effective.
- The measure helps increase participation in a cost-effective program.

- The measure incentive is offered during a transitional period until a program revision is complete.
- The measure is a pilot or research project for a limited number of customers.
- The measure is required by law or consistent with Commission policy and/or direction.

All these exception criteria (with the possible exception of the last one) support the rationale behind the cost-effectiveness tests. They recognize situations where thinking more strategically complements the numerical calculation as a means of providing cost-effective results. This extensive use of a non-quantitative exception process to address shortcomings of the TRC test is unusual among states.

Non-Energy Benefits

Businesses and households make few investments solely for energy purposes. Energy Trust and its regulators deal with the other reasons (called non-energy benefits) in a few different ways.

Incremental Measures. For new homes and buildings and for mechanical equipment replaced near the end of its life, Energy Trust does not assume its help is making the whole investment happen. For example, programs can rarely offer incentives at a level that will significantly influence when a consumer buys a house or a heating system. In these types of cases, the “incremental cost and savings” is considered. That is the cost and savings difference between what the consumer typically purchases (called the “baseline”), and the more efficient version that the program is encouraging through its technical assistance and incentives. A “typical” purchase may be include the minimum efficiency legally allowed under codes and standards. Sometimes a purchase may be for a more efficient level that is not required, but most commonly purchased. A good example of this is LED lights. Today many LED lights are more efficient than the minimum required by law, and an increasing number of consumers purchase them without incentives.

Quantifiable Non-Energy Benefits. Where Energy Trust can estimate the value to consumers of non-energy benefits with reasonable effort and precision, Energy Trust includes these benefits in the TRC calculation. For example, for efficient showerheads, faucet aerators, washing machines and some other measures, Energy Trust calculates the dollar value of the savings from reduced water use, including the reduced cost of water treatment at municipal waste plants. Energy Trust adapts values for these benefits from the Regional Technical Forum (RTF), a regional analytic group that Energy Trust co-funds. For some industrial process measures, it is practical to calculate increases in volume produced, improvements to product quality or reduced labor needs. Since industrial value streams are sensitive issues, Energy Trust calculates them only when measures otherwise do not pass cost-effectiveness tests and when that information is available.

Difficult to Quantify Consumer Non-Energy Benefits. Many benefits vary greatly from site to site or their value may vary based on perception making them difficult to quantify with any precision. These include benefits such as comfort, health and aesthetics. States diverge in how they address these types of benefits.

- In Oregon, the Oregon Public Utility Commission (OPUC) will consider exceptions to the TRC for measures where Energy Trust can show that the benefit is clear, significant in size and applies in most situations. There is a formal process for Energy Trust to apply for exceptions. OPUC follows a relatively simple approval process for situations where measures with these non-energy benefits are a small portion of program savings. The OPUC uses a more formal track for major measures. Energy Trust puts considerable effort into documenting reasons for exceptions and often clarifies the request one or more times at OPUC staff request. Exceptions are only requested when there is a strong case, and consequently, OPUC grants most exception requests. If the OPUC grants an exception based on the prospect of future changes in cost-effectiveness, it may be granted for only a limited time. As a general guideline (not a formal rule), the OPUC will only consider difficult-to-quantify non-energy benefits if the measure has at least a TRC of 0.5 (the benefits to the utility

system and participant are at least half the costs). If the TRC is less, the OPUC may question whether ratepayer funding for the measures is influential and important. The OPUC in one case allowed an exception for measures that had TRCs of significantly less than 0.5. In this instance, this exception was for home weatherization measures which, for gas heated homes, sometimes have TRCs of 0.2 or 0.3, meaning that the benefits to the utility system and participant were roughly a quarter of the cost. In this case, the OPUC allowed continued incentives up to a limit, or cap. It did this on the principle that many of the people who had not yet installed these measures were from limited income households. Providing incentives on these improvements for years to higher income customers and then discontinuing them without providing specific support to limited income customers seemed inequitable.

- Washington has no formal policy for difficult-to-quantify non-energy benefits. In situations where these benefits are important, they provisionally allow utilities to use the UCT instead of the TRC test. The UCT does not consider consumer costs or benefits. Because the Washington Commission focuses most on the cost-effectiveness of a utility's entire program portfolio, this issue for individual measures has not become a significant issue.
- Some other states, such as Massachusetts, have reviewed a range of studies for many of these benefits, and arrived at accepted values per kWh or therm. The OPUC has been critical of this practice, however, as it requires that the analyst choose a number within a wide range of values provided by different studies. The OPUC believes that its use of exceptions with specific justification allows the Commission to consider these benefits without arbitrarily selecting a number from a large range.

There have been efforts in the Northwest to quantify some of the more difficult-to-measure benefits. The Regional Technical Forum studied the health benefits from reduced atmospheric wood smoke that resulted from replacing wood stove use with ductless heat pumps. They concluded that the benefits were very large, but highly variable from location to location and uncertain.

One way to quantify such benefits is to find someone with a different value stream to pay for them. This is the topic of the board learning paper on partnering to capitalize benefits beyond energy.

Societal Non-Energy Benefits. Some positive aspects of efficiency measures benefit society in general and not only the utility or ratepayers. Examples include: (1) the overall benefits from reducing atmospheric carbon dioxide, (2) health benefits from improving moisture control in homes, and (3) overall economic benefits from energy efficiency jobs. However, these societal benefits are not included in the Oregon version of the TRC test[1]. This is because the Oregon Public Utility Commission considers them to be outside of the scope of the role set out for them by the Oregon Legislature.
The subject of non-energy benefits has generated far less attention in Washington because there is not so much focus on measure-by-measure analysis.
In states that utilize the societal test, benefits such as reducing the social cost of carbon, health benefits, and employment benefits may be considered in that test. States vary considerably in the range of societal benefits included and in the effort to quantify them.

Carbon Costs

Carbon dioxide emissions present a special case of non-energy benefits. In Oregon, utilities are required to consider the potential future cost of carbon regulation to the utility in forecasts of gas and electric costs. Thus, these “carbon compliance costs” are included in the avoided costs used in the UCT and the TRC to show the benefits of efficiency. If carbon regulation comes, whether it is in the form of a tax or a cap and trade system, there will be a cost imposed on fossil fuels that will be paid through utility rates. Given the uncertainty about future Federal and state carbon regulation, however, utility approaches to carbon cost estimates have varied. Utilities often present a range of scenarios for these possible future carbon costs. NW Natural, in its most recent Integrated Resource Plan, included significant likely carbon costs. By having this non-energy benefit identified, the cost-effectiveness ratios for Energy Trust’s programs for NW Natural improved.

Carbon compliance costs are not necessarily the same as the societal cost of carbon. Estimates of the societal cost of carbon vary significantly. The Federal government recently rescinded an estimate of this cost that was created under the Obama administration.

Is future carbon regulation likely to significantly increase the value of energy efficiency? This does not seem too likely. A preliminary estimate conducted by Energy Trust of the initial 2017 legislative proposal for “cap and invest” shows that carbon pricing might constitute about 10 percent of the value of electric efficiency and 20 percent of the value of gas efficiency. However, utilities have already incorporated a significant portion of that value into Energy Trust’s avoided cost forecasts as prospective compliance costs. Therefore, carbon legislation, at least as initially envisioned, might have a modest additional impact of Energy Trust’s efficiency cost-effectiveness calculations[2].

Alternative Tests

Recently, an advocacy group called E4THEFUTURE published an update to the California Standard Practice Manual, called, the National Standard Practice Manual (NSPM). The NSPM is not a replacement to the California Standard Practice Manual. It is more of a guide to how to apply alternative tests to produce reasonable and balanced results.

Much of the practice guidance outlined in this new NSPM is consistent with how Energy Trust and the Oregon and Washington commissions apply cost-effectiveness tests. However, a few of the more interesting recommendations differ with Oregon and/or Washington practices. These are discussed below.

- **Symmetry.** The NSPM recommends that if a cost-effectiveness test includes costs of a specific type, then benefits of the same type should be included. For example, the costs the customer pays should be included in the TRC only if all the customer benefits are included. The OPUC discourages including benefit numbers in the tests when that number is highly uncertain, but instead attempts

to address these benefits through the exception process, which allows lower TRC values for measures with difficult-to-quantify benefits, as described above.

- **Policy Goals.** The NSPM encourages regulators to have all the state's policy goals drive the selection of cost-effectiveness tests. The OPUC structured its rules to reflect the responsibilities delegated to that agency by the Oregon legislature. However, other state policy goals (such as addressing climate change and economic development) that are held by Oregon's government, but not delegated to nor assigned by law to the OPUC, and are not reflected in the Oregon tests.
- **Level of Analysis.** The NSPM recommends against testing individual measures, but suggests that the tests be applied at the program or portfolio level. Oregon requires that measures be tested individually, while Washington largely does not. This has been an area of significant debate. While in theory testing individual measures reduces ratepayer costs by only funding measures that benefit ratepayers, it imposes a degree of additional, detailed work that (1) might not be worth the effort or (2) provide meaningful results. Oregon is in a somewhat unusual position in that it has both the measure tests and the exception criteria, which address many of the objections typically lodged against measure-by-measure analysis. Energy Trust sees additional challenges with the measure-by-measure test as it expands its work with management-focused approaches to efficiency (e.g., Strategic Energy Management) and with use of load data to determine savings (e.g., in its pay-for-performance pilot). With the support thus far of OPUC staff, there has not yet been a need to distinguish individual measures for behavioral and management approaches. The commission has expressed willingness to explore other areas where measure-by-measure tests prove unworkable.
- **Discount Rate.** The NSPM recommends against using the utilities' risk-adjusted cost of capital as the discount rate for cost/benefit analysis, but recommends that regulators consider consumer and societal perspectives. Oregon uses the risk-adjusted cost of capital. Washington considers multiple perspectives. One analysis by the Northwest Power and Conservation Council indicated that the

average consumer discount rate is close to utility cost for capital, so this may be a distinction that does not cause much of a difference. If it is important, that may be the case for weatherization measures with very long lives because the discount rate has a larger impact on the value of long-lived measures.

A recent review of action in response to the NSPM manual shows that while a handful of commissions are beginning public processes to review the new guidance, there has yet to be little or no revision of cost-effectiveness rules as a result. Many of the reviews are just beginning. The Washington commission is planning a review in 2018.

Where Does the Value Come From?

Historically, most of the value of electric savings came from reducing energy generated by fossil fuel plants, regardless of the time of day, week, or year in which the measures save power. Most of the savings was from reduced generation, while small portions were from reduced losses on power lines and transformers, and from reduced transmission and distribution construction due to smaller loads. Likewise, almost all of the value of gas savings was associated with a therm of gas savings, regardless of the timing. Additionally, OPUC permits an additional 10 percent adder to value based on the premise that not all efficiency benefits can be quantified.

Recent utility cost forecasts show significantly reduced value from energy savings per se, and an increase in value from the *timing* of savings, specifically whether the savings occur at a time that reduces the need for system capacity. It is becoming expensive to buy additional power at peak times due to the cost to build a plant that runs very few hours a year to meet peak loads. For gas, reducing the maximum gas volume in a delivery contract by reducing energy use at peak times also has significant financial savings.

One of the benefits for efficiency is reduced costs for transmission and distribution construction. Energy Trust currently uses utility estimates that are average values for all the locations served by the electric and gas utilities. There is much variation around this

average. At any given time, there is no need for new construction for most of the distribution system, and therefore the value comes from a limited number of locations that are experiencing constraints on the installed capacity. The value is spread across the entire utility system, so on a per-kWh or per-Therm basis it is small. This “locational value” is complex to determine. It often depends on whether there are inexpensive solutions to local system constraints, such as shifting load between substations. It is most clear-cut at isolated, single-line parts of the system, as is the case in some rural areas. It is most complex where the distribution system is heavily networked, looking less like radial lines and more like a spider web. Energy Trust has begun working with Pacific Power, and separately with NW Natural, to develop pilot projects that use efficiency and renewable energy to reduce investment in energy delivery system upgrades.

Work on valuing savings from reducing gas loads is in its infancy. NW Natural has moved ahead of most of its peers nationally in creating an analytic framework to value peak gas savings. The value is significant, but not as dramatic as for electric. Energy Trust is just beginning to explore what this means for efficiency value. Additionally, other gas companies in Oregon are reviewing NW Natural’s work and considering their own approaches. Energy Trust’s work on targeted projects to reduce these costs has started by focusing on how we can locally accelerate efficiency and renewable energy where it is most valuable.

Separately, the OPUC is in the midst of a Resource Value of Solar docket. While the OPUC has focused this docket on developing a methodology to determine what value solar brings to different parts of the grid, the resulting approach may influence many aspects of how to value local efficiency, too. The docket is scheduled to conclude in summer 2018.

Quantifying Peak Savings

The increased value of peak savings to Oregon ratepayers challenges Energy Trust and utilities to create methods to reflect that value when making cost-effectiveness decisions and in reporting. There are several parallel projects underway, in addition to the

Resource Value of Solar docket, to create a sound planning environment for valuing peak.

- Historically, Oregon's winter peak has been highest, and utilities have estimated the value of avoiding peak loads based on winter load and price patterns. As summer energy use increases, and summer peaks increase in importance, Energy Trust is developing a method to value energy savings based on contribution of efficiency measures to reducing both summer and winter peaks.
- Energy Trust is reviewing load shapes provided by the RTF to make sure that the summer peak savings estimates are reasonable and consistent with available data.
- Energy Trust is co-funding a regional end-use metering project that will, over the next five years, provide improved data to estimate the impact of efficiency measures on peak (among many other uses of the data).
- Energy Trust is exploring with PGE a possible project to use smart meter data to evaluate actual peak savings from a selection of custom measures. This will complement the regional load research effort in a number of ways.
- The OPUC, Energy Trust, utilities and stakeholders are in a process to create a regular PUC-mediated process and a schedule to update avoided costs. As part of the first round of that process, these parties are developing a method to determine how much of the value from electric peak savings is from reducing summer versus winter peak. This may significantly influence the value and direction of Energy Trust's portfolio of efficiency measures. Conclusions are expected in mid-2018.
- As Energy Trust develops the tools described above to value peak, we will also need to provide improved guidance and training for Energy Trust contractors who are estimating savings from custom measures, to ensure that they are incorporating the most appropriate load shapes in measure analysis.
- Energy Trust will also commission a small best practices study to compare our approach to that employed in regions such as the Northeast and California, where peak savings have been a primary determinant of energy efficiency value for many years. There should be a great deal to learn from these regions;

although, the issues related to a dual summer/winter peak, with neither completely dominant, may be unique to the Northwest. The efforts of Energy Trust's Northwest peers, including the Northwest Power and Conservation Council, will also be informative in addressing these issues.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

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[1] The next section discusses benefits to the *utility system* from reduced carbon emissions.

[2] There is a variety of other ways that such legislation might impact Energy Trust. This statement exclusively concerns cost-effectiveness.

Distribution Systems and Energy Efficiency
Board Learning Paper

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EnergyTrust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by the Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020 – 2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. **These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.**

Introduction

Energy efficiency is the cleanest, cheapest, and most important resource for the utilities and ratepayers of Oregon and Energy Trust is the prime organization delivering that resource. Energy Trust's programs can have significant impacts on utilities' ability to effectively manage their distribution systems. The location of solar installations, for example, can affect local distribution issues on the grid. Additionally, Energy Trust's energy efficiency programs, with the types of improvements they encourage and the specific location of participant sites, can potentially be used as tool to manage constraints on the local grid.

Utilities across the country are investigating expanding the use of distributed energy resources, commonly referred to as DERs[1] as they transition to more renewable resources in the generation mix and create a more resilient and flexible system. Because of the high cost of building new central generation facilities, economics is clearly a factor, but it's not the only driver for this change. Changes in public policy and

consumer demand and expectations of customers for their utilities are also playing a significant role in this transformation.

The evolution of DERs creates new challenges and drives changes in how utilities manage their distribution systems. The traditional planning process for upgrading and expanding electric distribution systems is inadequate in the age of two-way electric and data flows and decentralized generation. As they expand distributed energy resources, utilities must invest in grid modernization[2] – a smart grid – to manage the grid and avoid outages while maintaining safety and reliability in the distribution system. Of particular interest in Oregon, this situation is also providing opportunities for real benefit to utilities seeking to delay or phase in transmission and distribution investments.

In envisioning a path toward grid modernization and deeper integration of renewables, utilities are figuring out how distributed energy resources could provide load relief and serve distribution system needs. This is a case where DERs are both a challenge and a solution – they are part of what is driving the need for change in grid management and planning, but they have equal or greater potential to be part of the solution.

Consider these scenarios: Instead of adding or upgrading distribution feeders, utilities may implement a combination of **demand response**[3] during peak hours and **targeted energy efficiency** to reduce overall load growth to distribution constraint and delay or eliminate the need for capital investment. Distributed generation sources like **rooftop solar on the customer side of the meter** could be installed in locations on the grid that can best support it and thereby eliminate distribution constraints. **Battery storage with solar** could smooth out the impact of rooftop solar on the grid or be a flexible asset to provide demand response and peak mitigation.

How this transition to a modernized, resilient and flexible grid will evolve to meet these new needs is a question that can be, and is being, approached in a variety of ways. How do we value investments and benefits of targeted DER deployment versus those of traditional distribution system upgrades? What might be the role for Energy Trust of

Oregon in our future delivery of energy efficiency and renewable resource services to customers to support these efforts?

Oregon has begun the process of addressing use of DERs to alleviate distribution constraints. Oregon utilities have been reporting on smart grid enhancements that include both transmission and distribution upgrades and operations improvements. There are several open dockets with the Oregon Public Utility Commission (OPUC) on related topics, including Resource Value of Solar and Storage.

In 2017, Senate Bill 978 directed the OPUC to explore changes to the existing regulatory system and incentives that could accommodate industry trends towards utility or customer owned distributed energy resources. Oregon's investor-owned utilities as well as Bonneville Power Administration are interested in taking a proactive approach to distribution planning processes and exploring the integration of more DERs into the grid. Through Energy Trust, Oregon also has a strong program infrastructure for energy efficiency and renewable energy. This foundation for collaborative development of targeted demand-side management pilots is being explored with some of Energy Trust's funding utilities.

Oregon's needs for addressing grid constraints are less urgent than California or New York where the cost of building new infrastructure, especially in cities, is higher. But constraints on the transmission and distribution system can happen anywhere, and there is interest from all parties to avoid building infrastructure when less costly – and potentially cleaner – alternatives are available. Oregon's approach is to learn from other states while moving forward at a more deliberate pace.

This paper provides background and summarizes opportunities and challenges in implementing DERs, specifically related to delaying investment in distribution system upgrades. It draws on interviews with stakeholders in the Northwest and case studies from numerous states, including Oregon, to illustrate different strategies and identify potential pathways for Energy Trust. This national conversation is actively underway for

electric utilities with needs to address distribution constraints. This paper focuses primarily on strategies for electric utilities. However, this is not solely an electric utility issue. Gas utilities may also face distribution constraints, particularly at peak times. Some gas utilities, including NW Natural in Oregon, are testing strategies to deploy targeted energy efficiency to offset gas pipeline constraints and ensure the safe and reliable delivery of natural gas.

Overview of Distribution Planning

The primary role of a utility is to ensure the safe, reliable and cost-effective delivery of electricity to their customers. The electric distribution system was designed to move electricity generated by a centralized power plant and deliver it to end-use customers through their transmission and distribution system. For natural gas utilities, transmission pipelines deliver natural gas to the distribution system of the local distribution company.

Figure 1 illustrates the layout of hardware of an electric distribution system includes:

- A distribution substation, which reduces transmission voltage from hundreds of kilovolts (e.g., 115 kV, 230 kV, 500 kV), to tens of kilovolts (12 kV is the most common);
- The feeders or circuits, which originate at the distribution substation and serve approximately 1,000 customers each;
- The customer, who is connected to the feeder by a service transformer, which reduces voltage from tens of kilovolts to hundreds of volts (e.g., 120 V for a typical household outlet or 240 V for an electric dryer).

This original design did not envision distributed energy resources, and instead assumed that power moved in a single direction from generation through transmission and distribution lines to reach end-use customers. As these new resources have emerged affecting the direction of power flows and as power demands have grown over the years, Oregon utilities have managed the relatively low penetration of DERs with

moderate upgrades to their distribution systems; however, other states have challenges that are more acute.

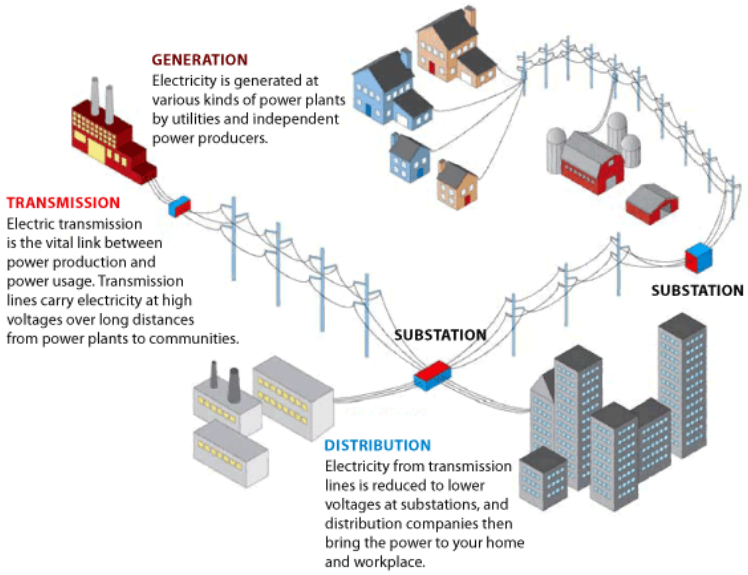


Figure 1: Layout of Typical Transmission and Distribution Systems

Utilities annually review their distribution systems against load forecasts to identify areas where new load could tax the distribution system. When faced with a distribution constraint, utilities first see whether they can reconfigure the distribution system by shifting loads through switches and by moving loads served by one substation to another substation. If this is insufficient to mitigate the constraint, the utility will look at investments in substation upgrades, capacitor bank replacements, or upgrading a feeder line to allow for more current-carrying capacity. More recently, utilities have considered non-wire alternatives[4], including DERs, to infrastructure investments; however, measuring the relative value of each of the varied alternatives is not clear-cut.

Oregon has taken steps to enable utilities to addresses this issue proactively. In the Northwest, the 7th Power Plan from the NW Power & Conservation Council[5] includes conservation resource projections for energy efficiency, distributed solar photovoltaic estimated costs and maximum achievable potential, and achievable potential for demand response in the region. This information informs plans for all utilities in Oregon.

In 2017, the OPUC indicated that utilities should begin distribution system planning to allow for the evaluation of the most beneficial placement and efficient use of new DERs.

Today's Considerations

I. Distributed Energy Resources and the Grid

To manage grid modernization costs many state regulators are starting to push for the deferral of upgrades to the transmission and distribution network through new investment in non-wire alternatives. Utilities and regulators are seeking long-term distribution planning approaches and acquiring analytical tools that support improved DER forecasting, assessment of DER locational value and analysis of least-cost hosting[6] capacity for rooftop solar. Depending on the scope of a distribution constraint, the types of DERs available, and the load forecasts, utilities may choose a number of different options.

Adding more DERs requires a comprehensive approach to grid modernization that, in turn, requires new operational capabilities for managing multi-directional power and data flows and variable grid conditions. These improvements can provide a more granular visibility into system conditions and the ability to meet load by reconfiguring the distribution grid and dispatch from a growing number of resources.

II. Opportunities: Using DER to address distribution system needs

Utilities can benefit from better DER planning in a number of ways. Providing up to date solar hosting capacity maps support a more efficient interconnection process while directing customers to invest in locations that do not lead to distribution constraints. More detailed planning expands the grid's capacity to accommodate DERs.

DERs, if deployed intentionally in specific locations on the grid, can provide a range of benefits for energy and capacity services and can also be a cost-effective alternative to traditional capital investment in infrastructure – "poles and wires."

- **Demand response** can be used to reduce load during peak times and shift usage to off-peak times
- **Battery storage systems** can provide both customer services and grid services. For instance, a battery storage system can store energy during off-peak for dispatch during peak demand times.
- **Energy Efficiency** reduces overall load, which can increase the hosting capacity of other DERs on the grid, with many measures also lowering load during peak times.
- **Solar** can provide generation to reduce load during daylight hours with the peak output dependent on the tilt and orientation of the array. Solar when paired with battery storage can become a DER option that utilities can call upon when needed.

Grid conditions and DER attributes dictate which DERs will be the most viable. For example, DER that can be dispatched when the network's peak demand occurs is generally more valuable than one that is not.

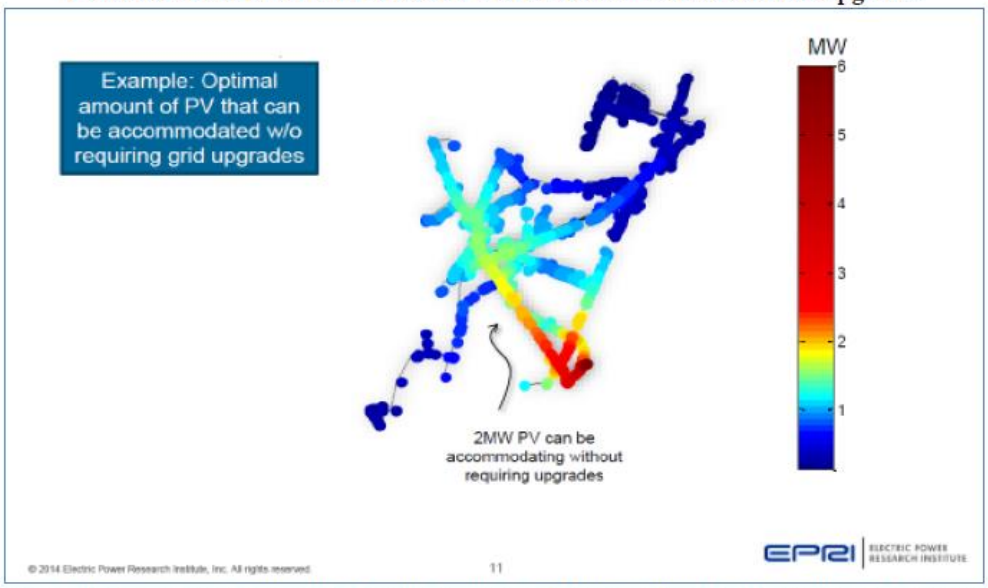
As an example, according to the 7th Power Plan[7], distributed solar has no peak demand reduction potential during the 6 pm winter peak hour and only about 30% of installed solar system capacity occurs during the peak summer hour. Energy efficiency, including the current mix of Energy Trust offerings, contributes more capacity savings during the peak winter hour than the peak summer hour. By combining long-term planning processes that incorporate these complexities and grid modernization efforts that allow for better visibility and management of DERs, utilities can reap the benefits of DER expansion.

III. Challenges: Using DERs to address distribution system needs

Planning and forecasting tools have not kept pace with the evolving needs of the grid, and utilities are working hard to close this gap. Distribution constraints are not always apparent to DER developers because grid maps, like that shown in Figure 2, showing

where DERs can be accommodated need to be created, updated frequently and made publicly available. This slows the analysis that can identify whether a given feeder can accept electricity from a DER and also ensure reliability.

Locations on the Local Grid Where PV Can Be Accommodated Without Upgrades



Source: EPRI map, presented in Greentech Leadership Group and CalTech Resnick Institute, "More Than Smart: Overview of Discussions Q3 2014 thru Q1 2015," Volume 2 of 2, March 31, 2015, page 42.

Figure 2: Example of DER Planning Tool

An emerging challenge for planners is implementing demand reduction efforts through targeted energy efficiency and demand response. Energy efficiency programs and their associated demand reduction cannot be easily attributed to a single location. Likewise, utilities may tap demand response to address generation capacity shortfalls and their demand response signals are made for the whole system, not specific areas. Developing strategies to localize both energy efficiency and demand response – make them more dispatchable -- is on the minds of distribution planners. Many grid operators, trained in the tradition of managing a distribution system fed by centralized power plants, are less confident in the reliability of DERs due to their frequently non-dispatchable nature.

Utilities have historically had a financial disincentive to invest in non-wires alternatives, including DERs, since utility revenues are based upon the value of investments in centralized assets comprising the utility's "rate base." But signs of change are in sight

as states look at different policies, up to and including mandates and incentives for DER deployment. For traditional transmission and distribution upgrades or centralized generation plants, standard practice has been that utilities request to recover their costs through rates, while earning a negotiated rate of return on top of the cost of the investments. However, for energy efficiency and other DER investments, they may only recover their costs. This can make DER investment less attractive to the utility's bottom line.

Developing distribution management systems that provide greater visibility would help address these challenges. Having better ways of modeling and predicting how DERs will be adopted by customers (e.g., which type of DERs, where and at what rate) is one area for improvement. Enhancing operational control to view and manage what's happening in real time on the distribution system is another. Every piece of the grid matters in its management. The characteristics of each link in the chain, ranging from the characteristics and technology of the current feeder networks, to whether there are other DERs nearby, influences what approach is most cost-effective and robust for multiple, sometimes competing, grid management goals.

Current Policy Efforts and Case Studies

Regulators in some states are pushing for distribution planning changes and least-cost planning that incorporates DERs. Some utilities see this as an opportunity to meet their states' DER policy mandates while reducing distribution costs.

I. New York

The New York Public Service Commission instituted a *Reforming the Energy Vision* proceeding in early 2015 to address distributed generation and energy storage, and the ability of utilities and regulators to adopt them, in part to mitigate the relatively high cost of forecasted distribution system upgrades in New York. Through this top-down approach, the utilities are creating Distributed System Implementation Plans and tools to support valuation of DER and enable integration of higher levels of DER through third-party engagement in the market and power system. New York sees the future of

the regulated utility as an enabler of customer choice and provider of distribution planning, integrated grids, and deployment of DER to cost-effective levels.

Prior to REV, New York has been proactive in integrating end-use efficiency into transmission and distribution system planning, with geo-targeted load reductions occurring since 2003 when distribution networks were approaching peak capacity. ConEd implemented geographically-targeted energy efficiency programs in over 1/3 of its distribution networks to delay or eliminate the need for distribution capacity expansion. Savings from these efforts were close to forecast and provided $300 million in net benefits to ratepayers[8].

In 2014, Con Ed received regulatory approval to invest in approaches to mitigate capacity constraints in Brooklyn and Queens and defer a $1 billion substation investment. The deferral of electric substations is expected until 2026 because of these efforts. Instead, a $150 million investment will cover increased incentives for customer-sited solutions, resulting in over 40 MW customer-sited load reduction measures (or $3.7 million per MW). Customer-sited load reduction could take the form of energy efficiency measures and on-site generation technologies.

II. California

In 2014, the California Public Utilities Commission (CPUC) initiated a Distribution Resource Plan proceeding that laid out the following goals for utilities:

- Characterize the ability of the utilities' systems to accommodate additional DERs
- Develop an approach to assign locational values in the distribution system
- Offer projections of DER growth and how that growth affects infrastructure investments
- Initiate pilot projects to demonstrate innovative technical and operational approaches to integrate DERs. In 2015, the California Investor-Owned Utilities filed distribution resource plans that described their proposed strategies to meet those goals.

Utilities and the CPUC are taking a bottom-up approach to their state's distribution system. They have jointly developed Integrated Capacity Analysis methods at the feeder level to identify the capacity of the distribution system to integrate DERs, and Locational Net Benefits Analysis methods to determine how to measure the value of DERs at specific locations on the distribution system. Southern California Edison and Pacific Gas & Electric have begun to explore how DERs, including energy efficiency, can be used to meet distribution system needs, looking at the load reductions achievable through energy efficiency at peak time periods and matching to the feeders that need it most.

III. Oregon

A. BPA: I-5 Corridor Reinforcement Project (South of Allston)

The Bonneville Power Administration had planned for an investment of more than $1 billion for 79 miles of 500 kV transmission line near Longview, Wash., called South of Allston, to address the issues of high congestion in its transmission system[9]. This project was halted in 2017 and BPA committed to evaluating how a non-wires alternative could alleviate constraints. Like other utilities, BPA is working on DER valuation analysis and screening criteria so that non-wires solutions can be evaluated as standard practice.

BPA began a two-year pilot in the summer of 2017 to analyze the costs, benefits and impacts of non-wires solutions South of Allston. It would be implemented on both sides of the meter -- customers will reduce demand on 10 summer days for four hours at a time, and BPA will forecast peak energy demands and then coordinate with generators to the south of the constraint to take the pressure off the transmission system. In terms of dispatchable resources, BPA is tapping into 46 MW of demand response for the pilot, but has chosen not to use storage at this time due to cost. BPA is also making targeted upgrades to system components – all in an effort to avoid building a new transmission line. If the pilot is successful at alleviating the strain, BPA will apply this approach to other congestion points in the system.

B. Pacific Power

Currently, Pacific Power is working with Energy Trust to identify areas where targeted community-focused DER solutions could improve system operation during specific locational peak hours and also possibly defer traditional system investments.

The first effort is a pilot in the North Santiam Canyon. The objective of this pilot project is to measure the impacts of increased marketing and outreach of existing Energy Trust energy efficiency offerings to residential, commercial and industrial customers. The results of this project will inform whether and how the utility and Energy Trust could jointly deliver targeted energy efficiency as a solution in areas at risk of distribution constraint.

Pacific Power also released a targeted locational demand response request for proposal, through which they expect to learn more about how to manage targeted demand response. The utility is developing screening criteria to help direct analysis to determine when non-wire alternatives would likely be cost-effective. The results of this pilot will produce data and findings to assist Pacific Power distribution planners in using these screening criteria.

> "PacifiCorp recognizes the role that distributed energy resources (DER) may play in the deferral or offset of traditional poles and wires infrastructure investments. Where feasible and cost-effective, DER solutions are expected to supplant traditional solutions for implementation." [10]

C. NW Natural

Energy Trust is currently working with NW Natural to implement a multi-year pilot to develop cost, savings and timing estimates for peak-hour gas targeted energy efficiency strategies to help NW Natural plan for future capacity constraints. The pilot builds on expertise within Energy Trust program delivery and lessons learned from similar efforts. It will test the results gained through a range of delivery strategies, including but not limited to: targeted marketing, targeted delivery, and increased incentives. The pilot

team will investigate the costs of these specific strategies that could help determine specific cost-per-therm for geographically targeted energy efficiency offerings.

Summary/Conclusions

I. How Do We Get There From Here? Enabling, Valuing, Planning And Regulating DERs

Reaching these goals requires that a few conditions be true:

DER Solutions are tested and reliable: Building the modern grid will require that currently available DERs, including demand response, storage and energy efficiency, are robust and reliable.

The value of DERs to the distribution grid is understood: Stakeholders in the industry must improve the valuation of DERs to the grid. Valuation methodologies must be developed and applied so distribution planners will have reliable data for decision-making on the locational net value of each DER.

Distribution planning tools exist and are in use: New solutions require a complete toolkit for planners to keep pace with changing DER integration. Utilities will help steer the market by incentivizing favorable locational deployment of DERs and dis-incentivizing unfavorable locations.

Grid modernization investments are made: All of these changes to optimize the current system are setting up a path toward the larger vision for grid modernization that can accommodate future complexity from even more DERs.

Utility policies and incentives are considered and developed: Policy changes will loom large as states address new areas, including setting conditions under which DER capacity procurements must be considered by utilities, and incentives for utilities to employ DERs to mitigate or defer distribution grid needs.

II. The Role for Energy Trust In Distribution Planning

Energy Trust serves roughly 70 percent of the state's electric ratepayers. The nonprofit's historic focus on energy efficiency and renewable energy programs has the potential to evolve to support partner utilities in different ways. Portland General Electric and Pacific Power serve very different territories and have distinct challenges in serving a growing population. Working with Energy Trust on geographically-targeted energy efficiency and renewable energy efforts to address distribution constraints or other future challenges with distribution could help all partner utilities defer costly distribution investment. One immediate opportunity is already underway to use targeted energy efficiency programs in communities to test what results are possible, what approaches are most effective and how much it will all cost compared to other non-wires alternatives or capital upgrades.

As explored earlier in this paper, Energy Trust is working currently with both Pacific Power and NW Natural to pilot how targeted energy efficiency and renewable energy program offerings can address distribution constraints with cost-effective solutions[11]. Based on this and on the development of locational avoided-costs, Energy Trust could potentially increase incentives incrementally in targeted locations.

Stakeholders see significant potential for using targeted energy efficiency as a lever for the distribution system, but they also warn of the risk of overcorrecting in the quest to meet locational needs. These stakeholders suggest careful consideration in the design of targeted energy efficiency and renewable energy efforts to ensure that they appropriately value locational benefits against other benefits.

All parties agree that a shared, big-picture view is necessary to build the grid of the future. Establishing a valuation framework to determine which DERs are cost-effective under what circumstances and how utilities and Energy Trust can combine DERs to alleviate distribution constraints is the research question at hand.

Energy Trust's next step is to continue on its path to learn from other states and from pilots here in Oregon. Developing these ideas from small-scale pilots to full-scale implementation will require that new distribution planning tools and processes be adopted by utilities. It also indicates a new paradigm for how the market interacts with utilities as they plan and operate the distribution system. Energy Trust's experience in working with customers, and with the businesses such as contractors, designers, builders and developers who serve the market, could be helpful to utilities as they make this transition.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

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[1] Distributed Energy Resources, or DERs, is used in this paper as a term that includes rooftop solar, energy storage, demand response, combined heat and power, fuel cells and energy efficiency to deliver power to customers.

[2] https://energy.gov/under-secretary-science-and-energy/grid-modernization-initiative

[3] Demand response provides an opportunity for consumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based rates or other forms of financial incentives. Demand response programs are being used by some electric system planners and operators as resource options for balancing supply and demand. Demand Response can take many forms, including direct load control of air conditioning and industrial process load shifting. https://www.energy.gov/oe/activities/technology-development/grid-modernization-and-smart-grid/demand-response

[4] Non-wires alternatives are electric utility system investments and operating practices that can defer or replace the need for specific transmission and/or distribution projects, at lower total resource cost, by reliably reducing transmission congestion or distribution system constraints at times of maximum demand in specific grid areas

[5] https://www.nwcouncil.org/energy/powerplan/7/plan/

[6] Hosting capacity is defined as the amount of solar that can be accommodated without impacting power quality or reliability under existing control and infrastructure configurations

[7] https://www.nwcouncil.org/media/7149926/7thplanfinal_chap12_conservationres.pdf

[8] Gazze et all, 2010, ACEEE Summer Study

[9] The same issues that apply to deferring distribution are also useful in how it works on the transmission side.

[10] Pacific Power. 2017. *Pacific Power Smart Grid Oregon Annual Report.*

[11] See pages 8-9 for more information

Long Term Energy Efficiency Forecasting
Board Learning Paper

Prepared by Spencer Moersfelder, Fred Gordon, Jack Cullen and Becky Engel
May 2018

EnergyTrust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by the Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020-2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. **These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.**

Introduction

Energy Trust is an administrator of Oregon energy efficiency programs for PGE, Pacific Power, NW Natural, Cascade Natural Gas and Avista Corporation; and Washington energy efficiency programs for NW Natural. For these funding utility partners, Energy Trust forecasts the potential future electricity and gas savings from energy efficiency, which can be used for budgeting, annual performance tracking, identifying long-term savings potential and informing utility Integrated Resource Plans (IRP). Efficiency forecasting through utility IRP processes is a major determinant of Energy Trust's goals and budgets. This paper describes how Energy Trust develops the 20-year forecasts that utilities use for their IRPs and how it relates to Energy Trust's budgets, goals and program planning. The following sections cover the purpose of these forecasts, the methodology to create them, what the forecasts means and limitations of the forecasts.

Purpose of the 20-Year Forecast

Energy Trust provides 20-year forecasts of potential energy efficiency savings and costs to utilities as part of their IRP process. Energy Trust forecasts both annual energy savings and energy savings during peak energy use periods. The PacifiCorp website provides a helpful overview of IRPs and its usage of them:

> “The Integrated Resource Plan (IRP) is a comprehensive decision support tool and road map for meeting the company's objective of providing reliable and least-cost electric service to all of our customers while addressing the substantial risks and uncertainties inherent in the electric utility business. The IRP is developed with considerable public involvement from state utility commission staff, state agencies, customer and industry advocacy groups, project developers, and other stakeholders. The key elements of the IRP include: a finding of resource need, focusing on the first 10 years of a 20-year planning period; the preferred portfolio of supply-side and demand-side resources to meet this need; and an action plan that identifies the steps needed over the next two to four years to implement the plan.
>
> “PacifiCorp prepares its integrated resource plan on a biennial schedule, filing its plan with state utility commissions during each odd numbered year. For five of its six state jurisdictions, the Company receives a formal notification as to whether the IRP meets the commissions’ IRP standards and guidelines, referred to as IRP acknowledgement. For even-numbered years, the Company updates its preferred resource portfolio and action plan by considering the most recent resource cost, load forecast, regulatory, and market information.
>
> “The IRP uses system modeling tools as part of its analytical framework to determine the long-run economic and operational performance of alternative resource portfolios. These models simulate the integration of new resource alternatives with our existing assets, thereby informing the selection of a preferred portfolio judged to be the most cost-effective resource mix after considering risk, supply reliability, uncertainty, and government energy resource policies.[1]”

In summary, an IRP assesses a utility’s demand and load over 20 years to identify years where there may be a deficiency of supply to meet load. The IRP model then identifies the ‘preferred’ supply (generation) or demand side resource to meet that deficiency (Energy Efficiency is considered a demand-side resource).

The PacifiCorp description above is representative of the IRP process at each of Energy Trust’s partner utilities. Energy Trust’s 20-year potential savings forecast quantifies the available, cost-effective achievable energy efficiency potential to inform and reduce a utility’s load forecast over

the IRP period, so they can accurately plan their generating mix to meet their customers' projected loads.[2]

Historically, Energy Trust works with utilities to update these forecasts about every two years, coincident with the utilities' obligation to provide a refreshed IRP to the Oregon Public Utility Commission (OPUC) and the Washington Utility and Transportation Commission (WUTC). To keep the resource model up-to-date, Energy Trust's Planning team makes continual updates to the model according to the most current information available, including updated market trends, program trends and measure level input data (e.g. savings, costs and efficiency saturations).

The 20-year forecast does not dictate annual savings goals or set incentive levels for Energy Trust. Instead, annual IRP targets that emerge from the 20-year efficiency forecasts inform the two-year Energy Trust budget and vice versa.

The processes for forecasting IRP targets and setting savings goals for budgets typically occur at different times. For example, previous IRP savings targets for a respective two-year period are taken into consideration when developing savings goals for a two-year budget. Similarly, Planning uses the savings goals from the last two-year budget as a starting point for developing a 20-year savings deployment for the IRP process.

In some cases, the IRP process for a utility coincides neatly with Energy Trust's budget process, resulting in the closest alignment between annual savings goals and IRP targets. However, due to resource constraints, Energy Trust does not have the ability to synchronize our budget process with the production of energy efficiency forecasts for all utility IRPs. Annual savings projections for early years in the 20-year forecast may be limited by planning that Energy Trust does with each utility to assure that associated revenue requirements are relatively smooth over the respective years. Erratic revenue requirements are disruptive to the utility rate-setting process because of the related impacts on utility ratepayers.

The importance of Energy Trust's 20-year efficiency forecast has grown over time as Energy Trust's achievements have increased. In the early years of Energy Trust, when savings achievements were still modest, utilities incorporated Energy Trust savings in the simplest possible way, by deducting a fixed amount of savings from the load forecast prior to forecasting the need for other resources. However, as time progressed, Energy Trust's results increased to have significant impacts on overall utility loads. For example, Energy Trust's 20-year forecast for the 2018 NW Natural IRP shows a 15.9 percent cumulative reduction in the load the utility would otherwise forecast in absence of Energy Trust efficiency programs. Similarly, Energy Trust's

20-year forecast for the 2018 PGE IRP shows a 19.9 percent cumulative reduction in the load the utility would otherwise forecast in absence of Energy Trust efficiency programs. These recent projections illustrate the important role that energy efficiency plays in helping utilities optimize their resource mix to meet their loads. The outcome is that the forecast that Energy Trust provides for utility IRP planning has become more important to utilities, OPUC and other stakeholders.

20-Year Forecasting Process

Until 2015, Energy Trust used an Excel-based system for producing the 20-year forecast. At that time, Energy Trust migrated to a Resource Assessment model in Analytica®[3] that was developed by a consultant. This Resource Assessment model is currently being used to produce 20-year energy efficiency forecast for our funding utilities' IRPs. The Resource Assessment model is an object-flow-based modeling platform that is designed to visually show how different objects and parts of the model interrelate and flow throughout the modeling process. The model utilizes multidimensional tables and arrays to compute large, complex datasets in a relatively simple user interface. The current model simplifies the complex interrelated stacking of variables required in the forecasting process. Compared to the previous Excel-based spreadsheet model, one significant advantage of the Analytica platform is that it can house all the data for every utility within one model, rather than having to maintain a separate spreadsheet model for each. This greatly reduces the upkeep cost to model energy efficiency potential for each utility.

Resource Assessment Model Methodology

While there are a large number of variables and inputs that must be managed in the model, the Resource Assessment model is essentially one large multiplication matrix. The model utilizes a 'bottoms-up' framework, where individual measure-level data are the base inputs for the model. These base inputs are scaled up to quantify cost-effective achievable 20-year energy efficiency potential for each utility in relation to other inputs provided by each utility. In addition, the model is also able to project demand savings for each utility according to each utility's defined peak periods. Figure 1 below is a flowchart of the 20-year energy efficiency forecast development process.

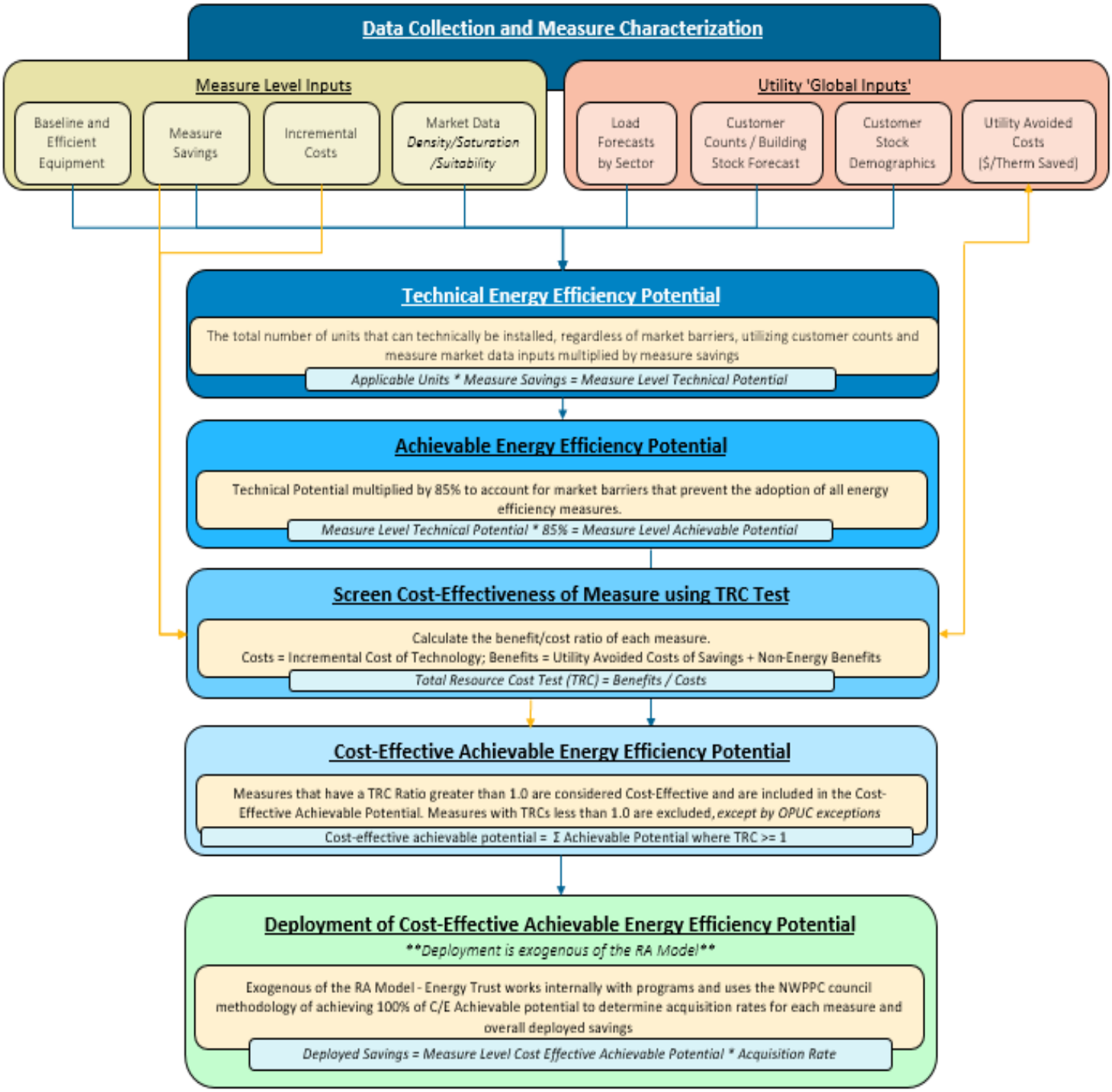

Figure 1: 20-year Energy Efficiency Forecast Development Process

As shown in Figure 1, there are a number of inputs necessary for this model, including inputs at the measure level and utility level (often referred to as 'global' inputs). Below is an overview of some of the inputs that go into the model:

- Utility/'Global' inputs
    - Customer counts, 20-year load forecasts, by customer type
    - Avoided costs, line losses and discount rate
    - Demographic statistics
        - Heating and hot water fuel splits
        - Energy use intensity for commercial and industrial
- Measure level assumptions
    - Savings, costs, operations and maintenance costs and savings, measure life, load profile, end use, baseline information, measure densities[4], baseline vs. efficient saturations, technical applicability, achievability rates
- Emerging Technologies (Figures 2 and 3 illustrate the total cumulative forecast for the 2018 NW Natural and PGE IRPs. This cumulative forecast is made up of savings from emerging technologies.)
    - The model includes a suite of emerging technologies that are not currently offered by Energy Trust programs, but offer the potential for significant savings in the future if they become viable in the market.
    - Emerging technologies are subject to a risk factor that functionally reduces forecast savings based on market risk, technical risk and data source risk.

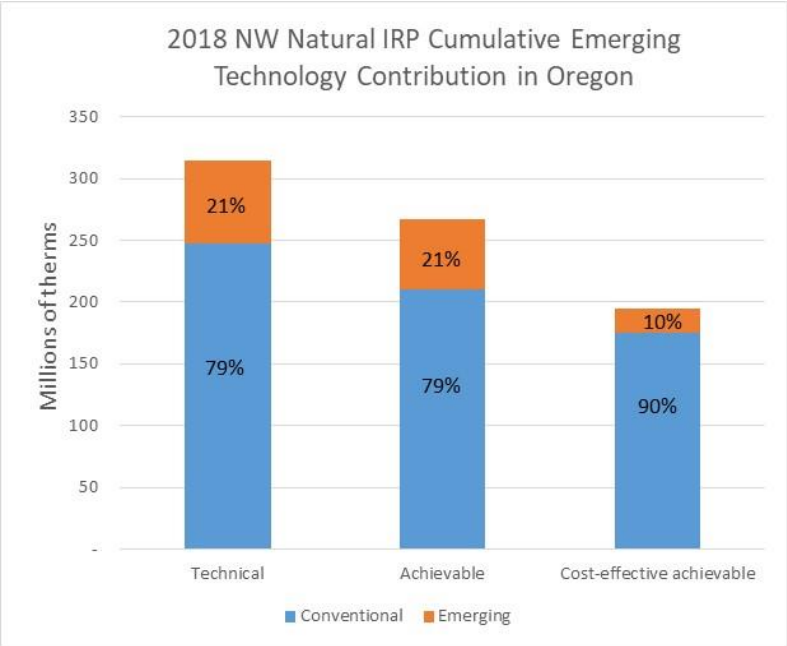

Figure 2: 2018 NW Natural IRP Cumulative Emerging Technology Contribution in Oregon

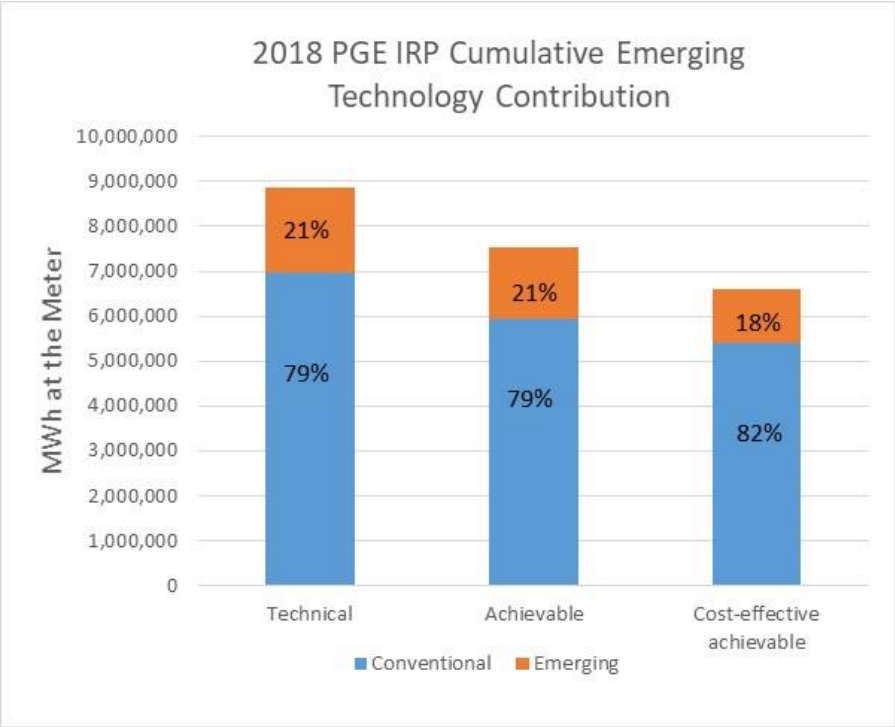

Figure 3: 2018 PGE IRP Cumulative Emerging Technology Contribution

There are several assumptions embedded in the Resource Assessment model as well:

- Program forecasts for years 1-5 are aligned with program measure assumptions and uptake and saturation adjustments, and are based on prior program activity.
- Cost-effective potential may come from programs or codes and standards efforts.
- Federal and state equipment standards, appliance standards, code changes and the forecasted impact of regional market transformation efforts are factored in. (E.g. assumptions about transforming retail lighting markets via regional efforts and Federal lighting manufacturing efficiency standards.)
- The model assumes utilization of energy use intensities per square foot in the commercial sector from regional surveys (NEEA's Commercial Building Stock Assessments). This data is used to translate utility load forecasts to estimates of building square footage, which is the typical units for efficiency resource modeling in the commercial sector.
- The model factors in deployment rates that are calibrated to Northwest Power and Conservation Council's 20-year total deployments from its 7th Power Plan.
    - The model assumes 100 percent acquisition of cost-effective retrofit potential at the end of 20-year periods in service territories where Energy Trust has had a sustained active presence, unless the representative measures are being offered via a cost-effectiveness exception from the OPUC and are notoriously hard to reach (e.g. insulation).
    - In service territories where Energy Trust has had a sustained active presence, the model assumes that by the end of 20-year period, acquisition rates for replacement on burnout and new construction measures will approach 100 percent acquisition, regardless of whether the savings come through programs or codes and standards.

Model Outputs and Final Savings Projections

Energy Trust's Resource Assessment model combines the inputs and assumptions described above to assess savings opportunities at the measure level. The model then scales these measure level savings to a utility's service territory. Using the utility and global inputs, savings outputs falls into several categories (described below and illustrated in Figure 4). Different utilities require different modeling outputs from Energy Trust based on the way that their own modeling uses Energy Trust inputs.

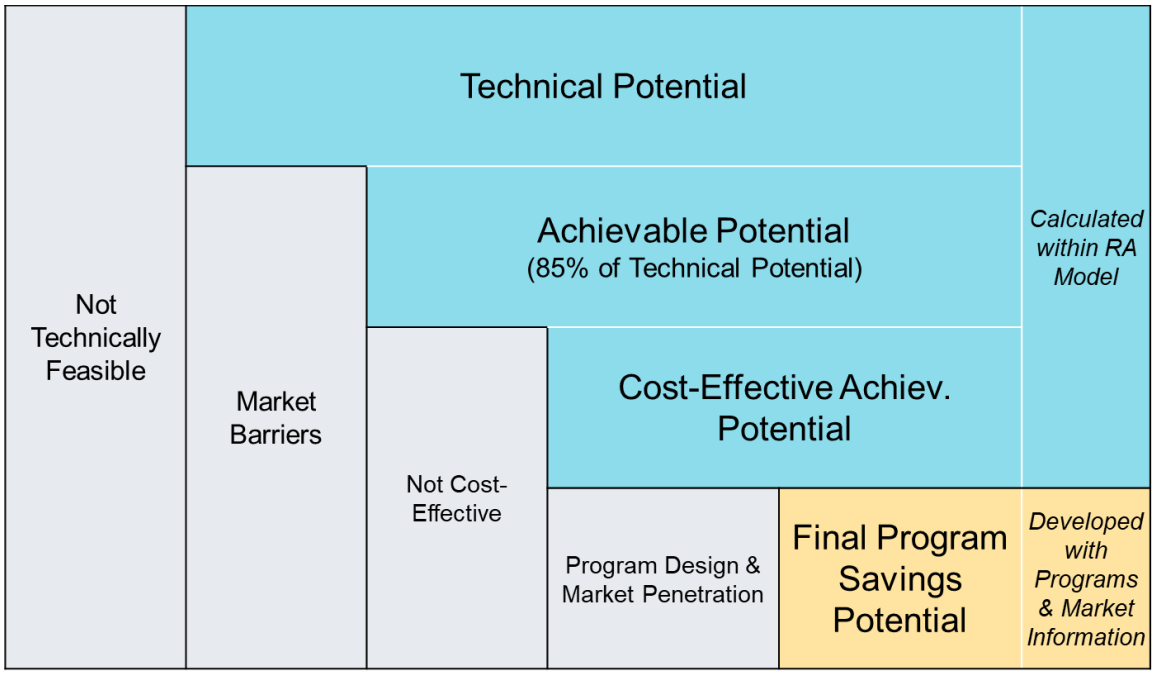

Figure 4: Types of Energy Savings Potential to Come out of Resource Assessment Modeling Process

1. There are some measures that are **Not Technically Feasible** because the measure is not a natural fit in some locations (e.g. a gas boiler in a commercial building in an area that is not served by gas).
2. **Technical Potential is total potential where measures can technically be installed,** regardless of market barriers or cost (e.g. a gas boiler in a commercial building in an area that is served by gas).
3. **Achievable Potential** is the portion of savings that Energy Trust can acquire if the customer can be successfully reached and influenced. Energy Trust assumes that a certain portion of customers will never install energy efficiency measures regardless of how Energy Trust attempts to reach these customers. To quantify Achievable Potential, multiply Technical Potential by 85 percent under the assumption that 15 percent of potential customers will never move to install energy efficiency measures due to **Market Barriers,** a commonly applied assumption in the Pacific Northwest.[5]
4. **Cost-Effective Achievable Potential** is the portion of Achievable Potential that has passed a cost-effectiveness screen using the Total Resource Cost (TRC) test. The TRC test compares the cost of an efficiency measure to the financial benefits of a measure, including the avoided costs that are specific to the utility conducting the IRP and quantifiable non-

energy benefits. Some special situations occur when calculating cost-effective achievable potential:

- ***Competition Groups***: There are some measures that could each individually be installed in the same singular location, but in practice, installation is mutually exclusive, and either one or the other can be installed in that singular location. The Resource Assessment model addresses this by screening these measures against each other in "competition groups" and the most cost-effective measure is selected to be installed first. If other measures within the competition group still pass the TRC test and the less cost-effective measures have incremental savings, then these savings are incrementally added to the 20-year forecast, as illustrated in Figure 5.

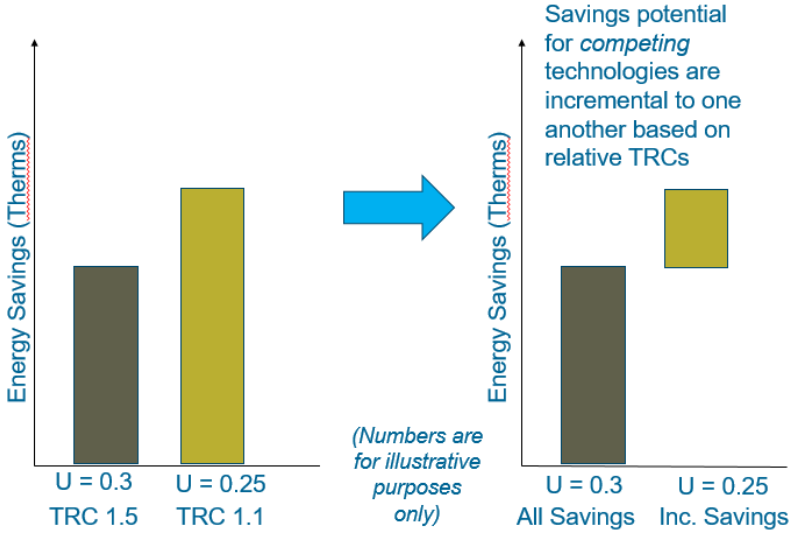

Figure 5: Incremental Savings Approach within Competition Groups

- ***C/E Overrides***: In some cases, measures are not cost-effective in an individual utility's IRP, but the measures are still offered by Energy Trust programs. This can occur because the measures are: a) cost-effective if screened using blended all-utility avoided costs[6] or b) the measures have a cost-effectiveness exception from the OPUC. In these instances the measures are forced into cost effective potential using a cost-effectiveness override within the model.

5. Deployed savings or the **Program Savings Projection** consists of cost-effective savings that have been "deployed" using market penetration curves (also referred to as ramp rates)

that reflect Energy Trust's best assumptions about what is achievable over time. For illustrative purposes, Figure 6 is the final savings deployment Energy Trust provided to PGE for its 2018 IRP and Figure 7 is the final savings deployment Energy Trust provided to NW Natural for its 2018 IRP.

Projecting the rate of savings acquisition in a deployment is more of an art than a science. Energy Trust currently uses different methods for near-term and long-term forecasting, resulting in a forecast that combines insights from the Planning group, Programs and model outputs. Planning staff works with programs to generate a five-year forecast and juxtaposes this forecast with the 20-year cost-effective achievable potential from the model to generate the final deployed forecast. The final deployed 20-year forecast consists of results assembled for the following respective time periods:

- The first two-years are based on the most recent budget exercise with some adjustments. The process to develop the most recent two-year budget is the most comprehensive and detailed assessment of what savings can be acquired by individual programs through their go-to-market mechanisms and offerings.
- Years 3-5 are based on projections of what programs expect based on market and program trends. These 3-5 year forecasts are compared to the overall cost-effective achievable potential that results from the forecast model and are sometimes adjusted if they don't otherwise seem to fit logically into the larger 20-year pattern that emerges in the deployment.
- Longer-term forecasts are projected using curves that start at the end of the five-year projection and lead to acquiring the largest feasible share of the resource at the end of 20 years. Adjustment are made to reflect quirks in the model or data which appear to be producing implausible results.

To meet utility IRP schedules, this forecasting work often happens out of synch with Energy Trust's annual budget cycle. The forecast for the first five years reflects our best attempt to anticipate what can be achieved without having the depth of review of the early years that emerges from the budget process.

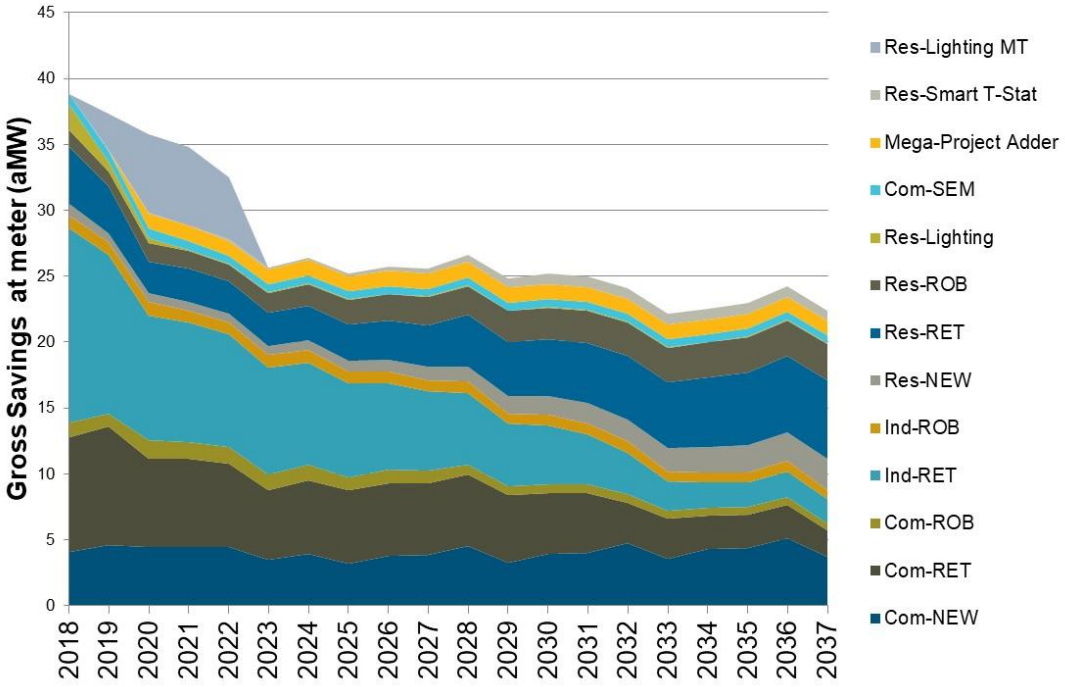

Figure 6: Final Deployment Curves for PGE's 2018 IRP by Sector and Type

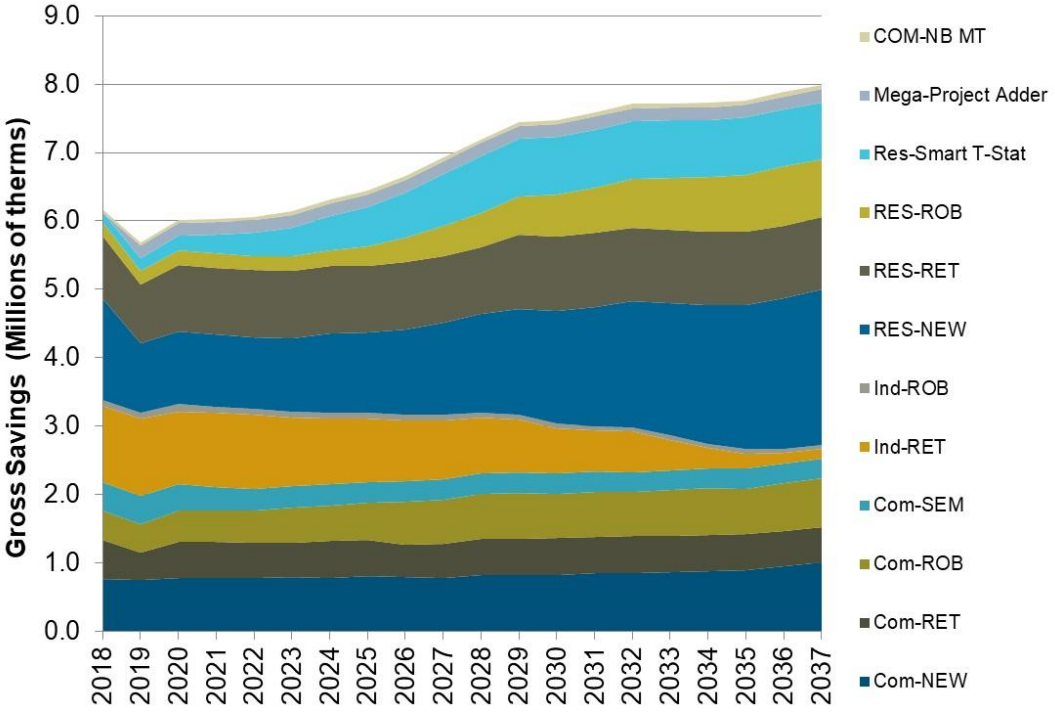

Figure 7: Final Deployment Curves for NW Natural's 2018 IRP by Sector and Type (Oregon)

A Process of Continuous Improvement

The Resource Assessment modeling process is always a work in progress. The model itself is a living instrument that is subject to constant iterative improvements to all measure level and utility level inputs and assumptions, such as savings, costs, and market data. It is a significant effort for Energy Trust staff to keep the model's measure assumptions current. This is an iterative and expanding process as the number of measures that Energy Trust offers continues to grow and as more emerging technologies come onto the market.

Energy Trust hosted a stakeholder meeting in September 2017 to solicit feedback on the Forecast Process and improvements to the model. Themes that emerged from this workshop included:

- Energy Trust achievements have been regularly exceeding IRP targets.
- Utilities and stakeholders are interested in receiving a forecast based on more than just "firm" resources.
- Utilities are interested in the best projection that can be provided. Achievements should fluctuate on both sides of the forecast over time.
- Short-term forecasts are most important to utilities and the OPUC in the following order:
    - 1-2 years
    - 3-5 years
    - 6-10 years
    - 11-20 years
- Advocates are still interested in long-term forecasts in context with the rest of the IRP process.
- A bottom-up approach (building up from measures to a portfolio) is the correct approach.
- The prior forecast has been missing some estimation of the resources that can't readily be seen.
    - New large single loads that utilities and Energy Trust have difficulty forecasting.
    - Emerging technology of the future that has not yet been developed to the point where it can be included in the model.
- Advocates request a standardized approach across utilities.
- Savings with high capacity benefits are of great value to utilities.
- There are complications that arise because utility IRP schedules do not align with Energy Trust's budgeting process.

As a result of prior experience and this feedback Energy Trust is making efforts to improve its IRP forecasts. Recent incremental improvements to the forecast include:

- 2015: Migration to the Analytica platform
- 2015: Inclusion of emerging technology with risk factors
- Ongoing: Iterative updates to measures, baselines and emerging technology
- 2017: Inclusion of additional behavioral savings and near net-zero homes and buildings
- 2017: Focused forecasting improvements in three time period segments:
    - 1-2 years (short-term)
        - Made modifications to savings from most recent budget, programs know best
    - 3-5 years (mid-term)
        - Programs and Planning worked together to extend program trends from years 1-2
    - 6-20 years (long-term)
        - Planning forecasted long-term acquisition rate
- 2017: Addition of forecast "megaproject adder" to account for large unidentified projects. These have previously not been forecast as loads or opportunities and have resulted in significant forecasting error. The addition is based on past large project savings averages.
- 2017: Adoption of deployment rates that calibrate to Northwest Power and Conservation Council's 20-year total deployments from its 7th Power Plan as follows:
    - Assumes 100 percent acquisition of cost-effective retrofit potential at the end of the 20-year period in service territories where Energy Trust has had a sustained active presence.
    - In service territories where Energy Trust had had a sustained active presence, assumes that by the end of the 20-year period acquisition rates for replacement on burnout and new construction measures will approach 100 percent acquisition regardless of whether the savings come through programs or codes and standards.

These improvements and other factors have resulted in Energy Trust increasing the total resource projections in forecasts that have been recently submitted to utilities for their IRPs. Figure 8 illustrates the increase from the 2016 to 2018 cost-effective deployment for PGE.

Likewise, Figure 9 illustrates the increase from the 2016 to 2018 cost-effective deployment for NW Natural. Key drivers for these increases include the improvements described above, as well as increases in avoided costs, especially in NW Natural avoided costs, which resulted in more measures passing the cost-effectiveness test in the model.

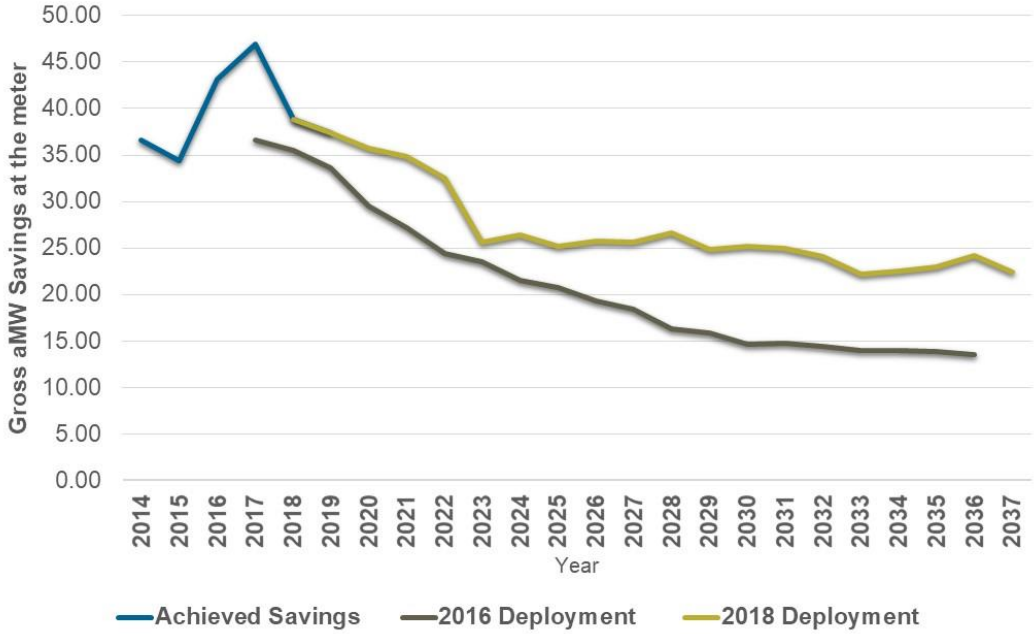

Figure 8: 2016 vs 2018 PGE Cost-effective Gross Savings at The Meter – Projections and Actuals

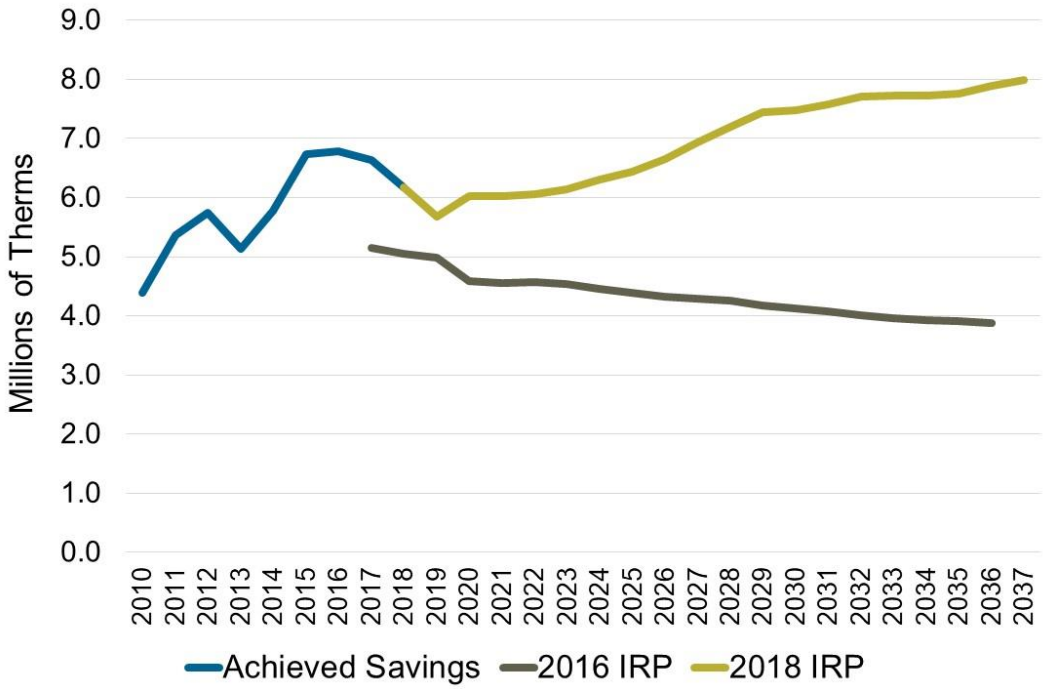

Figure 9: 2016 vs 2018 NW Natural Cost-effective Gross Savings at The Meter – Projections and Actuals (Oregon)

Even with these forecasting improvements, there are remaining challenges that contribute to forecast uncertainty. Forecasts are forecasts, not predictions. Despite best attempts to make forecasts accurate, actual results are subject to a multitude of unpredictable factors. Energy Trust will continue to strive to enhance the accuracy of forecasts by looking for creative approaches to overcome these unpredictable challenges:

- Difficult-to-predict economic conditions and weather.
- Uncertain utility load, population growth and building forecasts.
- Difficult-to-predict pace of market uptake for some measures.
- Unforeseeable emerging technologies and solutions.
- Industrial facilities which tend to have highly customized energy efficiency projects which are difficult to generalize in our Resource Assessment model.

Key Takeaways

Energy Trust puts together 20-year efficiency savings and cost forecasts for utilities that are designed to assess the energy efficiency resource based on quantifying savings potential that will result from a wide variety of energy efficiency measures installed in suitable end-use

locations. These forecasts are used for utility Integrated Resource Plans and Energy Trust planning. Energy Trust recognizes that forecasts are uncertain by nature. Regardless, Energy Trust strives to make continuous improvements to forecasts to make them as useful as possible.

These forecasts provide a view of the energy efficiency resource available in the short, medium and long-term. This view, while uncertain, is useful for directional thinking about Energy Trust strategy and the forecast should be referenced in the 2020-2024 Strategic Planning Process.

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[1] https://www.pacificorp.com/es/irp.html

[2] Renewable energy is considered in electric IRP's. However, Energy Trust's work in this area is considered as part of a larger portfolio of available renewable resources and is generally not singled out. In general, renewable generation potential is much larger than the financial resources available to Energy Trust, and the major determinants of market deployment include government tax and incentive policy, policy regarding other benefits of projects such as water conservation, grid management developments, innovation in program delivery, and rapid changes in technology and product cost. This creates a very different environment for forecasting.

[3]http://www.lumina.com/why-analytica/what-is-analytica1/

[4] Measure densities are defined as the number of units per the scaling basis of the sector. A scaling basis is how the measures are scaled from the measure level to a utilities service territory – it is the link between measure data and utility data. For example, in the residential sector, the scaling basis is almost always 'number of homes' so that measure level data can be scaled up based on the number of homes that a utility serves. However, most measure savings are given 'per unit' such as per light bulb and in order to properly scale the savings, the average number of light bulbs per home is a necessary measure level data point for the model. This average number of measure units per the scaling basis (homes in this case) is the 'density' of a measure. For example: Measure is an LED bulb, there are an average of 35 screw-in lighting sockets per Single Family home (the density), and a utility serves 500,000 Single family customers resulting in 17.5 million total screw in lighting sockets in that utility's service territory.

[5] https://emp.lbl.gov/sites/default/files/lbnl-3960e-hrcp.pdf Back in the 80's, a $20 million program was run by Bonneville Power Administration and Pacific Power and Light in Hood River, Oregon to test the limits of energy efficiency potential. Results of the program demonstrated that 85 percent of all eligible participants would install energy efficiency measures when installation of the measures was offered free of charge. The converse result is that 15 percent of potential participants withheld from the program; and this has resulted in the widely accepted assumption that it is not possible to influence 15 percent of the market regardless of how enticing you make the deal. Since then the Northwest Power and Conservation Council has conducted a follow-up study to vet the 15 percent number and came up with a similar result. Admittedly, the 15 percent number is imprecise, but the Hood River experiment has never been repeated and seeing that it is the best estimate available, the number is widely used around the region to convert Technical Potential to Achievable Potential.

[6] Energy Trust offers the same measures throughout Oregon because this is a more effective and efficient approach to delivery than offering slightly different portfolios of measures for each utility. This is particularly important to ensure effective engagement of contractors, distributors and retailers who work across multiple utility service territories.

Electric and Advanced Mobility
Board Learning Paper

Prepared by Jeff Allen, Jay Ward, Spencer Moersfelder, Becky Engel
February 2018

EnergyTrust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by the Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020 – 2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. **These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.**

Introduction

Energy efficiency is the cleanest, cheapest and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering that resource. Transportation is a topic pertinent to Energy Trust because transportation is the largest source of energy use and greenhouse gas emissions in Oregon[1],and is undergoing dramatic transformations that hold the promise of dramatic efficiency increases.

Transportation consumes an extraordinary amount of energy in Oregon. In 2017, Oregon's roughly 3.2 million passenger vehicles travelled about 36 billion total miles. That travel consumed approximately 1.4 billion gallons (170 trillion BTUs) of gasoline in 2015. To put this in perspective, that is the equivalent of 49.8 billion kWh or 5,685 aMW. For context, Energy Trust of Oregon-supported projects saved and generated 728 aMW from 2002-2016. Other forms of transportation, such as trucking, freight and aviation, consumed additional energy. Overall, in 2015 transportation emitted about 37 percent of Oregon's carbon dioxide emissions.[2] Americans spend about $1.4 billion per day on

gasoline and diesel for on-road use (versus $1 billion per day on electricity). Oregon drivers spend over $3.8 billion per year for gasoline.[3]

Internal combustion vehicles are only about 25 percent efficient in translating the energy content of gasoline into motion. An electric vehicle (EV) is about 60 percent efficient, consuming 70-80 percent less energy per mile.[4] According to the Northwest Energy Coalition, "EVs can be thought of as just another energy-efficient appliance, like an LED bulb or a heat pump."[5] Electric and advanced mobility offer dramatic efficiency opportunities. As illustrated in Figure 1, even a five to ten percent adoption rate of EVs could save more energy than current regional electricity conservation plans. Electric vehicles also offer the potential to accept excess renewable energy off peak, feed that energy back to the grid at peak times and offer other grid services.

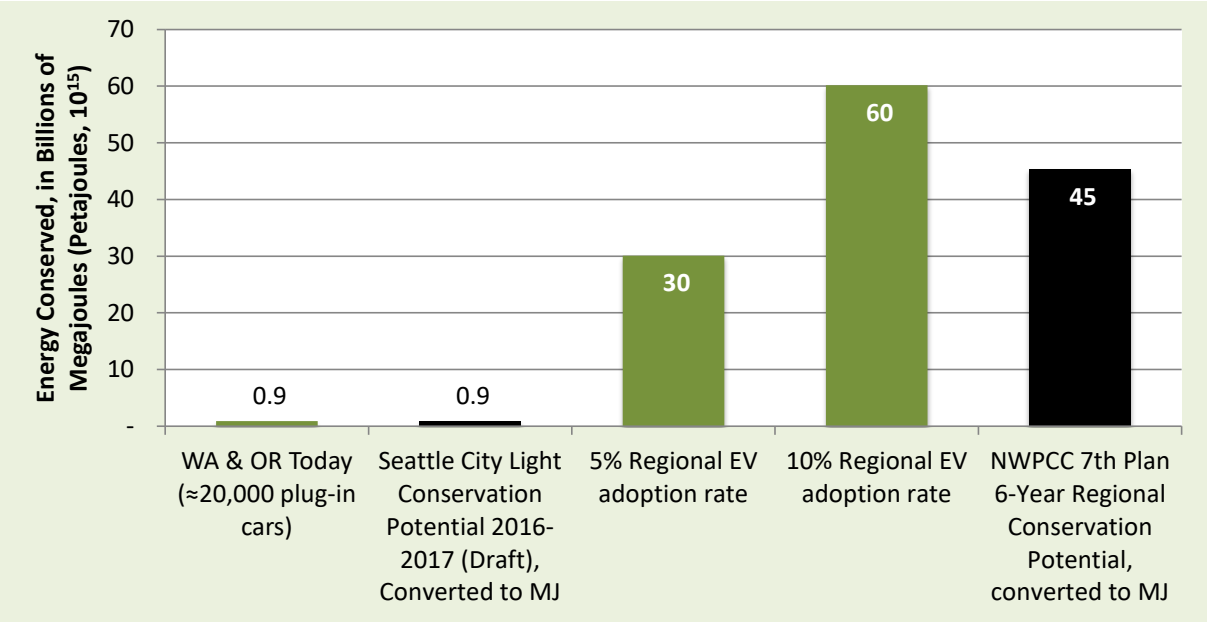

Figure 1: Relative Conservation Potentials (in Joules) From EVs and Current Utility Sector Conservation Programs[6]

Transportation electrification has the potential to be one of the most the most significant societal energy changes, but there are other autonomous, connected, electric and shared technologies (often referred to as "ACES") that could dramatically reduce energy use and carbon pollution from transportation. For example, the average American car today is parked over 90 percent of the time, and has an average occupancy of just 1.08 people when it is driven, yielding a "capacity factor" of well under 2 percent.[7] ACES

technologies could allow vehicles to be used more hours in a day, carrying more passengers per trip, increasing vehicle capacity factors and reducing energy consumed per passenger per mile.

The transformation underway in mobility creates significant energy opportunities, and brings utilities and the transportation sector together in new and disruptive ways. This paper briefly discusses these disruptive trends and technologies; describes the current and projected future deployment of these technologies in Oregon; and identifies opportunities where coordinated interventions by stakeholders will be required to ensure positive outcomes for energy efficiency and society at large.

Transportation Electrification and Electric Utilities

Transportation electrification will have impacts on electric utilities. Utilities can expect a 13 percent to 40 percent increase in electricity consumption among households that own an EV that is charged at home and driven 5,000 to 15,000 miles a year.[8] Over 75 percent of charging happens at home overnight, which can benefit utilities by flattening the load curve. Conversely, EVs also could increase afternoon peak loads as drivers come home and plug in. However, unlike lights or air conditioning, EV drivers have little preference about when energy is flowing to the car, as long as charging is complete by a certain time. All vehicles, and most chargers, offer options for delaying or managing the time of charging.

Studies also have shown that widespread EV adoption will have little to no effect on generation, transmission or distribution systems. For example, a report by Southern California Edison, home to 12 percent of the nation's EVs, found that grid impacts in its service territory were modest (only one percent of upgrade work), despite the fact EVs may tend to cluster in specific neighborhoods.[9]

In fact, most evaluations related to the rate impacts of EVs show that increased EV adoption will put downward pressure on rates by increasing the utilization of the system and spreading fixed costs. As shown in Figure 2, a modeling study in California found that additional revenue from EV charging exceeded the marginal costs to deliver

electricity to the customer, providing positive net revenues of several thousand dollars per car.[10] Studies in Washington State found similar, yet more modest, benefits. A national study recently completed by MJ Bradley & Associates for CERES found a payback of more than three-to-one to customers for utility investments in transportation electrification.[11]

Overall, electric utilities have much to gain from transportation electrification. Consumers also expect utilities to be involved in this space. A survey of consumers conducted by the Edison Electric Institute found that almost two-thirds wanted their electric utility to take a leadership role in encouraging a shift toward electric transportation.[12]

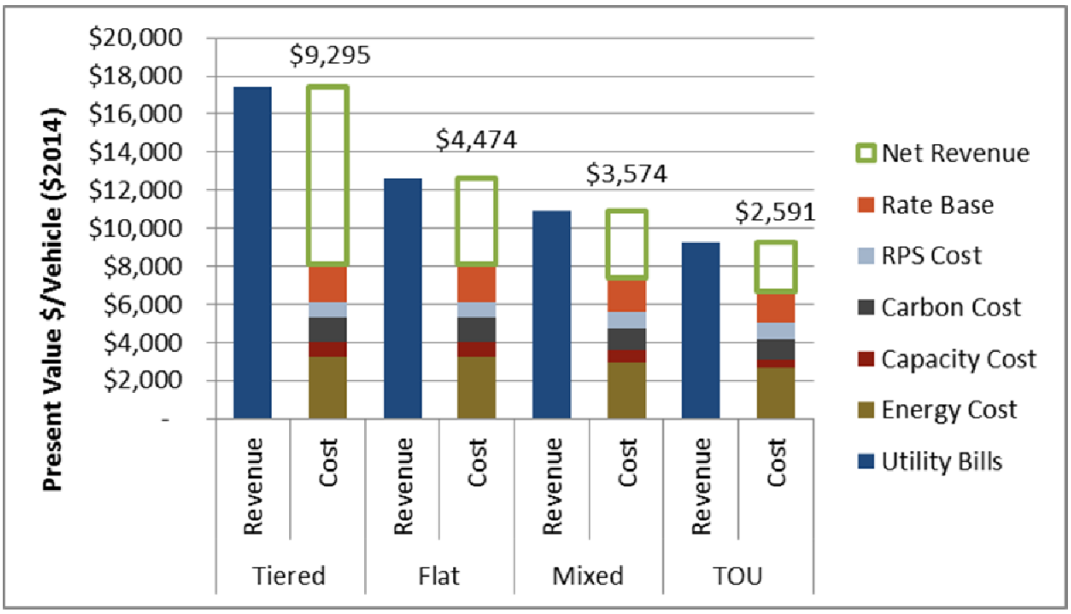

Figure 2: Ratepayer Costs and Benefits in Several Rate Scenarios in Present Value per Vehicle[13]

Transportation Electrification is Evolving Quickly

Electric vehicles offer dramatic energy and environmental benefits for both electric utilities and society. They produce no tailpipe air pollution, thus improving air quality in population centers. Depending upon the generation resource used to charge them, EVs can also dramatically lower carbon pollution compared to gasoline cars. The Union of Concerned Scientists estimates that electric vehicles powered by Pacific Northwest utility electricity achieve the equivalent of driving a gasoline car that gets 75 miles per

gallon – if such a thing existed. EVs also produce fewer contaminants (oil, coolant, etc.) thereby reducing pollution in storm water runoff.[14]

While they are currently more capital-intensive, electric vehicles are far cheaper to operate. For example, powering a car with electricity in Oregon is roughly equivalent to buying gas for $0.97 a gallon.[15] Driving on domestically produced electricity reduces spending on foreign oil. On average, a dollar saved at the gas pump and spent on the other goods and services that households want creates 16 times more jobs.[16]

Modern EVs only became widely available in 2011, but sales have been increasing rapidly. Cumulative U.S. EV sales hit 500,000 in August 2016, with over 16,000 electric vehicles registered in Oregon. Worldwide EV adoption rates are projected to climb steadily, and Morgan Stanley expects EVs to account for between 10 and 15 percent of the American new car market by 2025. These bullish EV adoption projections are driven, in part, by a dramatic fall in the cost of lithium-ion batteries used to power EVs.

In Oregon, EV sales are poised to double by 2020 aided by state and federal investments and policies. For example, SB 1547, passed in 2016, requires Oregon's investor-owned utilities to develop transportation electrification plans. Both Portland General Electric and Pacific Power have developed and submitted modest initial plans and have reached proposed settlement agreements that would inject approximately $9 million into charging and other EV programs over the next three to five years. Oregon also passed legislation in 2017 that will create a $2,500 point-of-purchase rebate for new EVs, and an additional $2,500 for lower income drivers that can be applied to used EVs.

Research shows that offering a point of purchase rebate is the best way to motivate consumers to purchase EVs[17] and sales are expected to climb when the rebates take effect in 2018. Oregon and California are among eight states that have adopted a binding Zero-Emission Vehicle mandate that requires automakers to sell increasing numbers of electric vehicles. Oregon Governor Brown has set a goal that all new vehicles sold will be electric by 2050. Additional investments in electric vehicle charging are coming to Oregon through Volkswagen's diesel settlements. Those settlements

commit Volkswagen to invest $2 billion nationally over the next ten years in EV charging infrastructure[18] and distribute $72 million to Oregon for clean air projects including transportation electrification.

Autonomous, Connected, Electric and Shared (ACES)

The electric vehicle revolution is coming simultaneously with two other revolutions in mobility: autonomous and connected vehicles, and shared mobility. Figure 3 illustrates these possible scenarios. These ACES technologies are attracting billions in investment from major automakers and from technology firms like Alphabet (Google's parent company) and Uber. A recent UC-Davis report projects a limited rollout of driverless vehicles through the early 2020s, followed by mass-market rollouts in 2025.[19] Although there are many uncertainties, if all three of these technical revolutions are embraced, the initiatives could cut global energy use from urban passenger transportation by more than 70 percent and reduce the number of vehicles by up to 99 percent.[20]

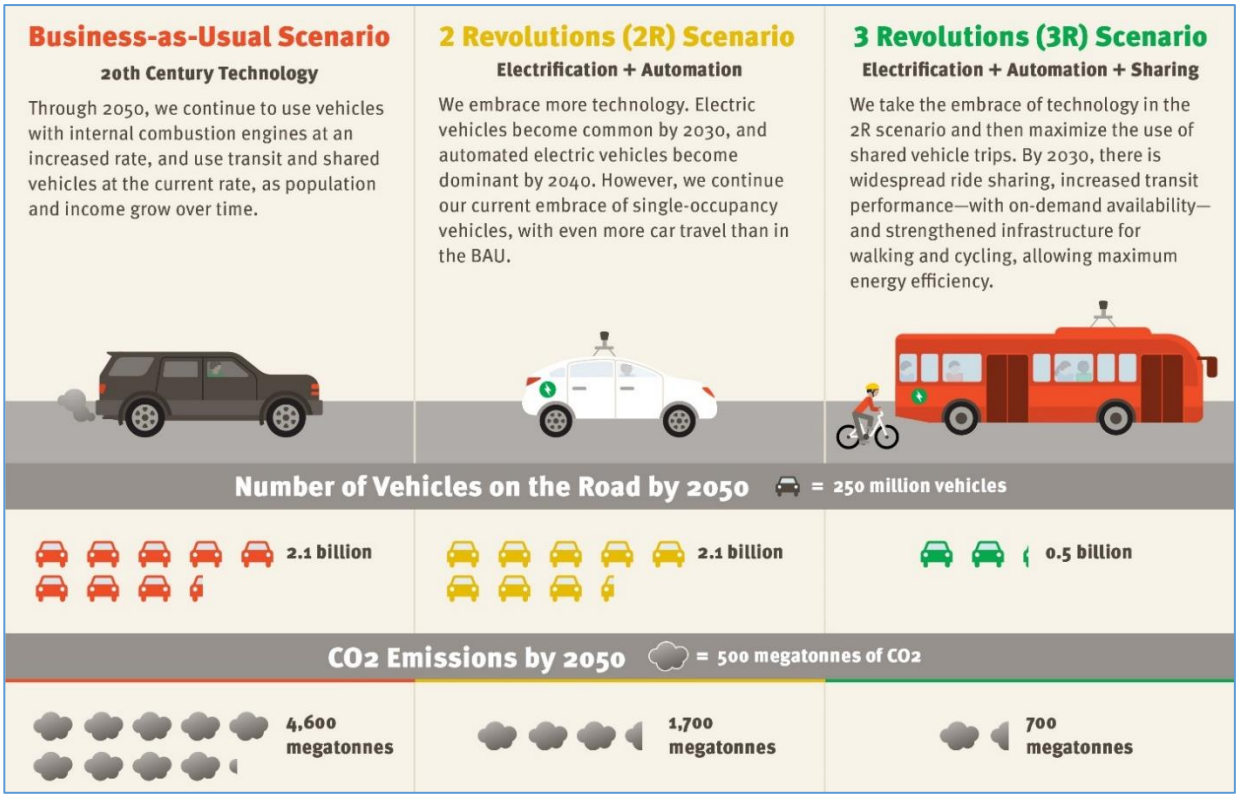

Figure 3: Potential Impact of Electrification + Automation + Sharing "Revolution" [21]

Transportation Electrification Opportunities

There are many stakeholders in the EV market, as outlined in Figure 4, and there are many areas where market intervention will be required to maximize public benefits. In most cases, it is not clear which stakeholders will own these key areas of work. Several of these areas are of particular relevance to the Energy Trust of Oregon.

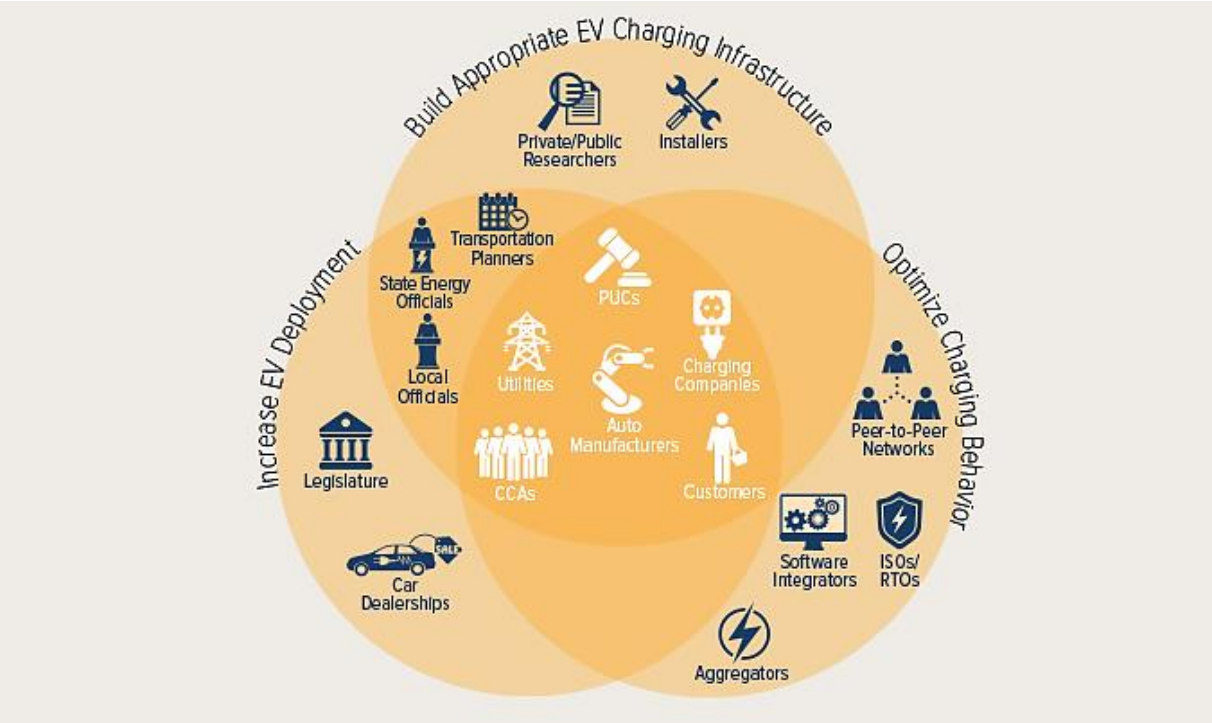

Figure 4: Areas of Intervention in the EV Market and Key Stakeholders[22]

I. Integrating EVs into Existing Efficiency and Renewable Programs

Many existing energy efficiency and renewable energy programs address transportation electrification and appeal to similar markets and consumers. Over time, these programs could better integrate transportation and electric vehicles in several ways. For example, some charging equipment is more energy efficient, and the ENERGY STAR® program has recently begun evaluating chargers. Because electricians and technicians are already on site upgrading and installing other systems, the best and least expensive time to add EV charging is during new construction or renovation. Implementing energy efficiency measures, can also free up capacity in existing homes or buildings for EV charging. Existing energy efficiency programs could leverage the opportunity to educate

and better inform customers about EVs, and how best to integrate charging into home and energy improvement projects. For solar installers, this is also an opportunity to "upsize" the solar system, sell additional equipment and create cross-marketing opportunities among market actors.

A PV solar system can also enhance EV benefits by decarbonizing the electric charging resource and helping to flatten the vehicle's demand curve. Consumers that add electric vehicles may reap more benefits (and a faster payback) from their solar array, and utilities could reduce costs for net-metered systems if customers consume more electricity on-site.

II. Making Charging Smarter

Promoting charging at off-peak times is the best way to maximize financial and grid benefits to electric utilities. Managed or "smart" charging programs are designed to control the times and associated rates when customers charge. Additionally, smart charging may include having vehicle batteries that serve as a dynamic demand response asset, that discharge energy back to the grid (Vehicle-To-Grid or VTG), or that provide other ancillary grid services such as frequency regulation. Managed or smart charging may use a combination of consumer education and marketing, time of use rates and even "gamification" strategies. These programs can even include real-time pricing transactions by customers, the utility, the charging provider or an automated system to better integrate renewables and maximize grid benefits. However, managing charging first requires a basic understanding of the different types of charging available to EV drivers.

Simply plugging the EV in to a standard 120V wall socket and using the vehicle's built-in converter is called "Level 1" charging. Level 1 charging takes eight hours or more to charge a fairly small-capacity EV battery. More than 75 percent of charging takes place at home, and roughly half of EV drivers manage with Level 1 charging. That share also is increasing. The fact that Level 1 charging is easy, cheap and available nearly

everywhere can help convince consumers to try electric vehicles. However, Level 1 charging is less energy efficient and makes smart or managed charging more difficult.

Dedicated charging equipment using a 240V outlet is referred to as “Level 2” charging. Residential Level 2 chargers on average cost about $600 and provide a reasonably fast charging option. However, many drivers are discouraged from upgrading to Level 2 charging by the soft costs of choosing equipment, finding a qualified electrician, getting an installation estimate, etc. Some utilities are working to streamline the process for customers by creating lists of approved equipment and trusted installers, but these efforts are slow and scattered.

Direct Current Fast Charging is limited to public and commercial settings, because installations can cost $100,000 or more. These fast chargers generally operate at 50kW currently and give EV drivers the ability to charge quickly while on a longer trip, or if daily plans change. Direct Current Fast Charging is critical for the industry to achieve a number of milestones, including increasing consumer confidence, enabling drivers to travel long distances, and the ability to use EVs in shared applications such as taxis or Uber rides. However, these installations represent a substantial power draw and will not be profitable until substantial numbers of EVs are using them. Historically, demand charges alone constituted well over half the cost of operating a fast charger. (The mismatch between charging and vehicles is a broader concern, sometimes referred to as the “hot dog and bun” dilemma.[23]) Close coordination with utilities can help reduce the need for transmission and distribution investments, reduce other soft costs and manage demand charges and other rate issues.

EV charging is poised to get smarter in the coming years, in line with broader trends towards demand response and a smarter grid. Vehicle-To-Grid technologies designed to enable the bidirectional flow of energy between the EV and the grid have already been proven in several small pilot projects. This grid interaction could support utility demand response and provide ancillary services to a grid operator, such as frequency regulation. There are also demonstration projects underway that deploy used EV

batteries to store renewable energy and provide grid services. These technologies are constrained mostly by programmatic issues, such as automaker battery warranties and utilities that see more immediate demand response opportunities rather than by technical limitations. It will take a combination of stakeholders to identify and overcome these barriers to ensure that EVs and charging infrastructure is ready for the future.

III. Leveraging Public Fast-Charging Installations

As it becomes increasingly clear that drivers expect to be able to fully charge their EVs quickly and conveniently, fast-charging installations are getting faster, larger and more complex. As opposed to early installations that might have a single 50kW plug, newer fast-charging installations are expected to provide 150kw or even 350kw capacity and include a half-dozen plugs. These fast-charging installations more often are incorporating on-site solar or wind generation and battery storage, primarily to reduce utility demand charges.

These large fast-charging installations with 1MW+ of load, onsite generation and integrated storage increasingly resemble micro grids that could provide a range of benefits beyond charging electric vehicles. These installations could provide grid benefits and strengthen the resilience of local communities during emergencies. For example, these installations could be used to charge emergency vehicles, pump liquid fuel, support key infrastructure like hospitals or for other critical needs. However, current market participants generally are not pursuing these opportunities. More work needs to be done to identify and document the benefits of these fast-charging “micro grids.” Some combination of stakeholders then will need to work together to plan and implement strategies to maximize these benefits.

IV. Engaging Consumers

Cost competitiveness alone will not be enough to drive consumers to shift to a dramatically new product, particularly with an emotionally charged purchase like a car. It will take a range of dedicated marketing and educational initiatives, from traditional

marketing to social media to providing convenient opportunities to test-drive EVs. At a minimum, consumers need credible information about electric vehicles and electric vehicle charging. Recent research shows that most consumers – even in high penetration markets like California – are unaware of the growing number of EV makes and models or the increasing availability of public charging facilities.[24]

No single entity currently owns the responsibility for this educational work, or for rigorous analysis of which interventions are most cost-effective. Individual automakers are focused on selling their own models, and EVs are not yet profitable. Some argue that electric utilities are in the best position to motivate massive numbers of consumers. This argument is based on the belief that electric utilities have much to gain from increased electricity sales, and because, as previously noted, utility customers want them to take a leadership role in encouraging a shift toward electric transportation.[25] However, dozens of utilities in Oregon acting independently and across service territories are unlikely to produce a collaborative communication strategy. Therefore, public-private partnerships will be critical to accelerate market transformation.

V. Encouraging Heavy-Duty Electrification

Electrification and ACES disruptions also are impacting a range of transportation modes and vehicles beyond private passenger cars. Electric transit buses increasingly are cost-competitive, for example, and systems in Los Angeles, Seattle and ten other global cites have pledged to go 100 percent electric with their transit fleets.[26] Electric school buses currently are being tested in several districts around the country, and like transit buses, are quickly reaching price parity. Forklifts, yard haulers, bucket trucks and other kinds of industrial equipment increasingly are being electrified to capture fuel savings, reduce health and environmental impacts and promote safety (for example, quiet electric motors safeguard against miscommunication between workers). More recently, Daimler Trucks and other companies have launched initiatives to compete with Tesla for producing electric, automated long-haul trucks.

Heavy-duty electric vehicles tend to use far more electricity than passenger cars, to operate on more predictable duty cycles, and to be managed by a smaller number of

commercial or industrial enterprises. These characteristics make them even more attractive than passenger cars for the kind of managed or smart charging programs discussed previously. These vehicles also create opportunities to broaden economic and other benefits of transportation electrification to reach more communities. For example, electric mining and industrial equipment can reduce manufacturing costs; electrified and semi-autonomous agricultural equipment can reduce cost for labor-intensive agricultural producers like nurseries; and electrifying buses can improve health outcomes for low-income populations.

So far, both public policy and utility programs in Oregon have focused more on passenger vehicles than on heavy-duty vehicles.[27] More work is needed to promote and support investment in heavy-duty electrification, to evaluate the return on investment, to develop and promote financing tools, and to share the results of pilots with others.

VI. Fostering Equity

Electric and advanced mobility technologies will tend to flow first toward their most profitable applications, not necessarily toward the ones where they are most needed, will save the most energy or yield the most utility system benefits. Low income and traditionally underserved communities tend to suffer the most from the health impacts of air pollution, as well as the economic impacts of limited mobility options. For most families, transportation is the second highest household expense. For rural and low-income families, it is often the first. Furthermore, low-income families tend to rely on older, less efficient vehicles and often live further from job opportunities. Low income consumers also face multiple barriers to adopting new technology, from limited access to credit, higher likelihood of living in apartments or remote locations where charging is difficult, and a lack of culturally appropriate marketing.

Electric vehicles could save more energy, and provide social and utility benefits, if low-income consumers can gain access to them. However, it is not clear how different stakeholders will work together to achieve this goal. For example, many utility regulatory filings simply agree that 10 to 20 percent of charging installations must be placed in low-

income communities and neighborhoods. That is inefficient and can even be counterproductive, by simply speeding gentrification without benefit to current residents. A number of pilot projects are demonstrating models that could be replicated, but these all rely on third party financing (e.g. from state carbon offset funds in California, or foundation funds in Oregon) and are generally driven by nonprofit organizations.

Hydrogen Fuel Cell Electric Vehicles

Fuel cell buses have been available for some time, and fuel cell cars have become available for individual purchase in California and select other markets in the past few years. Fuel cell electric vehicles can be thought of as a specialized form of electric vehicle that uses hydrogen (rather than a battery) for energy storage.[28] Hydrogen has the advantage of providing more energy density and range, but hydrogen-fueling infrastructure is expensive (several million dollars per station) and presents an even larger challenge than electric car charging, since there are no options for home fueling.

Just as the technology used to produce electricity has a substantial impact on the net energy and climate benefits of battery electric cars, the methods used to produce hydrogen are key to evaluating fuel cell vehicles. Much of the current hydrogen being used for vehicles is produced from natural gas, with few efficiency benefits. Longer term, however, hydrogen could be produced from otherwise surplus renewables, or from renewable natural gas. [29] This could potentially be stored directly in the natural gas infrastructure. Pilots are underway in Germany, California and Ontario, with early work underway to develop a pilot in the Pacific Northwest.

Many automakers view fuel cells as part of the long-term strategy for fully decarbonizing transportation, and some are more bullish on the technology. However, dropping battery prices has made battery-electric and plug-in hybrid vehicles the frontrunner technologies in the short term. Automakers are prepared to bring hydrogen vehicles to Oregon as soon as the fueling infrastructure is available. However, no entity yet has stepped forward to invest in that infrastructure, and therefore the path forward remains unclear.

Natural Gas Vehicles

Natural gas, typically in compressed form, is another prominent alternative to gasoline or diesel. For some time, compressed natural gas has been the best alternative fuel for heavier or medium duty vehicles, which would otherwise burn large quantities of diesel. Natural gas has been quite cost-competitive recently due to relatively low prices, and can reduce greenhouse gas emissions and air pollution substantially. The currently available Cummins Westport “Near Zero” engine reduces air pollution by 90 percent compared to diesel, for example. Like electric vehicles, natural gas vehicles also offer resiliency benefits to fleets and local communities, and tend to keep more resources circulating in local economies.

While the infrastructure to compress natural gas and fuel vehicles has been slow to develop, and has served as a barrier to wider adoption, recent innovations have created disruption and opportunity. First, Oregon startup company Onboard Dynamics has developed a portable compressor that reduces costs[30] and produces renewable natural gas as a byproduct of organic sources (e.g. from digesters at waste water treatment plants, dairy farms, food waste, etc.). This example offers a promise of carbon-negative emissions. Furthermore, this fall, the Oregon Department of Energy is expected to release a study evaluating the quantity of renewable natural gas available, barriers to its development, and recommendations for the future. On the policy front, gas utilities such as NW Natural and utility regulators have begun to engage more significantly to support adoption of natural gas vehicles.

About Energy Trust of Oregon

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Terminology and Definitions

ACES- Autonomous, connected, electric, and shared vehicles.

EV – Electric Vehicle. A vehicle that uses one or more electric motors for propulsion.

BEV - Battery Electric Vehicle—also referred to as an all-electric vehicle. A vehicle that solely uses an electric engine for propulsion.

PHEV - Plug-in Hybrid Electric Vehicle. A vehicle that contains both an ICE engine and an electric engine, which can be recharged by plugging it into an external power source.

ICE – Internal Combustion Engine. An engine that heats a fuel with air to cause a reaction that creates a force that moves a vehicle over a distance. A traditional gas-powered car is considered an ICE vehicle.

ZEV – Zero-Emissions Vehicle. A vehicle that emits no emissions - which are generally carbon dioxide, water and nitrogen. A BEV, like the Nissan Leaf, would be considered a ZEV.

Fuel Cell Electric Vehicle (FCEV) – A type of electric vehicle that uses fuel cell technology. Fuel cells convert chemical energy from a fuel into electricity (usually from a reaction of Hydrogen with Oxygen.)

Level 1 AC Charging – The slowest form of charging, which uses a plug to connect the vehicle to a standard household 120V outlet at 1.4 or 1.9 kW and uses the on-board vehicle charger to convert AC to DC power to charge the car battery.

Level 2 AC Charging –Uses EVSE to provide power using a 240V outlet up to 19.2 kW and uses the on-board vehicle charger to convert AC to DC power to charge the car battery.

DCFC – Direct Current Fast Charge –also called Level 3 charging. This is the fastest form of charging, as it bypasses on-board charging. Not available for residential use.

EVSE - Electric vehicle supply equipment. A unit that supplies electricity to recharge an EV. (Also called a charger, although this is a misnomer as it is truly just a means by which electricity flows from the outlet to the EV.)

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Expanded Goals to Support Energy Savings and Generation

Prepared by Debbie Menashe and John Volkman
April 2018

Energy Trust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by the Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020-2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. **These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.**

Introduction

Energy efficiency is the cleanest, cheapest and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering on that resource.

At the 2018 strategic planning retreat, the board will begin to discuss direction for the next Energy Trust strategic plan. Planning efforts are informed by, among other things, projections of the long-term energy efficiency resource, implications these projections may have for Energy Trust as an organization, and information provided to the board through these board learning topics. Additionally, at the recent board training on strategic planning processes, Holly Valkama of 1961 Consulting presented some basic considerations for strategic planning. This training provided some initial groundwork and terminology for strategic plan development in the coming year.

Currently, energy savings and generation goals guide Energy Trust. These goals are basically quantitative targets set by the board and are influenced by OPUC performance metrics and utility IRPs. In addition to these savings and generation goals, Energy Trust is in a position to consider whether there should be other goals related to the support of ratepayer benefit and administration of the public purpose charge.

This paper aims to kickoff and support any board discussion of potentially different or additional goals for the upcoming strategic plan development by outlining:

- Lessons learned from the establishment of recent goals beyond quantitative energy efficiency and renewable energy,
- Goal-setting best practices,
- Examples of how other organizations have developed strategic plan goals and considerations for measurement, and
- Examples of other outcome-based goals.

Based on the 2018 retreat discussion, staff will work with the Strategic Planning Committee to structure a process to define potential goals or objectives for the 2020-2024 strategic plan. The board will receive updates about potential goals periodically and will consider draft goals during the 2019 strategic planning retreat.

Discussion

A. Lessons learned in expanding goals to date

For the first time in the 2015-2019 Strategic Plan, Energy Trust's board approved two "Operations" goals beyond energy savings and generation:

Five-year operations goals

- Align internal operations and management to efficiently support Energy Trust strategic goals and objectives, optimizing resources and systems and maintaining an effective, open, transparent and accountable business.
- Sustain a culture of highly engaged staff.

Unlike the energy goals, which have been part of every Energy Trust's strategic plan, the Operations goals focus on outcomes and do not have specific quantitative markers. Following the 2015 Management Review, Energy Trust engaged in a series of process-mapping exercises to identify measurable indicators for the Operations goals. The exercises focused on process including ISI, incentive processing and customer service. Identifying meaningful objective, quantifiable markers for the operations goals proved difficult and labor-intensive. Therefore, instead of measuring success by quantitative markers, Energy Trust reports progress according to whether specific tasks have been accomplished. It is unclear if these progress indicators are sufficient to assist the board in measuring whether the organization is on track to achieve the Operations goals.

In an organization like Energy Trust where the focus is squarely on accomplishing the quantitative conservation and generation objectives, the experience in measuring and reporting progress on the Operations goals has been frustrating and not well understood across the organization. If Energy Trust sets strategic goals in addition to quantitative savings and generation in the next strategic plan, **board and staff should consider the tradeoff between the need to define difficult-to-measure aspects of the mission and the challenges that this can bring.**

Goal-setting best practices. Strategic plans typically use a combination of Vision, Mission and Goal statements to establish an organization's direction, role and priorities.[1] It is interesting to compare Energy Trust's current strategic plan elements to these descriptions of Vision, Mission and Goal:

> **Vision:** The best vision statements are short, clear and memorable. They paint a picture of how things would look if the organization were wholly successful, long-term. Energy Trust's 2015-2019 Strategic Plan's Vision is "a high quality of life, a vibrant economy and a healthy environment and climate for generations to come, built with renewable energy, efficient energy use and conservation."

Mission: Essentially, mission statements describe an organization's core activities. In the 2015-2019 Strategic Plan, this is stated as a Mission and Purpose statement: "Energy Trust provides comprehensive, sustainable energy efficiency and renewable energy solutions to those we serve."

Goals: The best goals say what needs to be done to achieve the Vision. Ideally, they are sufficiently defined to facilitate decisions and appropriately measurable to determine the scale of the task and whether it is being accomplished. Goals can have different timeframes.

Goals describe outcomes rather than outputs or tactics. That is, they describe a destination, leaving the necessary outputs and tactical details to the executive team and staff. Goals or outcomes[2] can be externally focused on products or development, but they can be internally focused as well. As stated above, the 2015-2019 Strategic Plan includes both quantitative energy savings and generation goals and internal operations goals.

Goal-Setting Considerations

- What's the appropriate balance of quantifiable goals and outcome-based goals, which represent difficult-to-measure aspects of the mission?
- What markers are relevant to the board to measure outcome-based goals?
- Should goals only be quantitative in nature?
- Do goals relate to Energy Trust Vision and Mission?

The elements of Vision, Mission and Goals serve two purposes. First, they provide external audiences with a clear sense of the organization's direction, role and objectives. Second, they guide the organization internally so that the organization's executive team can make decisions, formulate budgets and recruit the right people to do the organization's work. In general terms, the clearer and more compelling the Vision, Mission and Goal statements, the better.

As Energy Trust proceeds to develop its next strategic plan, a discussion about goal-setting is warranted. Terminology should be clarified and defined. Should strategic goals

be quantitative, or should there be qualitative or process goals as well? Do the goals define outcomes only, and what expectations are there for the practicality of developing measurable targets to demonstrate progress toward those outcomes?

B. Examples of how other organizations have developed goals

For context about goal-setting best practices, it may be helpful to consider how other organizations develop strategic goals that are both quantitative and outcome-based in design.

For example, Oregon Housing and Community Services (OHCS) has been engaged in strategic planning for several years. The organization uses the discipline to guide and focus its resource investment. For 2018, OHCS developed and published seven strategic planning goals. These goals describe desired outcomes for change. They are not quantifiable, but each goal is accompanied by a series of specific tactics to guide activities.[3]

In contrast, consider Proctor & Gamble's Sustainability Strategic Plan Goals. Proctor & Gamble's goals are quantitative and explicitly focused on keeping the organization "on track to one day deliver that [sustainability] vision." Proctor & Gamble tracks and reports progress toward these quantitative goals.[4]

Northwest Energy Efficiency Alliance (NEEA) identifies two outcome-based strategic goals. Though neither goal is quantifiable, each is assigned a Five-Year Success Metric for measurement towards progress.[5]

- Goal 1: Fill the energy efficiency pipeline with new products, services, practices and approaches.
- Goal 2: Create market conditions that will accelerate and sustain the market adoption of emerging energy efficiency products, services, and practices.

Examples of Other Outcome-based Goals

Energy Trust's unique role of value are its expertise and success in delivering ratepayer benefit through its administration of the public purpose charge. Nevertheless, it is possible that the board may consider other outcome-based goals in addition to quantitative energy efficiency and renewable energy goals.

For example, the board may consider goals relating to some of the board learning topics explored over the last several months, or goals relating to other areas that have been referred to in strategic planning retreats, such as:

- Carbon dioxide reduction,
- Demand management, or reduction,
- Prioritizing energy savings or generation in particular geographic markets, and
- Operational goals (e.g. diversity and equity)

This section discusses these examples and some of their pros and cons.

A. Carbon dioxide (CO2) reduction

CO2 reduction is an incidental benefit of Energy Trust energy programs, which meet demand with energy savings and renewable energy instead of energy generated with fossil fuels. These reductions are derived from Energy Trust programs, and Energy Trust reports these reductions. However, they are not, and have not to date been, identified as a strategic goal of Energy Trust programs.

In 2007, Energy Trust's Policy Committee, with OPUC and stakeholder representatives, considered whether to capture the monetary value of these incidental CO2 reductions. If Energy Trust did so, it might affect the cost of Energy Trust programs that reduce CO2. However, the Committee concluded that doing so did not make sense in the absence of a law or regulatory framework for CO2 reduction.

Oregon policymakers continue to consider legislation that would cap CO2 emissions and use revenues from emissions trading to benefit consumers and impacted

communities. If the latest version of that bill were to pass in 2019, the OPUC would establish a framework for how funding would be administered. In the meantime, without that framework, it would be difficult for Energy Trust to define a CO2 reduction goal.

B. Demand response

Energy Trust programs reduce energy consumption overall and also influence timing of energy use. Utility demand response programs seek to influence the timing of energy use, reducing demand during peak periods without necessarily reducing overall energy consumption. Demand response programs do this by controlling equipment or operations. Generating energy to meet peak demand is particularly expensive, and reducing demand at these times lowers utility costs. Demand response also can reduce the need for expensive transmission and distribution facilities.

Oregon's investor-owned utilities have primary responsibility for reducing the cost of grid operations through demand response programs, backup generation, energy storage and grid management. Energy Trust is working with utilities to find ways to use efficiency and renewable programs not only to reduce system demand directly through reduced loads and local generation, but to help utilities more efficiently and effectively reduce peak demand. If energy efficiency is considered in the demand response equation and peak management, and if Energy Trust's strategic plan identified this connection as a unique role of value, then a strategic goal around demand response could be considered by the board.

C. Diversity, Equity and Inclusion goals

In 2018, Energy Trust established a Diversity, Equity and Inclusion (DEI)) Operations Plan. This Plan contains ten DEI goals, some that are objective and quantifiable, and others that are process-oriented. The DEI goals are in service to Energy Trust's need to expand participation in conservation and generation programs, especially among potential customers who may not have been served by Energy Trust programs. With forecasts for energy efficiency resources trending downward, it is essential that Energy Trust reach all customers to capture all potential conservation resource. As such, the board could consider whether DEI goals should be included in some manner in the next Strategic Plan.

D. Goals prioritizing energy savings or generation in particular markets

Energy Trust programs currently identify objectives to achieve broad energy conservation or renewable energy goals, but it could establish goals that are more specific to subsets of the market. For example, Energy Trust is running geographically targeted pilot programs with PacifiCorp and NW Natural to avoid costly upgrades or investments in the local electric and gas distribution system. The organization could also identify other energy saving and generation objectives based on market penetration, for example a specific percentage of new buildings in the new construction market (thereby avoiding lost opportunities) or targeted adoption rates of a specific technology in the small or medium business sector or established participation rates by particular customer groups such as low-income or rural customers. Such objectives could be viewed as part of each program's planning to meet broader energy goals. Alternatively, the board could elevate one of these areas by identifying it as a goal with a quantitative metric within the Strategic Plan.

Summary/Conclusions

Strategic goals can be powerful tools to focus both internal and external stakeholders on an organization's strategic direction. As Energy Trust proceeds into development of its next strategic plan, a discussion about goal-setting is warranted. Lessons learned from the operations goal in the 2015-2019 Strategic Plan are instructive. For the 2020-2024 Strategic Plan, Energy Trust should engage in focused and intentional goal-setting development. This process could consider goals beyond quantitative energy efficiency and renewable generation goals to identify and focus the organization on strategic capabilities that support these resource acquisition goals and objectives.

However, terminology and goal structure should be clarified and defined. Specifically, the organization should consider whether it will only define goals that are quantitatively measured, or whether goals can also be defined with qualitative or process-oriented measurement targets. It may be instructive to consider how other organizations develop strategic goals.

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[1] Terminology differs. In the April 4, 2018 Strategic Planning Training at Energy Trust, Holly Valkama identified the following as typical and possible elements of a strategic plan: Vision, Mission/Purpose, Unique Role of Value, Organizational Values, Objectives, Strategic Initiatives. Clarity around terminology will be important for a better understanding of strategic goals for the next Energy Trust strategic plan.

[2] ibid

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New Opportunities from Data
Board Learning Paper

Prepared by Scott Clark, Andy Griguhn, Erika Kociolek, Golnaz Moini, Alex Novie, Heidi Redfield and Rob Strange
April 2018

EnergyTrust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020-2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.

Introduction

Energy efficiency is the cleanest, cheapest and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering that resource. Data is pertinent to Energy Trust because it is used to track, report on and evaluate its work. Acquiring additional data, as well as finding new and innovative ways to leverage existing data, can help Energy Trust better serve customers and save energy.

This paper is divided into four sections:

- Section I describes several broad trends in data that are important and salient for the energy industry;
- Section II summarizes trends specific to the energy industry;
- Section III provides an overview of the current state of data at Energy Trust, and describes planned work related to data in 2018 and 2019; and
- Section IV describes potential new opportunities related to data in 2020 and beyond.

I. Trends in Data

This paper is focused solely on **data**. Data represents and quantifies properties of real-world phenomena. Examples of data include the square footage or energy consumption of a building. Data is needed to get any insight, but it would be difficult for an average person to gain insight from looking at, for example, thousands of records of building square footage. Data needs to be organized and analyzed so that it yields meaning. Analyzed data is considered **information**, which can answer questions such as, what buildings consume the most energy in the 97204 zip code? **Knowledge** often requires multiple types of data and information and requires analytical thinking about the information obtained to make sound conclusions. Knowledge can answer questions that are predictive and forward-looking, such as, what is the expected electric demand for the 97204 zip code over the next 10 years? Once knowledge is acquired, then one can gain **wisdom**. Wisdom is not necessarily proven. It can be applied to situations where no data is readily available - for example, how can new emerging energy efficiency technology help lower the demand of energy in the businesses and residents in 97204 zip code?

As shown in Figure 1 below, data, information, knowledge and wisdom build on each other to form a hierarchy. The fundamental piece to the hierarchy is data that is managed properly and invested in to ensure that it is accurate, precise, and organized in a manner such that it can be consumed for a wide range of analysis. When the data is good quality, it can be used over and over again to create a myriad of information.

Figure 1. Data, information, knowledge and wisdom hierarchy1

The current information age is characterized by rapid technological advances and staggering amounts of data. According to one estimate, in 2013 ninety percent of the data in the world was created in the prior two years.[2] Technological advances have increased the amount of data that exists. Advancements also have enabled the collection, storage and analysis of data. While there are many broad trends in data that could be discussed, this paper will focus on three interrelated trends that are particularly important and salient for the energy industry: big data, internet of things and artificial intelligence and machine learning.

Big Data

The current expanse of data is often labeled "big data." IBM scientists characterize big data by any or all of three "V" words: volume, variety and velocity.[3] Volume is relatively straightforward, but variety and velocity merit some explanation. In this context, "variety" refers to different types of data, ranging from structured data (e.g., meter readings, survey responses, etc.) to unstructured data (e.g., tweets, images, etc.). "Velocity" refers to the frequency with which data is collected. The promise of big data is the potential to use it to gain insights and intelligence.

Internet of Things

Recent, rapid technological advances have contributed to a growing number of "smart devices." Such devices contain sensors, are internet-connected and have the ability to communicate and interact with each other and with other systems. Smart devices themselves, as well as the systems that support and connect to them, are referred to as the "internet of things". These ultra-connected devices contribute to the growth of big data.[4] A 2014 Forbes article imagines what a future of the internet of things could look like:

> "Say for example you are on your way to a meeting; your car could have access to your calendar and already know the best route to take. If the traffic is heavy your car might send a text to the other party notifying them that you will be late. What if your alarm clock wakes up you at 6 a.m. and then notifies your coffee maker to start brewing coffee for you?"[5]

A key challenge is interoperability of equipment and systems; currently there is no market standard to ensure smart devices can communicate and interact. In addition, privacy and security are key challenges. Data gathered from smart devices can contain, or could be used

to infer, private information that users do not wish to be made public. Furthermore, smart devices and systems appear to be vulnerable to hacking.

Artificial Intelligence & Machine Learning

Artificial intelligence refers to technologies that enable machines to replicate human intelligence in terms of learning, evolving and decision-making absent human intervention. The advent of big data, as well as technological advances enabling data collection, storage and analysis, have allowed machines to access large volumes of data. In turn, machines can analyze data to identify patterns and learn ("machine learning").

Companies currently use machine learning in a variety of ways. For example, credit card companies use machine learning to proactively identify potential fraudulent charges and contact customers for verification. Ride-sharing companies use machine learning to estimate arrival times for customers and assess optimal pick-up locations.

II. Energy Industry & Data

The trends described in Section I also apply to the energy industry. However, there are several additional trends specific to the energy industry that are important to mention. This section first summarizes the current state of data in the energy industry, and then identifies emerging trends.

A. Current State

- **The collection of more granular usage and consumption data through advanced metering infrastructure (AMI). "**Smart meters" (meters that record hourly or sub-hourly energy consumption and quickly relay that information back to the utility for billing) are not new. PG&E first started installing them in 2006. By 2012, the three largest investor-owned utilities in California had almost fully deployed smart meters. In Oregon, PGE has almost fully deployed smart meters, while Pacific Power is in the process of deploying smart meters and expects to be fully deployed by the fall of 2019.[6]
- **Utility investments in IT systems to manage billing and customer engagement.** Utilities are moving from outdated billing systems to more advanced systems called customer information systems (CIS) or customer care and billing (CC&B) systems. These systems enable utilities to better segment customers, which in turn enable the

utility to deliver both traditional services (bill pay, outage reporting, etc.) and new services to customers.[7] These systems can support personalized, self-service portals that aggregate services in a single, customer-centric online marketplace.[8] Many of these portals integrate smart meter data where available.[9]

- **Investments in data and analytics services for demand-side management (DSM) program planning.** DSM program administrators strive to accomplish a variety of objectives, such as customer engagement, customer segmentation and targeting, campaign tracking, energy benchmarking, load disaggregation and program evaluation.[10] To reach these goals, program administrators have begun investing in and integrating data systems and tools. Some investment is internal, while some investments are for products and services provided by vendors such as Oracle (formerly Opower), EnergySavvy, Bigdely, FirstFuel and TROVE. These vendors' business models are often based on a software-as-a-service (SaaS) fee structure rather than a time and materials structure. SaaS vendors are less reliant on consulting hours and more focused on data processing and analytics products that have a component of self-service access for their clients.[11]
- **Real-time evaluation.** For a variety of reasons, evaluation has significantly lagged behind program implementation. This delay disappoints those eager to shape program design and optimization using insights and information about impacts. In recent years, there has been a push for more real-time, automated, and ongoing evaluation, sometimes referred to as M&V 2.0. Vendors such as EnergySavvy and Open EE Meter have developed products and services designed to rapidly analyze large amounts of data and estimate energy savings using data in monthly, daily, hourly and 15-minute increments. Early studies have shown that the energy savings estimated by these products and services align with those estimated using traditional billing analysis approaches. The difference is that these evaluation products and services can do so on a much quicker timeline. Currently, these products and services have not fully replaced traditional billing analysis approaches, although they could in the future, if approved by regulators.
- **New and expanding program designs.** Energy efficiency programs are investing in and scaling program designs that require data and analysis. Examples include pay-for-performance, retro-commissioning and strategic energy management. Programs are

also leveraging vendor-provided products and services such as thermostat setback and demand response programs provided by Nest, and personalized energy reports provided by Oracle (formerly Opower), FirstFuel, Simple Energy and others.

- **Growth in building energy management systems (EMS), energy management information systems (EMIS) and other smart devices.** There has been a proliferation of EMS and EMIS to manage and monitor buildings, and a proliferation of other smart devices such as thermostats, advanced power strips, etc. Increasingly, EMS and EMIS, as well as other smart devices, are connected to, and communicate with, other systems and devices, including smart meters.

B. Emerging Trends

- **More insight into locational load management.** Advances in data and analytics capabilities provide new, more granular insight into capacity constraint analyses across transmission and distribution systems. For example, data and analytics can help identify the optimal technologies to offset grid operation challenges and system planning for specific locations.[12]

- **Greater connectivity.** Utilities may begin communicating with EMS, EMIS and other smart devices. Further, they may directly control these devices to shift load and/or possibly incentivize (using rates, for example) load shifting. Analytics platforms with machine learning capabilities are already consuming this information and using machine learning to identify patterns and learn more about energy consumption habits.

- **Non-intrusive load metering (NILM).** Load shapes describe how much energy a piece of equipment or a building uses over a period of time – e.g., a day or a year. For example, Figure 2 shows a sample daily load profile. Typically, obtaining load shapes involves installing sub-metering that is invasive and costly. There is interest in NILM, which involves using computer algorithms to identify load shapes for equipment without the need for sub-meters. NILM relies on smart meter data to provide the inputs for the algorithms that disaggregate meter-level energy usage into its component parts. Figure 3 provides an example of disaggregated smart meter data for a variety of equipment at a single location. The more granular data are, the more useful they are for NILM.
    - A related trend is the collection of extremely granular data (i.e., from one minute to one-second or sub-second intervals) to support NILM. Recent studies

comparing sub-metered data to NILM estimates show accuracy varies greatly and require further refinement.[13]

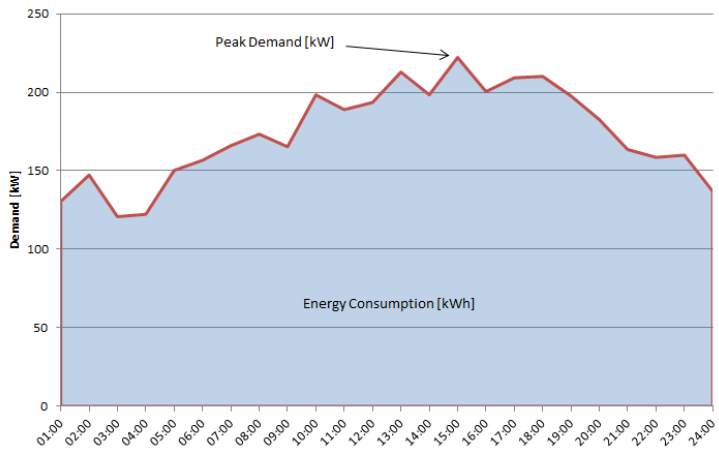

Figure 2. Example daily load profile14

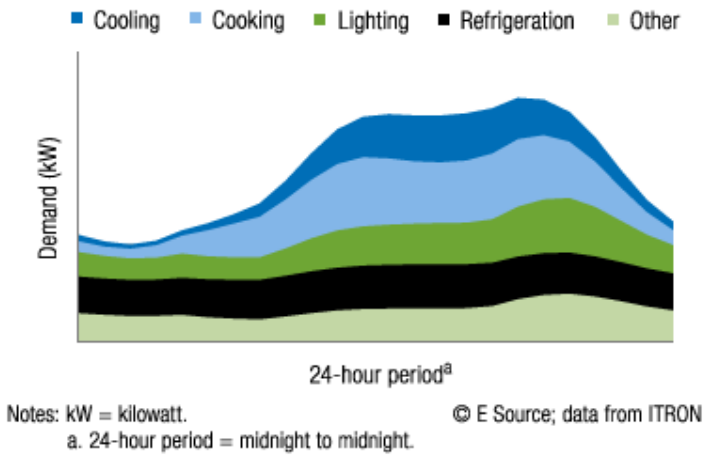

Figure 3. Example of load disaggregation for a commercial restaurant15

III. Energy Trust & Data

This section provides an overview of the current state of data at Energy Trust and describes planned work related to data in 2018 and 2019.

A. Current State

Energy Trust collects a wealth of data, including information about customers, sites and projects. These data are collected to track, report on and evaluate its work. Data collected by

Energy Trust are entered and stored in three key applications: Project Tracking (PT), a Customer Relationship Management System (CRM) and Great Plains.

As shown in Figure 4, PT stores data about Energy Trust's product offerings and details about incentives and savings associated with measures. Project Tracking also facilitates the tracking of projects from beginning to end, and enables the organization to forecast future savings from large commercial and industrial projects. The various project players (e.g. a customer, their contractor, their program delivery contractor) are also tracked in PT, but their details (e.g., address, etc.) are stored in CRM. CRM stores information about people (contacts) and companies (accounts), as well as information about sites. Great Plains is the system that stores information about Energy Trust's annual budget as well as transactional payment information that supplements data stored in PT.

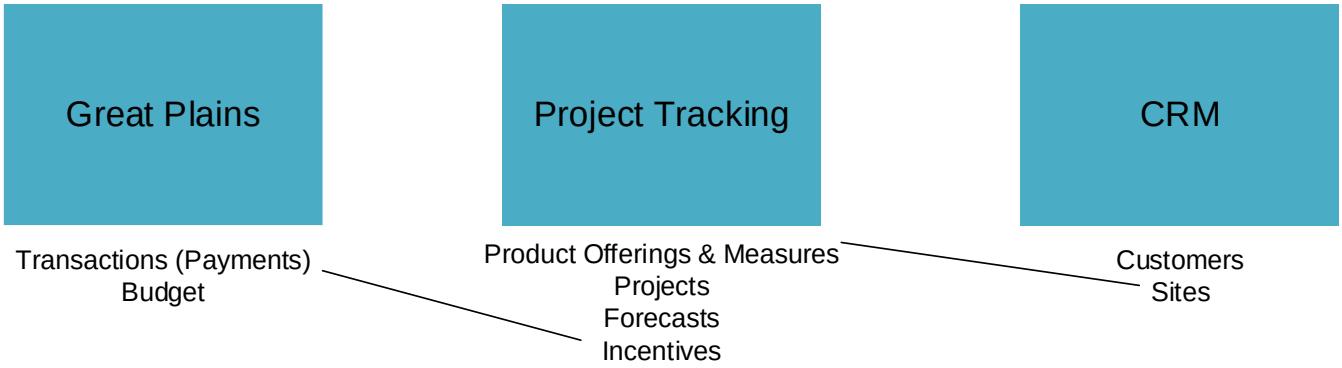

Figure 4. Relationship between Great Plains, Project Tracking and CRM

Data entered into PT and CRM come from a wide variety of sources, such as program management contractors (PMC) and program delivery contractors (PDC). Data are available to be viewed, extracted and analyzed by staff. Staff can view and extract data using a variety of tools, including these applications' user interfaces, various reporting platforms and structured query language. Staff may have access to one or more of these tools, depending on their role.

Energy Trust has invested in a variety of third-party datasets to provide points of comparison to, or to complement, data collected by Energy Trust. In the past, PMCs have primarily procured and used third-party data. A concerted effort in 2017 brought the procurement of third-party data in-house.

To date, Energy Trust has procured the following third-party datasets:

- *US Census* – Provides demographic data at the state, county, tract, block, and block-group levels from the American Community Survey and Decennial Census;
- *Weather* – Daily weather data from the National Oceanic and Atmospheric Administration can be used to "normalize" energy consumption data, ensuring that energy consumption across time periods with different weather are comparable;
- *Geospatial* – Energy Trust has a variety of geospatial data, including school and legislative districts, Census geographies and heating and cooling zones, which can be used in reporting and analysis;
- *CoStar* – Provides building-level information about commercial and industrial facilities in Oregon, including facility ownership, square footage and year constructed;
- *InfoUSA* - Provides customer-level information about Oregon businesses, including square footage, industry type, number of employees and contact information;
- *County Tax Assessor* – Provides information parcel-level information about residential, commercial and industrial properties for 16 counties in Oregon, including square footage, year constructed and zoning;
- *Utility Customer Information (UCI)* – Energy Trust's funding utilities provide monthly energy consumption data on a regular basis;
- *City of Portland Commercial Benchmarking* – The City of Portland requires commercial facilities over 20,000 square feet to submit information about energy consumption, energy performance ratings, square footage, year constructed and building use type; this building-level data is publicly available from the City of Portland.

In addition, Energy Trust is in the process of procuring the following dataset:

- *COBID* – Provides information about certified emerging small businesses, minority-owned businesses and women-owned businesses.

While third-party datasets are useful on their own, combining them with data collected by Energy Trust enhances their usefulness. In 2017, Energy Trust developed a robust, automated process to link third-party datasets containing site addresses to data collected by Energy Trust, which has allowed staff to use third-party data in many different ways. As the organization

considers future uses, the terms and conditions of many of these datasets preclude Energy Trust from sharing or selling the data.

Staff with varying levels of data-related knowledge and analytical capabilities work with and use the datasets described above. Staff can visualize and analyze all of the data described above using multiple tools, ranging from Microsoft Excel to more sophisticated statistical and visualization software, such as Stata, R, ArcGIS and PowerBI.

In addition to using data to track, report on and evaluate Energy Trust's work, staff are increasingly using data to identify and assess potential new savings opportunities (for example, high energy users with specific housing characteristics). Staff are also using data to support cross-organizational initiatives such as the Diversity, Equity and Inclusion (DEI) initiative and locational load management pilots with Pacific Power and NW Natural.

B. 2018-2019 Roadmap

Work to improve data happens on an ongoing basis. Energy Trust's IT Steering Committee reviews and prioritizes large investments of IT time and resources into enhancements. The Business Systems Prioritization Team reviews and prioritizes smaller investments of IT time and resources into enhancements.

The IT Steering Committee and Business Systems Prioritization Team have helped set the course for planned data-related work in 2018 and 2019. The work plan takes into account Energy Trust's 2015-2019 Strategic Plan, annual goals and feedback from users received as part of the Reporting Outreach Project (completed in 2017) and the UCI Data Project (also completed in 2017). Key work in 2018 and 2019 is listed below.

Data ownership

- **Establishing data ownership** by empowering staff to develop expertise regarding a specific piece of Energy Trust's data and systems. Data owners will apply their expertise by monitoring and curating data in order to ensure its accuracy and integrity. They will also participate in developing standardized, "sanctioned" datasets that can be used by other staff in the organization. This will ensure the appropriate use of the data by users. Energy Trust staff will also develop automated data integrity checks, where appropriate, to assist data owners in proactively monitoring data.

- **Creating meaningful metrics to track data quality**. Such metrics will allow data owners to quickly assess data quality so that they can address incomplete or inaccurate data.

- **Updating guidelines for UCI data** to support staff in new and innovative uses of UCI data while ensuring compliance with utility data sharing agreements.

Creating new datasets and linking datasets

- **Creating new datasets**. The data collected and procured by Energy Trust often requires processing before it can be used for analysis. For example, the monthly meter readings provided by the utilities would be more usable as monthly or annual estimates of energy consumption aggregated across multiple meters.

- **Linking multiple, disparate datasets together**. Developing standardized methods for linking datasets is critical for analysis. Energy Trust's Project Tracking, CRM and Great Plains applications link together by design. However, third-party datasets are more difficult to link to the data stored in these systems, because they may be at a different "levels." For example, a site record in CRM represents a floor in a building, while a record in a third-party dataset may represent a tax lot or a whole building. Work is underway to develop methods and rules for linking these datasets together so that they can be effectively analyzed.

Delivering training on data analysis and visualization tools

- **Expanding organizational knowledge** on key Energy Trust concepts, processes and datasets for both internal staff and external contractors, by creating documentation, delivering trainings and facilitating meetings focused on knowledge sharing and collaboration on the proper use of data.

- **Training, enabling and empowering staff who have a wide range of data-related knowledge and analytical capabilities to use Microsoft PowerBI.** PowerBI is a dashboard and data visualization tool. Once staff are trained on this tool, Energy Trust can use PowerBI to fulfill reporting needs without having to engage outside assistance. Successful utilization of PowerBI will require greater understanding of Energy Trust's

data through expanded documentation and staff training and establishing sanctioned datasets.

- **Training, enabling and empowering staff to visualize and analyze data in a geo-spatial context**. Staff can use tools such as PowerBI and ArcGIS to visualize and analyze data in a geo-spatial context. To do this will require staff training and establishing sanctioned geo-spatial datasets.

Performing and making use of data analysis

- **Leveraging data for Energy Trust's DEI Operations Plan**. Energy Trust's DEI Operations Plan contains ten goals. The first step toward reaching these goals is to understand the current state, which can be done through a comprehensive analysis of data from PT, CRM and Great Plains, as well as third-party data.

- **Leveraging data for program targeting**. Energy efficiency and renewable energy opportunities that are easiest to obtain have been depleted. The wealth of data collected and procured by Energy Trust could be mined in new ways to identify potential opportunities – for example:

    - Large energy users

    - Customers that have completed a walk-through survey, site assessment or technical energy study but who did not follow-through with recommended activities or projects

    - Customers who have already installed energy-efficient lighting systems could be targeted with HVAC efficiency offers

- **Providing more timely impact evaluation results**. Energy Trust is currently working with Open EE Meter to develop a billing analysis dashboard. The hope is that this will allow more billing analysis to occur on a much quicker timeframe. Energy Trust staff are reviewing Open EE Meter's methods and comparing them to the billing analysis methods currently used by Energy Trust. Staff plan to test and validate the energy savings estimated by Open EE Meter against traditional billing analysis methods. In the future, the products and services of Open EE Meter (or another similar vendor) could

potentially replace the current billing analysis tools and methods (pending approval from the board evaluation committee and regulators)**.**

Exploring opportunities to collect and/or receive additional data

- **Enhancing systems to track project opportunities.** Currently opportunities and forecasts are tracked at the project-level only. However, Energy Trust is developing recommendations for how to enhance its systems to track more project opportunities and forecasts at the measure level across all programs. This change could increase the organization's collective ability to provide detailed analyses on technical services delivered and measure-level trends, and enable staff to provide even more detail for utility integrated resource planning.

- **Exploring opportunities to collect and store more data from customers and/or market actors**. Examples of new opportunities to collect data include data from customers' smart devices and data about customers and facilities from online Home Energy Reviews, walk-through surveys and site assessments and studies. Another opportunity includes collecting full-category (inefficient and efficient) data from midstream and upstream program partners.

- **Exploring opportunities to receive more data from customers and market actors**, for example, obtaining access to interval data from the electric utilities.

IV. Data-Related Opportunities for Energy Trust

A. 2020 and Beyond

In light of the data trends described in Sections I and II, Energy Trust can build on the current data foundation described in Section III and explore new opportunities.

Building on current work

- **Gather more data on internal processes.** These data could support analysis to identify opportunities for improvement in internal processes.
- **Utilize data to create more detailed, localized and targeted market assessments**, which could provide valuable insight to staff working on localized load management pilots.

- **Utilize data for program development, pilots and new initiatives.** Acquisition and analysis of appropriate data could benefit Energy Trust new product development methodologies like Lean Startup.
- **Expand customer visibility into activities with Energy Trust.** Business Customer Reports were developed to give these customers a better understanding of their engagement with Energy Trust. Expanding this type of offering (for example, by incorporating UCI data and working to make existing data more accessible by customers) could be very useful tools for customer engagement.
- **Establish metrics for participation and penetration rates.** In 2017, Energy Trust analyzed participation and penetration rates, which was a manual and resource-intensive process. Obtaining agreement on key metrics and developing automated processes to calculate such metrics could help assess and track on program effectiveness and resource potential on an ongoing basis.

New opportunities

- **Develop customer insights for on-going engagement.** Energy Trust could acquire consumer behavior data and combine that with participation and usage data. Energy Trust potentially could use this combined data for individualized customer engagement at various levels of granularity.
- **Utilize machine learning to lower acquisition costs.** Energy Trust could utilize some aspects of artificial intelligence and machine learning to uncover trends and modify program implementation based on those trends. This analysis occurs today but could be much faster and potentially automated with machine learning.
- **Capture or gain access to sensor and smart meter data.** With an explosion of data from controls, sensors and smart meters, Energy Trust could explore how acquiring, accessing and/or analyzing these data could benefit programs.
- **Serve in an advisory/consultative capacity to interested parties outside of energy efficiency and renewables.** Energy Trust is developing deep knowledge of demographic and firmographic data through its annual Customer Insights study, Fast Feedback surveys and the acquisition of third-party data. There could be an opportunity for Energy Trust staff to consult with other organizations (e.g., water conservation,

transportation, carbon & climate) seeking to utilize these types and other types of data in furthering their work.

B. Skills and Resources

Many of the activities and new opportunities listed above require new skills and resources. Below are several actions that could support those activities and new opportunities:

- **Adding staff with specialized data analysis skills.** There are specialized skills needed to analyze large datasets and make data out of data. Data scientists who possess these skills are increasingly common in data-driven companies.
- **Increasing the skill sets of current analysts and making time to focus on new opportunities.** Energy Trust analysts currently spend most of their time on ongoing production work. The activities and new opportunities listed above would demand time and energy and require the development of new skills.
- **Creating and implementing a plan for big data.** Utilizing big data effectively requires a comprehensive plan for storage and access.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

Additional Resources

M&V 2.0

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NILM

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[6] https://www.pacificpower.net/about/nr/nr2018/Smart-Meters-Oregon.html
[7] Phone interview with Seattle City Light (2/20/2018).
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[12] Email exchange with DNV GL (2/22/2018).
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Partnering to Capitalize Benefits Beyond Energy
Board Learning Paper

Prepared by Michael Colgrove, Jed Jorgensen, Sue Hall, Becky Engel
February 2018

Energy Trust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020 – 2024). This series of papers will educate and inform the Board about the potential impact of these topics enabling them to better assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. **These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.**

Introduction

Energy efficiency is the cleanest, cheapest and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering that resource. Energy savings and renewable generation are not the only outcomes of Energy Trust's programs, however. Benefits beyond energy can be as important and, in some cases, more important to the project owners than the energy improvements.[1] There are also benefits important to other entities like utilities, foundations, government agencies, private markets or institutional organizations. Collectively, these benefits can create opportunities for Energy Trust to leverage its funding and increase program participation.

In the energy efficiency and renewable energy fields, benefits beyond energy, also referred to as "multiple benefits," "co-benefits," "ancillary benefits," or "non-energy benefits,"[2] typically refer to an entire suite of benefits that result from the adoption of an energy-efficient or renewable energy technology. They include a variety of benefits from many different stakeholder perspectives. They could include health, security, aesthetic

or comfort improvements. They also might include water savings, carbon reduction, economic development, air quality improvements, productivity enhancements or increases to disposable income. Figure 1 illustrates some of these benefits graphically.[3]

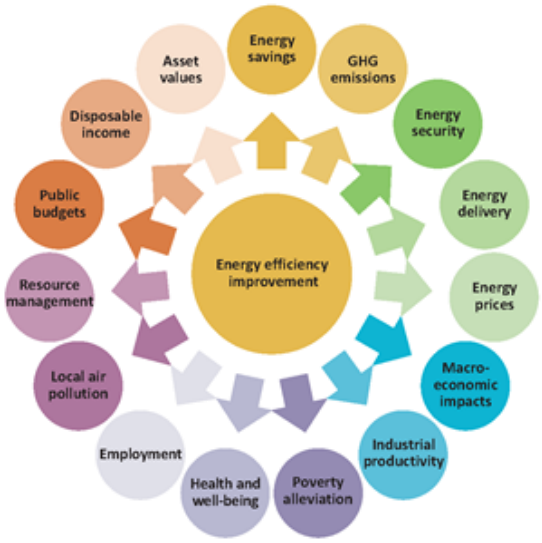

Figure 1: The multiple benefits of energy efficiency improvements

Generally, benefits fall into two categories: those that directly accrue to the end-user and those that are valued at a more societal level. The benefits that accrue directly to the consumer have been categorized in literature[4] as:

- improved indoor environment, comfort, health, and safety,
- reduced noise,
- labor and time savings,
- improved process control,
- increased amenity or convenience,
- water savings and waste minimization, and
- direct and indirect economic benefits from downsizing of equipment.

Energy Trust uses many of these consumer benefits in its program outreach, marketing messaging and promotional materials as ways to motivate customers to participate in its programs. The value of these consumer-level benefits is generally captured in an owner's decision-making process and are reflected in the cost they are willing to pay.

The other group of benefits – those valued at a more societal level – are the focus of this paper. These benefits include carbon reductions, water savings through environmental reclamation projects, economic development impacts, public health improvements etc. There are organizations, businesses, philanthropies and even entire markets that find value in these types of benefits and are willing to pay projects to

realize them. This paper will explore some specific examples of how these entities are paying to realize some of these societal benefits.

Organizations and Markets

Several organizations have long recognized societal benefits such as those associated with energy efficiency and renewable energy projects. Foundations historically have provided grant funding for programs that combat poverty, promote affordable housing or address deteriorating water resources. Government agencies regularly use taxpayer funding to promote economic development, address employment issues and implement resource management policies. Relatively recently, however, organizations have started exploring new partnerships to leverage their funding with that derived from ratepayers. That interest stems from the realization that many clean energy projects produce benefits other than energy – benefits valued by these other organizations. Three areas of benefits – water stewardship, carbon and public health – have some of the more established participants and formalized structures.

I. Water Stewardship

In the field of water resource management, the Bonneville Environmental Foundation (BEF) has been instrumental in connecting water reclamation projects and the benefits they produce with companies seeking to offset their water consumption. Through its Water Restoration Program, BEF acts as a broker to connect corporations with sustainability goals to projects that conserve water. The program's Water Restoration Certificate (WRC) is the means through which these projects are funded. BEF identifies water projects that meet the requirements of corporations who can then purchase Water Restoration Certificates (one WRC = 1,000 gallons of water restored). The funds from the purchase of certificates are then used to support the project's development.

There are numerous reasons why companies have adopted water stewardship policies. Some have formal sustainability goals. Others see reputational risks that can be offset by investment in water stewardship (for example, breweries, water bottlers, the National

Hockey League or other industries that use or are perceived to use significant amounts of water in their products). Still others have recognized real supply chain risks resulting from local water restrictions or insufficiencies that can be offset by water stewardship projects.[5] For these reasons, many companies seeking water restoration certificates express a desire to support local projects that have a direct impact on their water supplies or on the communities where they are located. BEF maintains an impressive database of water stewardship projects throughout the United States. BEF works to connect those projects to companies interested in supporting water reclamation.

BEF projects fall into four classification types[6]:

- *Water Management Agreements* where water rights holders can designate some of their water to be used for environmental benefits;
- *Irrigation Infrastructure Upgrades* where funding is provided to irrigation districts to support infrastructure modernization and water conservation;
- *Natural Hydrologic Restoration* where funding supports projects that restore physical conditions to facilitate natural flow conditions that recharge groundwater tables, replenish depleted rivers and support fish, wildlife and recreation; and
- *Information Technology Systems* such as high-tech water sensing and management systems that assist farmers with conserving water.

When it comes to water efficiency projects of the type typically found in energy efficiency projects (low-flow aerators and showerhead replacement), it is more challenging for BEF to provide support. Whereas building or homeowners realize savings in their site's water consumption (and therefore see utility savings on their water bills), it is the municipality that actually saves the water. Unless BEF can get assurances from the municipality that those water savings will remain in the natural environment (in either streams, rivers or the groundwater aquifer), it cannot issue Water Restoration Certificates and, therefore, cannot use investors' capital to support those efficiency projects. Most municipalities would use those types of water savings to support further growth of the municipality, not contribute to water restoration goals.[7]

Despite this limitation, BEF works with several companies that are eager to support municipal efficiency projects, such as showerhead, faucet and toilet retrofits to support underserved communities, reduce energy use and reduce water use. While BEF is unable to convert these projects to Water Restoration Certificates, they provide support to help develop and move these projects forward. Instead of realizing BEF's primary goal of environmental flow benefits, these projects focus on achieving other benefits such as reduced water cost for tenants or reduced energy use.[8]

II. Carbon Reduction

It is widely recognized that clean energy projects deliver co-benefits in the form of greenhouse gas (GHG) reductions. Over the last couple of decades, new markets evolved in the U.S. and internationally that place a monetary value on the reduction of GHG emissions, which contribute towards global climate change – creating new carbon capital markets. These carbon capital markets comprise both compliance and voluntary markets. Both operating in largely complementary ways with a common objective to integrate the value of carbon reductions into marketplaces to accelerate the pace of innovation needed to progress more rapidly towards a lower carbon future.

Compliance markets, such as those in California, Washington and the East Coast, assign value to carbon based on regulatory requirements. These regulations require certain larger GHG emitters to cap their emissions on a declining basis, allowing them to trade among themselves any carbon reductions that fall below the cap. Trading excess carbon reductions enables these larger emitters to meet the cap's requirements in the most cost-effective manner. For example, those who can invest in new technologies or encourage reductions among their customers can sell excess allowances to those who cannot.

These "cap and trade" compliance markets also allow capped entities to purchase carbon allowance offsets, typically taken from uncapped sectors such as forestry and agriculture, in limited volumes to meet their obligations. Offset projects must meet stringent requirements to demonstrate that GHG reductions are "beyond business as

usual" – that is they achieve GHG reductions beyond what would have occurred anyway – and that they meet integrity standards that are enforced through third-party project certifications. One such certification is California's Climate Action Reserve. This organization evaluates project eligibility and the volume of credits generated by using accredited methodologies and rules that govern how credits are evaluated and issued.

Voluntary carbon capital markets emerge when organizations purchase credits voluntarily. Examples of entities that have purchased voluntary carbon credits include companies such as Microsoft and Google, utilities such as Seattle City Light, cities from the Carbon Neutral Cities Alliance, campuses committed to Second Nature's American College & University Presidents' Climate Commitment (ACUPCC)[9] and even individuals. Many of these entities purchased credits because they aspired to achieve carbon-neutral goals or other GHG objectives.

In voluntary markets, organizations do not purchase credits because of regulatory compliance requirements. Instead, purchases are driven largely by sustainability and competitive/business interests, which credits can help secure. Carbon credit purchases thus have become an integral part of many companies' sustainable business strategies as they seek to "do well by doing good." As in compliance markets, independent certification of credits is the primary source of credibility. Organizations that provide this certification include the Verified Carbon Standard, the Gold Standard and the American Carbon Registry.

III. Public Health

For years industry experts have recognized that energy efficiency improvements also benefit the health of occupants. Tightening a home or building's exterior, thus preventing unwanted airflow, also helps minimize airborne contaminants such as smoke or pollutants. Window replacements, weather-stripping, insulation and heating system replacements or tune-ups help maintain comfortable indoor air temperatures, which can eliminate the use of fuel-based heating devices or gas ovens as a heating source

(which also are sources of carbon monoxide).[10] Properly exhausting furnaces and other heating appliances help effectively flush combustion contaminants out of the structure.

Unfortunately, these health benefits are notoriously difficult to measure and verify. Anecdotal stories abound, but hard evidence is rare. Numerous occupants of newly constructed, high-efficiency apartments or homes regularly report fewer asthma incidents in their children, or report generally improved standards of living.

However, the Green & Healthy Homes Initiative is one organization leading national efforts to measure the health benefits of energy-efficiency measures. The Green & Healthy Homes Initiative was charged by the Council on Foundations and the White House Office of Recovery to lead the national effort to integrate lead hazard control and healthy homes with weatherization and energy efficiency work. Its mission is "to break the link between unhealthy housing and unhealthy families by creating and advocating for healthy, safe and energy-efficient homes."[11]

To break this link, the Initiative is exploring a model called "Pay for Success." According to the Nonprofit Finance Fund, "Pay for Success is an approach to contracting that ties payment for service delivery to the achievement of measurable outcomes."[12] The first pay for success project launched in the U.K. in 2010, followed by the U.S. launch in 2012. The pay for success model has been used since to address a variety of social needs such as public health, childhood education, recidivism and homelessness.[13]

Under the pay for success model, there are three parties typically involved: (1) an impact investor such as a foundation, commercial entity or community-based organization that funds the efforts of (2) a service provider such as an organization that administers a health-related program or intervention and is then reimbursed by (3) a back-end payer, usually a government agency or an insurer, when outcomes are achieved.[14] Figure 2 illustrates this relationship graphically.[15]

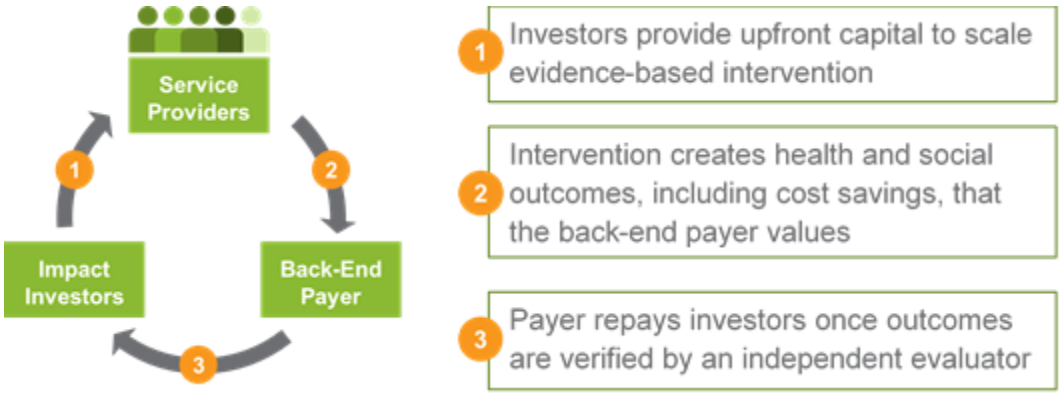

Figure 2: Pay-for-Success Model

The Green & Healthy Homes Initiative is engaged in a number of feasibility assessments across the U.S. to determine the potential for the pay for success model to address specific public health issues related to housing, such as lead poisoning and asthma. They are also working with various organizations to explore the potential to leverage the pay for success model with existing ratepayer-funded energy-efficiency programs in New York, Connecticut and the Tennessee Valley.[16]

In cases where energy efficiency programs are already addressing the energy usage of homes, the pay for success model can provide incremental funding to support various health and safety issues, such as mold remediation, that are typically not allowable under energy efficiency programs. When specific health outcomes, such as reduced asthma rates, are realized, a back-end payer such as a state health plan or Medicaid health plan pays the service provider for the health and safety work.

Case Studies

I. Bonneville Environmental Foundation and Oregon

The Bonneville Environmental Foundation has supported more than 50 water stewardship projects through its Water Restoration Program throughout the U.S. including Oregon. Oregon projects include the Middle Deschutes River water management agreement project in central Oregon and the Sevenmile Creek water

management agreement project in the Klamath Basin. The following case studies are excerpted from BEF's Water Project Portfolio.[17] While these projects specifically do not include an energy nexus, they illustrate the types of water stewardship projects that would qualify for Water Restoration Certificates.

The Middle Deschutes River Case Study from Bonneville Environmental Foundation


Photo by Robert Warren/Bonneville Environmental Foundation

The Middle Deschutes River is a 35-mile section of the iconic Deschutes River that flows between the city of Bend and Lake Billy Chinook, Oregon. In this section of the river, deep canyons and public lands comprise one of the most scenic desert canyons in the state of Oregon. Red-band trout, otters, ospreys, and myriad wildlife species inhabit this section of river and depend on clean, healthy flows of water.

However, historically most of the flow to the middle Deschutes River was diverted near the City of Bend to serve agricultural needs throughout central Oregon. Thanks to partnerships with businesses like the Portland Trail Blazers, the Deschutes River Conservancy, and local irrigation districts, new solutions have been developed to restore over 115 cubic feet per second of flow to the Middle Deschutes during the summer months BEF and our partners' purchase of Water Restoration Certificates® helps provide funding that allows the Deschutes River Conservancy to negotiate lease agreements with irrigators and keep these flows in the river, fostering a healthy ecosystem for people, plants and wildlife.

While agency-led monitoring efforts are underway to assess the positive impacts of this restored flow, fly-fishing guides and biologists who regularly visit this area continue to report improved populations of Red-Band trout.[18]

Sevenmile Creek Case Study from Bonneville Environmental Foundation


Photo by Klamath Basin Rangeland Trust

The Klamath River Basin, covering more than 12,000 square miles in southern Oregon and northern California, is considered one the most important waterfowl areas in North America. It is home to six National Wildlife Refuges and supports more than 430 species of wildlife. Extreme over allocation of water resources in the upper Klamath River Basin has resulted in inadequate stream flows and the degradation and/or loss of critical riparian and aquatic habitat.

The conflict between agricultural and ecological water needs in the basin remains one of the most significant environmental issues in the western United States. Sevenmile Creek is located upstream of the Upper Klamath National Wildlife Refuge and contains some of the best remaining stream habitat in the Upper Klamath Basin. The area is home to [a] myriad [of] species and is designated as critical habitat for threatened bull trout, native redband rainbow trout and the sensitive Oregon spotted frog. Irrigation diversions within the watershed have partially or completely dewatered critical streams, while return flows are often too warm or nutrient laden to provide adequate habitat for listed and threatened species.

Historical water use in this area has led to the diversion of the entire flow from the upper reaches of Sevenmile Creek, resulting in the complete dewatering of two miles of the stream and limiting fish access to some of the most critical, intact habitat in the stream system. This dewatering also prevents high quality, cold, clear water from flowing down the remaining 17 miles of Sevenmile Creek to areas located in the National Wildlife Refuge.

Since 2004, the Klamath Basin Rangeland Trust has tested the results of improving flows in Sevenmile Creek. Keeping water in the stream has improved habitat and provided a critical migratory corridor for endangered and threatened species. Through habitat monitoring, there has been a demonstrated linkage between keeping water flow in stream and improvements to fish habitat. With increased flows, the Oregon Department of Fish and Wildlife has reported dramatic increases in the occurrence of redband trout.

With funding provided in part through the sale of Water Restoration Certificates this project will restore approximately 1.2 billion gallons of water per year to a critical and previously dewatered stream system. The transaction will be completed on a voluntary basis with the landowner. The property will continue to be operated as an active cattle ranch with dryland grazing helping preserve the local agricultural economy while still meeting the needs of endangered species.[19]

II. Chevrolet's Campus Clean Energy Efficiency Campaign

In 2010 Chevrolet made a voluntary commitment to invest $40 million in carbon credits with the goal of retiring eight million tons of CO_2 to benefit the planet. Chevrolet's goal was to seek out credits in the clean energy and energy efficiency sectors from the U.S. voluntary market. It initially found few credits available, however, because there were no energy efficiency-based carbon methodologies to certify and issue credits. As a result, Chevrolet asked the Climate Neutral Business Network to develop a new clean energy efficiency carbon methodology in 2012, which was ultimately approved and accredited by the Verified Carbon Standard (VCS), a leading international carbon certification organization.

To be certified, energy efficiency projects needed to be able to prove that the GHG reductions they produce are additional - that they reduced GHG's on a beyond-business-as-usual basis and met other integrity standards. To evaluate beyond-business-as-usual performance, the new campus methodology established benchmarks based upon the top 15 percent of campuses' emission reduction performance. For

campus-wide projects, for example, the required benchmark performance level was an annual emission reduction of about 5 percent per year.

The methodology also provided the core foundation upon which carbon credits could be measured and verified by independent, third-party certifiers, ensuring that the resulting credits had integrity (e.g. no double counting, secure ownership, well monitored, etc.). This included accurate, conservative accounting for the resulting credit volumes. This methodology created the foundation for Chevrolet's Campus Clean Energy Efficiency Campaign.

Using this new methodology, the campaign worked with U.S. university campuses to measure GHG reductions resulting from energy efficiency improvements. Universities that received VCS certification for the GHG reductions that resulted from their projects were eligible to secure carbon credits for their efforts. Chevrolet then provided funding to purchase and retire those carbon credits. Overall, Chevrolet committed to purchase up to $5 million of these campus projects' credits, retiring them on behalf of the planet toward its carbon reduction goal. Figure 3 illustrates the relationships between each entity in this process.

Chevrolet launched the Campus Clean Energy Campaign to help invest in and promote a clean energy future, not only in its vehicles but in communities throughout the nation.[20] By creating the VCS campus energy efficiency methodology, Chevrolet not only opened up the carbon capital markets to campuses through its own credit purchases but also gave the campuses access to the broader carbon capital market and its investors. All of this new carbon capital was then accessible to help accelerate campuses' energy efficiency efforts. As a result, Professor Koester from Ball State University remarked that this was a "once in a decade" achievement.

Chevrolet and its campus partners found that carbon funding can contribute 5-25 percent of the incremental capital needed to deliver clean energy efficiency results at

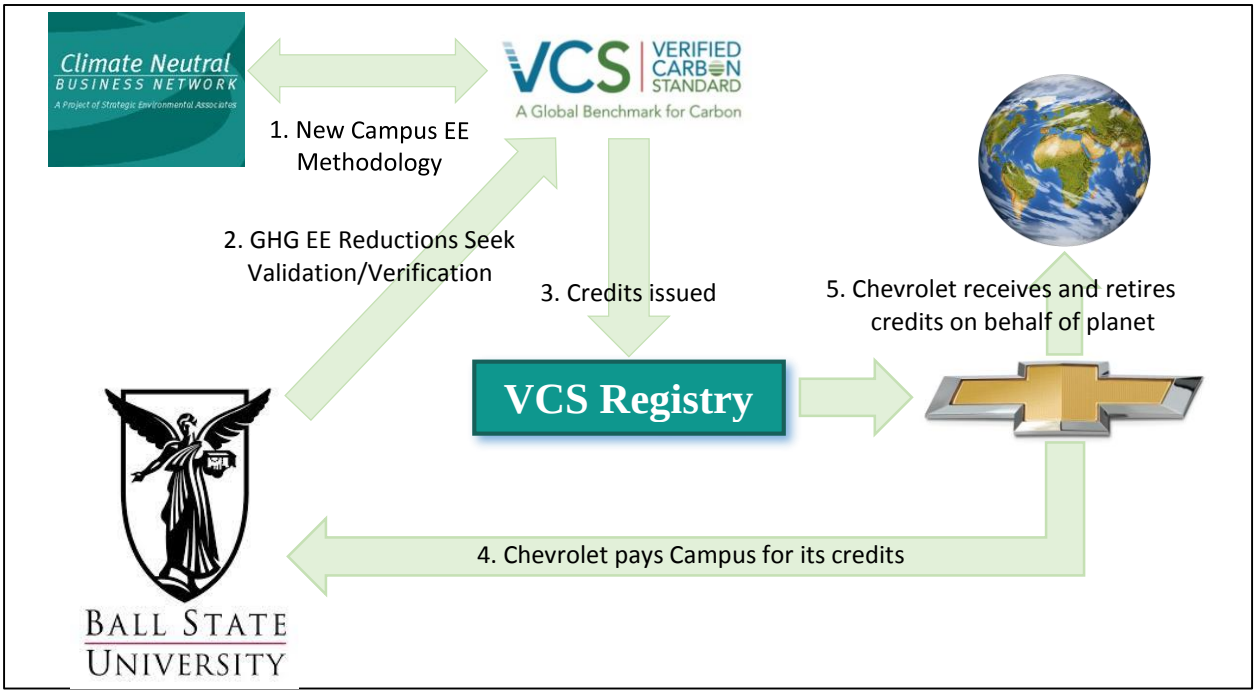

Figure 3: Chevrolet's Campus Clean Energy Campaign process

this level of campus energy efficiency leadership. The monies are designed to reward top-performing campuses and to help expand clean energy efficiency and climate performance based on a compelling business case to spur campus clean energy leadership.

Eleven Chevrolet campus partners brought forward projects whose carbon credit sales confirmed the value of this business case. These include Ball State University's geothermal campus-wide project, Valencia College, Spelman College, Boston University and Oregon-based Portland State University and Southern Oregon University. Valencia College remarked that the estimated return on incremental capital from selling carbon credits was highly positive: "At the $3 per square foot incremental cost that [U.S. Green Building Council] estimates is needed to achieve high energy efficiency performance, Valencia would achieve a 7-14 percent return on incremental capital over a 10-year span at $5-10/ton pricing for project carbon reductions."

Ball State University's Professor Koester further elaborated on the long-term financial benefits that can arise for campuses if they structure the new carbon capital proceeds as an internal green revolving loan fund. He said, "The financing made available through Chevrolet can seed the creation of green revolving loan funds at colleges and universities; with such initial capitalization, colleges and universities can continue to pay forward the impact of current efficiency yields toward additional conservation and energy use reductions. This is a virtuous circle that empowers campuses to pursue deep systems-thinking efficiencies. It's a great way to find new roads to travel together towards a clean energy future."

Venture capital market experts at MIT agree with Professor Koester. They consider that clean tech investments now require access to more patient capital (that is, capital investments that do not require short or immediate returns on investment) in order to succeed. This suggests that the current private venture capital markets favor information technology and medical new venture investments, which face fewer challenges (exit barriers, duration

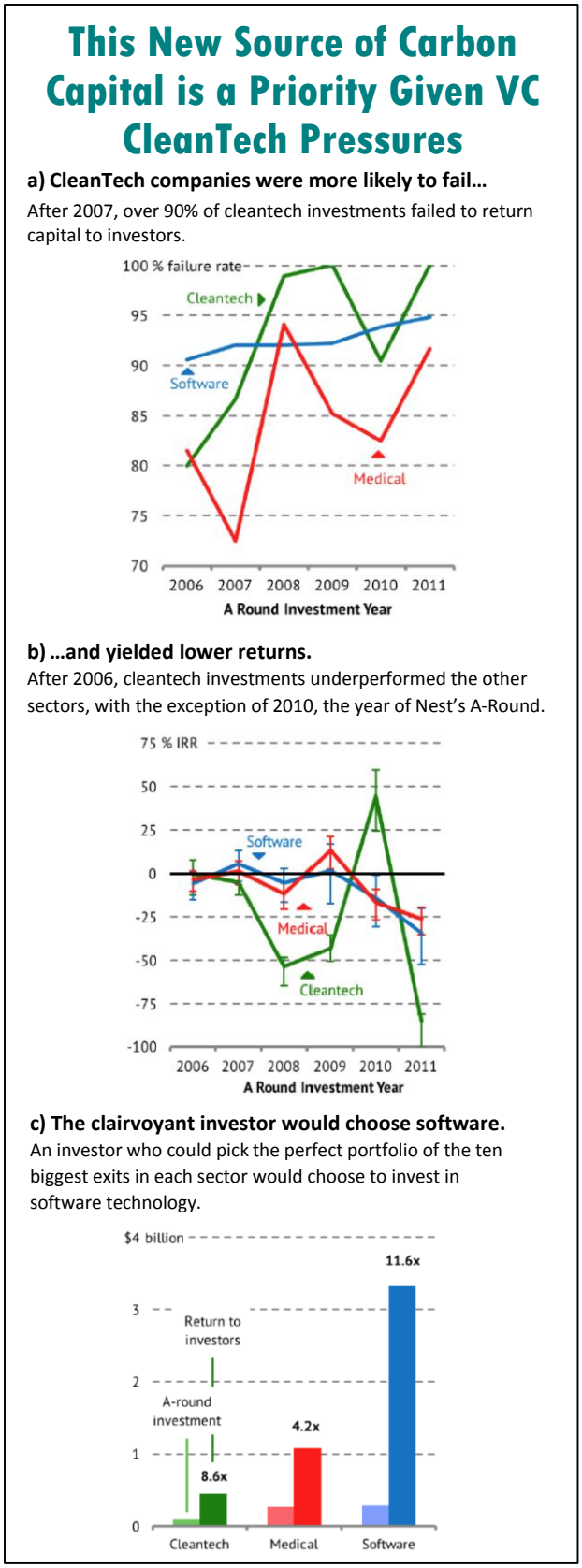

Figure 4 Cleantech Market Performance

before IPO, etc.). Figure 4 illustrates the performance of various markets compared to the cleantech market. The carbon capital markets are precisely such a source of patient innovative capital, which MIT considers as mission critical for clean tech investments whose primary benefits drive the future of the U.S.'s GHG reduction performance.

III. Green & Healthy Homes Initiative's Pay for Success Projects

In 2017, the Green & Healthy Homes Initiative conducted an analysis of the New York State Energy Research and Development Authority's (NYSERDA's) residential sector work to calculate a potential rate of return on the health benefits of its energy efficiency efforts. The analysis showed a positive rate of return and prompted a follow-up discussion with NYSERDA and various New York State health organizations to outline an approach using the pay for success model.[21]

In this case, the health organizations, such as the New York State Medicaid Program, would identify a pool of high-cost members based on a specific diagnosis code, for example, asthma. NYSERDA would then target this member pool with its residential energy efficiency program. If NYSERDA's home performance contractors discovered opportunities to remediate health issues in the homes, NYSERDA, using ratepayer funds, would provide an incremental payment to address those issues. In this adaptation of the pay for success model, NYSERDA and its ratepayer funds essentially take the place of the initial impact investor. That means that NYSERDA might provide an energy efficiency incentive of, for example, $5,000 to improve the efficiency of the home, and another $1,000, for example, to remediate the health problems.

On an annual basis, then, the State Medicaid provider would assess the costs associated with the initial pool of target members. If those costs decreased, NYSERDA would receive a share of those savings. The approach would be successful if NYSERDA's share of the savings equaled or exceeded the incentive provided per home to address the health issues.

In this particular case, attribution is not necessarily an issue. That is, the State Medicaid provider would not necessarily be concerned about whether the reduction in costs to deal with the targeted health issues were directly a result of NYSERDA's remediation efforts or a result of some other cause. This is not always the case in the more traditional pay for success model where the impact investor may want more rigorous demonstration that the efforts they funded directly resulted in the health benefits.

The Green & Healthy Homes Initiative is exploring similar energy efficiency and health models with the Connecticut Green Bank and the Tennessee Valley Authority and is engaged in discussions with Minneapolis, Chicago and Louisiana. If successful, these efforts could establish a model where ratepayer funds could leverage health care funding to deliver a more comprehensive set of benefits to energy efficiency program participants.

IV. Energy Trust and Farmers Conservation Alliance

Energy Trust has little, if any, direct experience partnering with other organizations to capitalize benefits beyond energy, but its partnership with Farmers Conservation Alliance on irrigation modernization projects has many similarities. Farmers Conservation Alliance (FCA) originally was created to market the fish screen (Farmers Screen™) that Farmers Irrigation District (FID) invented and patented in the mid 1990's. As FCA worked to move the Farmers Screen through federal approval processes, it met and worked with many irrigation districts in the region, developing the contacts that would be so important for the work it is doing now.

As FCA was moving along that course, Energy Trust began working on hydropower projects with irrigation districts like FID, Swalley, Central Oregon Irrigation District (COID), and Three Sisters Irrigation District (TSID). In 2013, Energy Trust worked with BEF to hire FCA to do a case study of the benefits that irrigation hydropower brought to the Hood River Basin.

That study demonstrated that hydropower was really more of an ancillary benefit of modernization for the water district. Importantly, hydropower provides an important revenue stream that can support additional modernization efforts. This realization led to the development of Energy Trust's current irrigation modernization program. FCA was selected through a competitive process to build out the program.

FCA provides development support, implementation oversight and assistance with finding additional sources of funding for both planning and implementation. To date, FCA has been able to help irrigation districts access approximately $25 million in federal funds and leverage an additional $6 million in state funds for piping projects, some of which are expected to begin in 2018.

FCA's ability to partner with federal and state government agencies and with Energy Trust allows irrigation districts to realize an entire suite of benefits including:

- Water savings – piping conserves water lost to seepage and evaporation – which can account for 25-60% of water flowing in a canal. The conserved water can be restored to streams and/or used to expand agricultural opportunities (often both occur).
- Energy savings – piping pressurizes gravity fed canals. In many cases, pressures are great enough that irrigation pumps can be completely eliminated across a whole irrigation district. Sometimes booster pumps are required to bring an area up to required pressures but this is usually done with a new variable frequency drive pump.
- Energy generation – excess pressure can be converted to hydropower. There is about 40MW of potential in the Deschutes basin alone.
- Drought resilience – the water savings from converting to pipe reduces the amount of water needed to be withdrawn from rivers for agriculture. During drought conditions that means farmers are able to stretch scare resources and there is more water available in stream.
- Water quality – leaving water in-stream can benefit the temperature of the stream. In addition, piping eliminates agricultural runoff into canals that have

return flows back to streams, resulting in less agricultural chemicals in those waterways.

- Habitat improvement – districts may choose to upgrade their fish screens, remove dams to provide upstream and downstream fish passage or fix streambeds that may have been channelized in the past for flood prevention or other purposes.
- Operation and maintenance savings – eliminating open canals can remove the need to have ditch walkers manually open and close canal gates to make water deliveries. Piping also eliminates problems associated with aquatic vegetation growing in canals (often treated with expensive, toxic chemicals), siltation and refuse dumping.
- Wildfire – in 2017, Farmers Irrigation District's pipes were tapped by wildland firefighters working the Eagle Creek fire in the Columbia Gorge.
- Reinvestment – pressurized water opens up new possibilities for farmers. At Three Sisters, many farms have moved to growing higher value crops and have switched on-farm irrigation technologies to save even more water. In addition, many farmers have invested in new farm tools, processing equipment and buildings.
- Jobs – infrastructure projects of this size bring a significant number of local jobs for engineers and construction companies, with multiplier effects in the local community.
- Liability – pipes eliminate the risk of canal failures, which can cause flooding. They also eliminate drowning risks.

Summary/Conclusions

Irrigation modernization is a strong example of how Energy Trust is involved with partnerships to capitalize benefits beyond energy. Other organizations are exploring similar partnerships to advance water stewardship, carbon reduction, and health improvements. These organizations have or could potentially work with many of the same companies that participate in Energy Trust programs. The decision to pursue energy efficiency is a complex one and rarely based on the energy benefits of the

project alone. It is important, therefore, that Energy Trust become aware of these efforts in order to effectively serve its customers and to deliver value to the ratepayers it serves.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

Additional Resources

An excellent resource detailing the nexus between energy efficiency, housing and public health is the Green & Healthy Homes Initiative's report *Achieving Health and Social Equity through Housing: Understanding the Impact of Non Energy Benefits in the United States*. It can be found at http://www.greenandhealthyhomes.org/sites/default/files/AchievingHealth%26SocialEquity_final-lo_0.pdf.

There are numerous additional resources on Pay for Success at www.payforsuccess.org.

For more information on the Chevrolet Campus Clean Energy Campaign, see the article *Chevrolet Helps 11 Colleges Reduce Their Carbon Footprint* located at http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2014/Nov/1118-clean-campus.html.

[1] Mills, E. and A. Rosenfeld. 1996. *Consumer Non-Energy Benefits as a Motivation for Making Energy-Efficiency Improvements*. Energy, 21 (7/8):707-720 [PDF], p. 4.201. Based on work originally published in *Proceedings of the 1994 ACEEE Summer Study on Energy Efficiency in Buildings*, pp. 4.201-4.213.

[2] © OECD/IEA 2014, *Capturing the Multiple Benefits of Energy Efficiency*, IEA Publishing. License: www.iea.org/t&c, p. 18.

[3] Note: This list is not exhaustive, but represents some of the most prominent benefits of energy efficiency identified to date. Based on IEA data from *Capturing the Multiple Benefits of Energy Efficiency* © OECD/IEA 2014, www.iea.org/statistics, License: www.iea.org/t&c.

[4] Mills, E. and A. Rosenfeld. 1996. *Consumer Non-Energy Benefits as a Motivation for Making Energy-Efficiency Improvements*. Energy, 21 (7/8):707-720 [PDF], p. 4.202 – 4.203. Based on work originally published in *Proceedings of the 1994 ACEEE Summer Study on Energy Efficiency in Buildings*, pp. 4.201-4.213.

[5] T. Reeve, Bonneville Environmental Foundation, personal communication, January, 11, 2018

[6] What are Water Restoration Certificates (WRCs)?, Retrieved from http://www.b-e-f.org/learn/what-are-water-restoration-certificates/

[7] T. Reeve, Bonneville Environmental Foundation, personal communication, January 11, 2018

[8] Ibid

[9] The American College & University Presidents' Climate Commitment established in 2006 is now the Presidents' Climate Leadership Commitments.

[10] According to the Oregon Health Authority (OHA), over 400 deaths a year occur due to unintentional carbon monoxide poisoning in the U.S. The sources of carbon monoxide include gas and oil furnaces, water heaters, fireplaces, and wood burning and gas stoves are sources in the home. The OHA specifically mentions to "never use a gas range or oven to heat a home," which, unfortunately, occurs in particularly cold weather or during power outages. (Carbon Monoxide Poisoning, retrieved from http://www.oregon.gov/oha/ph/Preparedness/CurrentHazards/Pages/carbonmonoxidepoisoning.aspx) Energy efficiency improvements like window replacements, insulation, air sealing, and heating system replacements or tune-ups can help ensure that comfortable indoor temperatures are maintained even in the coldest weather thus eliminating the need for supplemental heating from carbon monoxide producing appliances.

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Solar+Storage
Board Learning Paper

Prepared by Todd Olinsky-Paul, David McClelland and Jeni Hall

April 2018

EnergyTrust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020-2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.

Introduction

Energy efficiency is the cleanest, cheapest, and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering that resource. Energy Trust also invests in clean, renewable energy generation and has supported the installation of more than 12,000 solar systems over the past 15 years. As costs for both solar and battery electric storage come down, a growing number of customers are choosing to install batteries as part of their solar systems or to add batteries to existing solar systems. For now, these "solar+storage" systems provide bill savings and backup power to the customer. In the future, these systems may present an opportunity to provide additional benefits for both individual customers and the utility grid as a whole.

This paper explores recent battery market and technology trends, potential applications and local policy considerations for solar+storage systems.

Solar+Storage definition

In this paper, **solar+storage** (S+S) refers to a solar photovoltaic (PV) system paired with battery electric storage, typically installed in the same location and using shared electrical components or controls. This paper focuses on distributed solar+storage systems installed at customer homes or business. However, there are many other types of energy storage systems, such as large flow batteries, pumped hydropower, thermal energy storage or compressed air systems. These systems fall outside the scope of this paper.

When configured such that it can **island,** or separate from the distribution grid and continue to run independently, a S+S system can be considered a **microgrid.** A microgrid, as defined by U.S. Department of Energy, is:

> "a group of interconnected loads and distributed energy resources (DER) with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid [and can] connect and disconnect from the grid to enable it to operate in both grid-connected or island mode.[1]"

Battery terminology

Battery storage can be characterized with a power rating (watts, kilowatts or megawatts) and a time rating, which refers to duration of discharge (generally expressed in hours). It is important to know both characteristics in order to understand appropriate applications of a battery. Multiplied together, the power and duration of a battery are its energy rating, which is expressed in kWh (kilowatt hours) or MWh (megawatt hours). For example, a battery rated to deliver 6 kW (kilowatts) for two hours of discharge would have an energy rating of 12 kWh. Alternatively, this same battery could discharge 4 kW for three hours or 2 kW for six hours. However, it could not provide more than 6 kW of power or discharge faster than its two-hour rating.

Technology and Market Overview

How does it work?

In the simplest S+S configuration, the battery absorbs excess generation from the solar PV system and then discharges this energy later, when it is needed. Some S+S systems allow the battery to charge from other sources in addition to the solar PV, such as from the grid or from another source of onsite generation.

Solar PV and batteries do require other technologies to make them work. These may include inverters, controls, isolating switches (to separate the system from the grid) or data acquisition systems. An **advanced solar+storage** system uses a microprocessor to control and optimize the use of the PV and battery to meet customer or utility goals. Systems may work independently with local controls or be **aggregated**, or grouped together

Why combine solar and storage?

In general, solar PV and batteries are complementary technologies that work well together in many settings. They are scalable, from small customer-sited systems to large, utility-scale projects. Additionally, they provide numerous services and can be used in various applications. They do not depend on fuel deliveries, making them ideal for resilient power applications.

Solar PV is a variable generation technology that has energy value (it produces energy) but little capacity value. In other words, by itself, a PV system cannot reliably supply needed power at a specific time, for example during peak demand hours. Storage, on the other hand, does not generate any energy, but once charged provides power when needed. Therefore, storage has relatively little energy value, but great capacity value. Used together, a S+S system can provide energy that is both renewable and more **dispatchable**, or available when needed.

Adding storage to solar also involves a few tradeoffs. Primarily, batteries add cost, complexity and losses to a relatively simple system. Storage is not 100 percent efficient, meaning some energy is lost while charging and discharging the battery. As discussed

below, storage may either increase or decrease the financial value of solar system for a customer, depending on the use case and available utility rates.

System configurations

S+S systems can be set up in various configurations and locations: on the transmission grid, on the distribution grid or behind a customer meter. The latter is known as a **behind-the-meter** system. Utilities, customers or third parties can own systems. Most of the time, S+S will be **grid-tied**, meaning connected to the utility grid. This is important, because grid-tied systems can provide benefits both to the host facility and to the utility or the grid, for example through demand response programs. Customers who use S+S systems to go completely off-grid cannot provide such benefits.

One customer benefit of S+S systems is the ability to **island** or isolate the system from the grid in case of a grid outage. This is typically not something solar can do alone; solar systems are configured to go down if the signal from the grid is lost, as a precaution to protect the lives and safety of line workers[2]. Adding energy storage and isolating switches to a behind-the-meter system allows a S+S system to safely island during a grid outage, then continue to provide electricity to its host facility while the grid is down, and finally reconnect to the grid when grid power is restored.

Modern, advanced S+S systems have potential to receive signals from the utility or grid operator. In some regions of the United States, storage systems can participate in wholesale electricity services markets, such as frequency regulation markets (although small systems may need to be aggregated to meet market requirements). Several utilities are experimenting with aggregating customer-sited S+S systems for capacity and transmission savings, as well as resilience.[3]

Storage Industry Trends

Prices

Prices of lithium ion batteries have fallen 79 percent since 2010. Price declines are expected to continue, although not as steeply. Combined with the steep declines in

solar prices, some analysts have predicted that behind-the-meter S+S will soon be competitive with retail electricity prices in numerous states.[4] Oregon, with relatively low power rates and average solar resource, is behind other parts of the country on this trajectory.

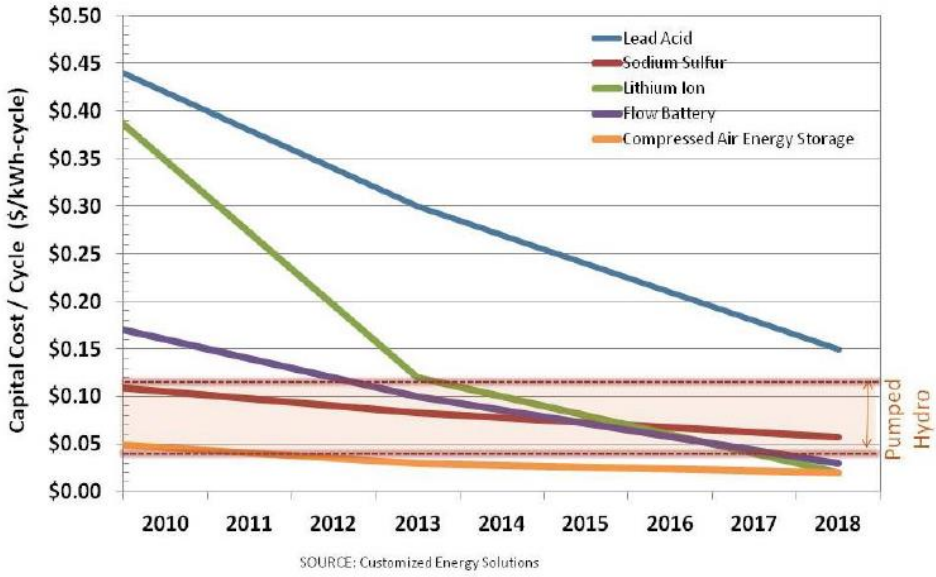


Figure 1: Massachusetts State of Charge report. Note that "The depicted levelized cost shown takes into account the total predicted cycle life, or the operational lifetime of the technology, and thus normalizes the capital cost over the entire lifetime of the project."

Chemistries

The current battery market is dominated by lithium ion technology. In Q4 2016, lithium ion batteries had a market share greater than 98 percent. Lithium enjoys a number of advantages, including that it serves the growing EV and consumer goods markets, which drive demand. As production capacity continues to increase, it is expected that prices will continue to fall.

There are other chemistries that may offer advantages over lithium for certain applications. Lead acid still has a place in the market, and there are up-and-coming chemistries such as advanced lead acid, which claims to combine the advantages of both lead and lithium, and flow batteries, offering significant advantages for certain applications. However, many analysts believe the industry is close to a point where

lithium's market share advantage could lead to "lithium lock-in," meaning that competing technologies may not have the opportunity to prove themselves in the market.

Applications

Behind-the-meter S+S is useful in a wide variety of applications that can provide resilient power, power quality improvements, consumer cost savings and revenues, utility cost savings and revenues and grid services. Importantly, it is often possible (and economically necessary) to "stack" multiple benefits. However, no one system can provide all services simultaneously, and the advantages of benefit stacking must be weighed against its potential to reduce battery life by increasing the frequency of charge and discharge cycles. Therefore, value-stacking calculations must be made on an individual project basis, taking all variables into account.

As shown in Figure 2 below, the types of applications that can be stacked depend on the location of the solar+storage system. Behind-the-meter systems have the potential to offer a full range of benefits to customer, utility and grid. Systems located on the utility grid offer a narrower range of services. However, behind-the-meter resources are typically more costly due to economies of scale, and require tradeoffs to balance utility and customer benefits. In particular, some services that batteries provide can interfere with the ability of a system to provide other services. For example, if resilience is a primary objective, the customer would need to reserve stored energy for an unexpected grid outage. In this situation, the amount of battery capacity available for other services would be restricted.

Certain grid-side services may require direct control of the S+S system by the utility. While this is possible with behind-the-meter storage, it is dependent on additional communications technology and an agreement between the customer and utility on how the system will be used. It is also possible for S+S to provide grid services without active control. For example, utilities may be able to achieve demand reduction through pricing signals, such as time-of-use rates, or with incentives for programming systems to reduce load during typical peak-demand hours.

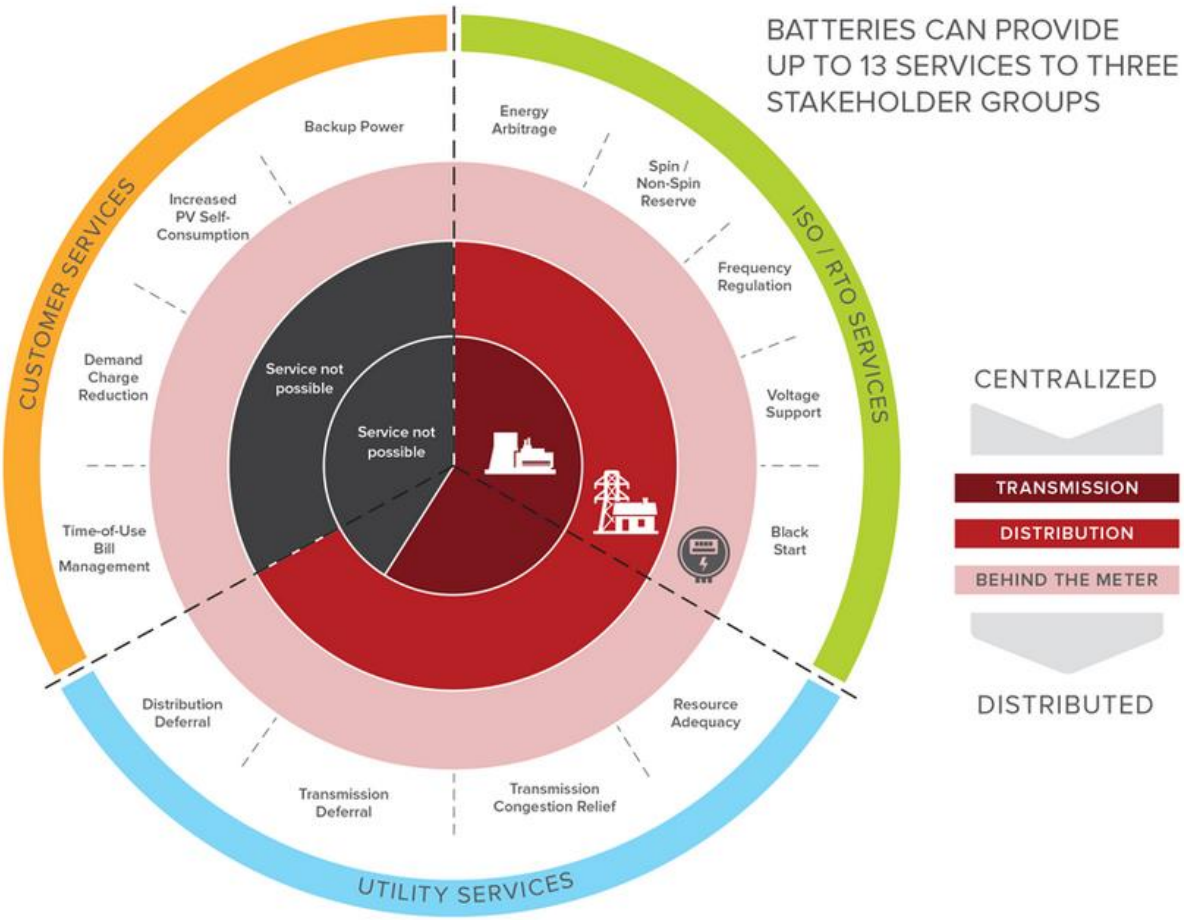


Figure 2: RMI The Economics of Battery Storage. Storage behind the meter can provide more benefits than storage on the transmission or distribution grids.

Use Cases for Solar+Storage

Customer cost savings and revenues

Compared to a solar system on its own, a S+S system may or may not provide additional utility bill savings.

Savings for commercial customers are often based on demand charge management. Solar PV lowers the energy portion of a customer's bill by reducing the amount of electricity the customer must purchase from the grid. However, solar alone cannot be

relied on to reduce the customer's demand charge, which is calculated based on the customer's highest demand for electricity each month. By adding storage, the customer can shift solar generation to peak demand times, thus capping peak demand and lowering demand charges. In markets where demand charges are higher, such as California, the Northeast and parts of the Midwest, these savings may be sufficient to drive a S+S market.[5] Residential customers do not generally pay demand charges and therefore cannot make use of solar+storage for these savings.[6]

Customers can also make use of S+S for energy savings when they have a time of use (TOU) rate structure with a wide enough spread between high and low rates. If utilities offer demand response (DR) programs, S+S customers may be able to participate. Theoretically, a S+S system could be used for both DR and demand charge management simultaneously, depending on available utility rates and offerings.

In areas where changes to net metering rules or rates cause reductions in bill savings for solar customers, the addition of energy storage may help to maintain bill savings by allowing customers to self-consume more solar energy, thereby offsetting the purchase of electricity at retail rates.

In some states, customers can sell services to a market for grid services. This allows customer to enhance revenues for behind-the meter S+S by selling capacity and/or grid services, such as frequency regulation to a utility or grid operator. Typically, these are commercial or industrial customers who have a large S+S resource primarily for the purpose of resilience and/or demand-charge management. Smaller commercial and residential customers may not be able to participate in these markets unless an aggregator is available to bundle and sell their services.

Resilient power

S+S that can island from the grid is ideal for resilient power provision because it is clean, fuel independent and can scale to meet various critical load sizes. S+S may also provide year-round cost savings and revenues, if TOU rates, demand-charge reduction opportunities or other forms of compensation are available to customers. Diesel

generators, by comparison, are polluting, fuel dependent and represent a sunk cost that will never produce revenues or cost savings.

Resilient power can be provided by S+S systems that either are located behind the customer meter or located on the utility distribution system. Examples of the latter include the Green Mountain Power microgrid in Rutland, Vt. and the Sterling Municipal Light Department project in Sterling, Mass. It currently is not possible to monetize resilience, but it does have a value and this value should be taken into account when considering the costs and benefits of a proposed S+S system.

As discussed in the Community Resilience learning paper, the potential for a Cascadia subduction zone earthquake poses a particularly difficult resilience problem, with some coastal areas projected to be out of power and inaccessible for months following a major earthquake. In these conditions, fuel for backup generators is expected to be extremely limited. S+S installations would provide an alternative source of power, allowing fuel to be rationed and reserved for the most critical infrastructure. Even if such a disaster occurred during a cloudy winter month, S+S could limit the consumption of precious fuel reserves and make power more widely available at emergency management sites, shelters, gathering places, communication nodes and homes.

Utility cost savings

The opportunity for utilities to realize cost savings and revenues from S+S depends on an individual utility's needs and the regulatory environment in which it operates. For some utilities, T&D investment deferral will be an attractive application. For others, capacity and peak shifting will be top priorities. In some cases, impending generator retirement may present an opportunity; or, resilience concerns may drive S+S deployment planning.

In the regulated power markets of the Northeast, the best economic case for utility S+S to date has been utility capacity and transmission cost savings, as demonstrated by Green Mountain Power and Sterling Municipal Light Department.[7] This model is now being adopted by numerous other utilities and electricity co-ops in the New England wholesale market.[8] At current prices, these projects have payback periods of six years

without subsidies. Other use cases for utilities include arbitrage (buying and selling energy on the market), frequency regulation, renewables integration, ramping (matching changes in load), transmission and distribution (T&D) investment deferral, replacement of retiring generation resources and resilience.

Some utilities are beginning to experiment with putting S+S behind customer meters. By remotely dispatching customer-sited systems, utilities can achieve the same capacity and transmission cost savings as would be achieved with a system on the distribution grid, while providing additional savings and resilience for customers. For an example of such a program, see the current Liberty proposal in New Hampshire[9]. Notably, Southern California Edison recently exceeded its mandated 50 MW storage procurement by procuring 260 MW, of which 160 MW was distributed, rather than centralized storage.

T&D deferral can be a good utility use case but is very location-specific. For example, the Brooklyn Queens Demand Management Program will defer a $1 billion substation upgrade using $200 million in load reduction strategies including customer demand management and storage. The program has been so successful that Consolidated Edison is now expanding it.[10]

In Oregon, Portland General Electric and Pacific Power are investigating savings opportunities and use cases for storage through active Oregon Public Utility Commission (OPUC) dockets, as discussed below.

Grid services

The category of grid services can refer to many different things, including ancillary services, a grouping of services necessary to maintain grid stability and security. S+S systems are often good at providing grid services, and can do so even from behind the customer meter if appropriate interconnection and controls are in place.

The value of grid services, and the ability of distributed resources to provide them, varies greatly from service area to service area. These services include capacity, frequency response and regulation, ramping and similar services. The increasing competitiveness of S+S in these areas can be seen in the fact that S+S is increasingly

competitive with gas peaker plants, which provide similar services. S+S is already cost effective compared to gas peakers in select markets, and some analysts project that within 10 years, S+S will be less expensive gas peakers in most markets[11].

In addition to market or regulatory rules that allow distributed resources to provide grid services, aggregators are often needed to provide market access to smaller, behind-the-meter resources. Aggregation can be performed by a utility or a third party company. In either case, the purpose is to bundle together the capacity of numerous small resources to create a larger cumulative resource. The key to aggregation is the ability to remotely dispatch the small systems that are being aggregated, and to share the resulting cost savings or revenues among all participants.

Third-party aggregators have arisen in some regulated wholesale markets where pricing is transparent and barriers to market entry have been removed. Third party aggregation is more difficult in areas where pricing is opaque and ancillary services markets either do not exist, or remain closed to third-party providers. In these areas, utilities may serve as aggregators for their customers.

Policy Considerations in Oregon

Federal policy and incentives

S+S is eligible for the federal Investment Tax Credit (ITC) and associated accelerated depreciation. Together, these two incentives can represent 60 percent of the installed costs of a project. Based on I.R.S. private letter rulings, storage added to existing residential solar is also eligible for the ITC.[12] However, these systems must charge 100 percent from the associated solar in order to receive the tax credit. For commercial systems, batteries may be charged less than 100 percent from solar, but this will result in the system receiving less than the full ITC. For these commercial systems, there is a 75 percent cliff for renewable charging, after which no portion of the ITC may be taken for storage. For more information, see guidance from NREL[13] and Deloitte.[14]

OPUC dockets

In 2015, Oregon House Bill 2193 tasked the OPUC with implementing a storage mandate for Portland General Electric and Pacific Power. PGE has proposed to procure 39 MW of storage, the maximum amount allowed under the law. PGE's proposal, now under review in docket UM 1856, includes a mixture of utility-scale batteries, micro-grids tied to pre-existing distributed generation and residential behind-the-meter storage[15]. Pacific Power's proposal is more modest: two utility-scale installations totaling 4 MW (docket UM 1857[16]). As part of the dockets, the utilities have evaluated various applications of storage, providing useful information to the OPUC on the opportunities and value of energy storage in Oregon.

In a parallel docket, UM 1716, the OPUC is investigating the resource value of solar (RVOS). The OPUC has identified 11 value or cost elements that make up the resource value, primarily: energy, generation capacity, transmission and distribution capacity and line losses. The resource value methodology includes a placeholder for grid services, valued at zero for now. In the order that adopted the RVOS elements, the OPUC noted that there are currently few S+S systems, but the RVOS methodology could be modified in the future to incorporate values provided by storage[17]. The OPUC has not yet determined how RVOS will be applied, or whether the RVOS will be a single value per utility or vary by location or type of system.

Utility distribution system planning

Distribution system planning may be very important for S+S deployment, especially for deployment on the distribution grid and for behind-the-meter projects, which will need to connect with the distribution grid. Because the grid was not designed for two-way flows of power, a variety of upgrades may be needed to enable distributed energy resource (DER) deployment to scale up and provide all the benefits of which it is capable. Adding the flexibility provided by storage may help mitigate constraints in areas where the utility has limited "hosting capacity" for local generation. Along with Energy Trust's learning paper on DER, numerous reports are available on this subject.[18]

Energy Trust Impacts and Connections

Energy Trust plays an active role in Oregon's solar market, helping customers install clean energy systems at their homes and businesses. Beyond financial incentives, Energy Trust also provides education, consumer protection and quality management services for customers, and business development and training for solar contractors. S+S systems have always been included in Energy Trust's standard solar incentive program, receiving the same incentives and services as other projects. However, the program has not considered the additional costs of storage in its above-market cost analysis used to set standard or custom incentive levels.

Interest from Energy Trust customers and trade allies in S+S has increased significantly. In 2017, 85 residential and five non-residential solar applications included storage. This was up from 15 S+S applications in 2016.

S+S is of particular interest for municipalities working on emergency preparedness. For example, the City of Portland is leading a working group exploring how to use S+S to meet community resilience needs in the aftermath of a Cascadia subduction earthquake. Energy Trust staff joined team members from the City, along with Multnomah County, Portland General Electric and Pacific Power to work on S+S solutions for resilience at the 2017 Rocky Mountain Institute eLab Accelerator conference.

Energy Trust is collaborating with the National Renewable Energy Lab (NREL) and Clean Energy Group to perform analysis of the resilience capabilities and financial benefits of S+S for 10 specific sites. Each of the sites serves the low-income community. Because a home or building's hourly load profile is unique to the equipment installed and the manner in which the home or building is operated, the costs and benefits of S+S systems are also unique to each site. In addition to this research, the Energy Trust Solar program is encouraging solar trade allies and customers to explore this technology by offering incentives for S+S feasibility assessments. These assessments provide customers with a preliminary system design and financial analysis so that they can gain an understanding of the cost and benefits of S+S for their site. In

anticipation of the growing demand, Energy Trust staff are coordinating across the Solar, New Homes and New Buildings programs to identify opportunities early in the design process to incorporate resilience and prepare sites to be "solar plus storage ready."

Based on feedback from the OPUC in its 2016 review of solar incentive programs, the Solar program is working to find ways that solar systems can provide additional benefits to the utility grid. This goal is reflected in the Solar program's approved 2018-19 Action Plan and includes activities focused on S+S:

Support applications of solar that provide higher utility value

- *Explore and test ways to deploy solar to meet peak energy needs, including pairing with energy efficiency, storage or flexible loads. Test methods to influence adoption of solar systems with more advanced controls for storage or flexible loads…*
- *Develop communication materials to address growing customer interest in solar plus storage.*

Summary/Conclusions

S+S is a hybrid technology that can provide greater benefits than either solar or storage alone. S+S is finding a growing market, both behind the meter and on the utility grid. Rapid price declines and changing market and regulatory structures mean that S+S is increasingly attractive for a number of applications. One key application for Oregon is resilience.

S+S can provide multiple benefits when located behind the customer meter. There are mechanisms for sharing benefits between customers and the utility, but this may involve trade-offs between customer and utility interests.

S+S still faces numerous barriers including technical, market and informational barriers. Energy Trust is already working with utilities, trade allies and customers to help address

some of these barriers in Oregon. Stakeholders may need to consider other policy and regulatory barriers over time, including appropriate valuation of S+S as a flexible, distributed energy resource.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

Prepared by staff of Energy Trust and the Clean Energy States Alliance.

About Clean Energy States Alliance

Celebrating 15 Years of State Leadership

Clean Energy States Alliance

Clean Energy States Alliance (CESA) is a national, nonprofit coalition of public agencies and organizations working together to advance clean energy. CESA members—mostly state agencies—include many of the most innovative, successful, and influential public funders of clean energy initiatives in the country. CESA works with state leaders, federal agencies, industry representatives, and other stakeholders to develop and promote clean energy technologies and markets. Learn more at www.cesa.org.

[1] https://building-microgrid.lbl.gov/microgrid-definitions
https://www.energy.gov/sites/prod/files/2016/06/f32/The%20US%20Department%20of%20Energy%27s%20Microgrid%20Initiative.pdf

[2] Solar inverters are required to disconnect from the grid or shut down during a grid outage. Typically, this means grid-tied solar systems without storage are unavailable during an outage. As an exception, certain solar inverters allow customers to power a single off-grid power outlet during a daytime outage. For example, inverter manufacturer SMA offers an add-on backup power outlet called the Secure Power Supply, http://www.smainverted.com/how-to-explain-secure-power-supply-to-homeowners/

[3] i. Such "virtual power plant" arrangements have been tried by Green Mountain Power in VT, Southern California Edison in CA, and Glasgow Electric Plant Board in KY, among others. Currently, the South Australia government and Tesla are planning the world's largest virtual power plant: solar+storage will be installed in nearly 50,000 South Australian households. Aggregated, these small S+S systems would deliver 250 megawatts of dispatchable energy, comparable to a traditional gas or coal plant. In the trial phase of the project, Tesla will install the systems in 1,100 public housing rental units, at no cost to the residents.

[4] https://www.rmi.org/wp-content/uploads/2017/04/RMIGridDefectionFull_2014-05-1-1.pdf and https://www.rmi.org/wp-content/uploads/2017/04/2015-05_RMI-TheEconomicsOfLoadDefection-FullReport-1.pdf

[5] A report by Clean Energy Group and NREL shows that millions of commercial customers across the country are paying demand charges in excess of $15/kW, which may be sufficient to make batteries a cost-effective solution for demand charge management. https://www.nrel.gov/docs/fy17osti/68963.pdf

[6] The current net metering docket in MA has explored numerous technical solutions to allow customers with storage to net meter while preventing "gaming" of the net metering program. It has also revealed that utilities would like to claim the capacity attributes of BTM S+S systems and sell them into the regional forward capacity market; however this would severely restrict the ability of commercial customers to engage in DCM due to competing claims on battery capacity. This is a battle likely to be fought through a number of dockets.

[7] http://www.sandia.gov/ess/docs/journals/SterlingMA_2017PES_SAND2017-1093.pdf

[8] Because prices for capacity and transmission services are set for the entire Independent System Operator (ISO) wholesale market, market values for these services are the same in all six New England states.

[9] https://www.transmissionhub.com/articles/2017/12/liberty-utilities-seeks-approval-in-new-hampshire-for-battery-pilot-program.html

[10] https://www.utilitydive.com/news/straight-outta-bqdm-consolidated-edison-looks-to-expand-its-non-wires-appr/447433/

[11] https://www.greentechmedia.com/articles/read/battery-storage-is-threatening-natural-gas-peaker-plants#gs.M4JphL0

[12] https://www.greentechmedia.com/articles/read/irs-says-that-batteries-can-take-the-federal-tax-credit#gs.4QcdMhA

[13] https://www.nrel.gov/docs/fy18osti/70384.pdf

[14] https://www.cleanegroup.org/webinar/financing-solarstorage-with-federal-tax-credits/

[15] http://edocs.puc.state.or.us/efdocs/HAH/um1856hah92141.pdf

[16] http://edocs.puc.state.or.us/efdocs/HAH/um1857hah142659.pdf

[17] OPUC Order 17-357 from September 15, 2017. The possible application of RVOS to solar with storage is discussed on page 15. http://apps.puc.state.or.us/orders/2017ords/17-357.pdf

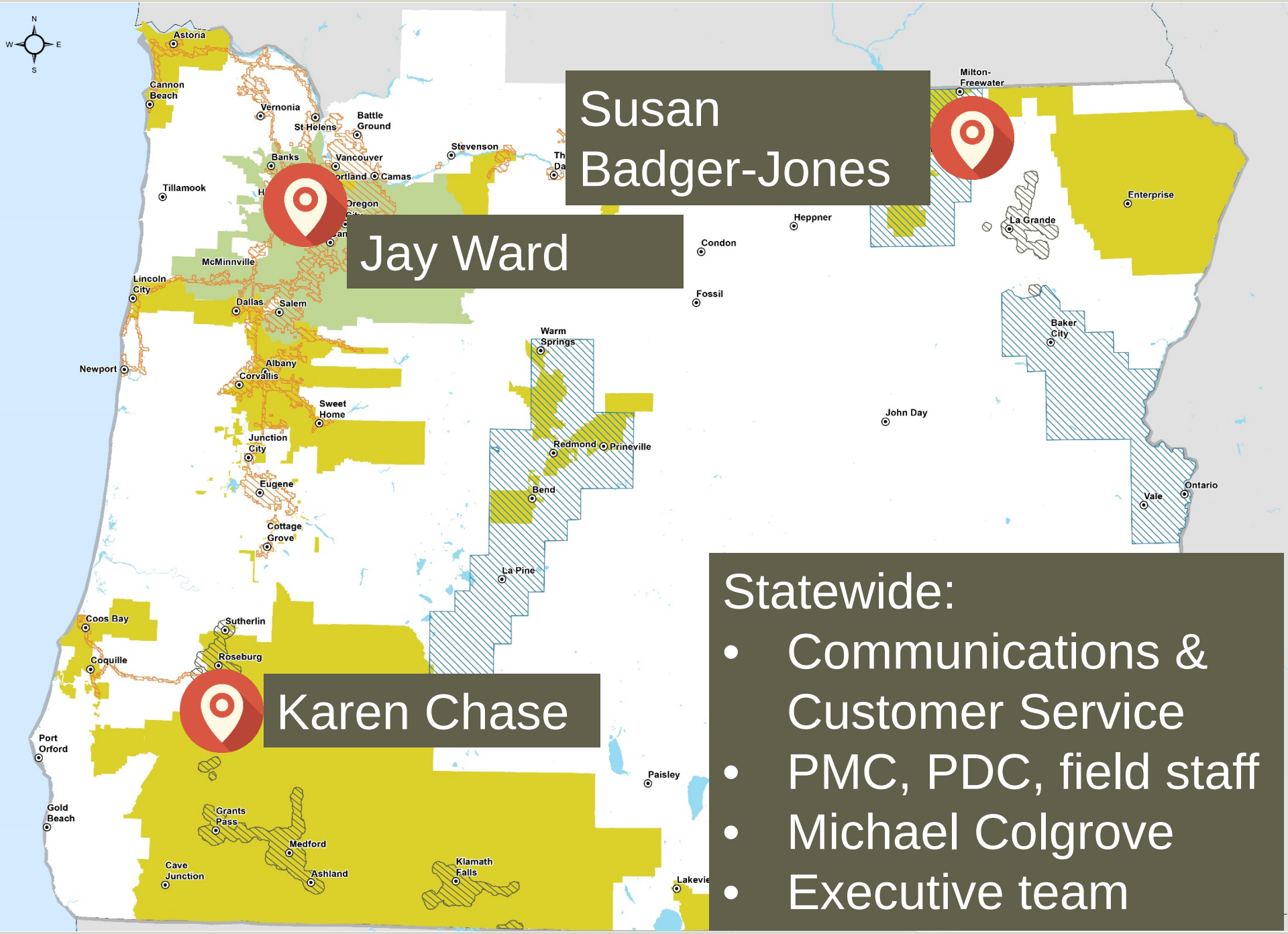
[18] PNNL, "State Engagement in Electric Distribution System Planning" (https://emp.lbl.gov/sites/default/files/state_engagement_in_dsp_final_rev2.pdf); Synapse, "Distribution Systems Planning"(http://www.synapse-energy.com/sites/default/files/Distribution-System-Planning.pdf); MN PUC, "Integrated Distribution Planning" (https://energy.gov/sites/prod/files/2016/09/f33/DOE%20MPUC%20Integrated%20Distribution%20Planning%208312016.pdf).

Mapping Relationships

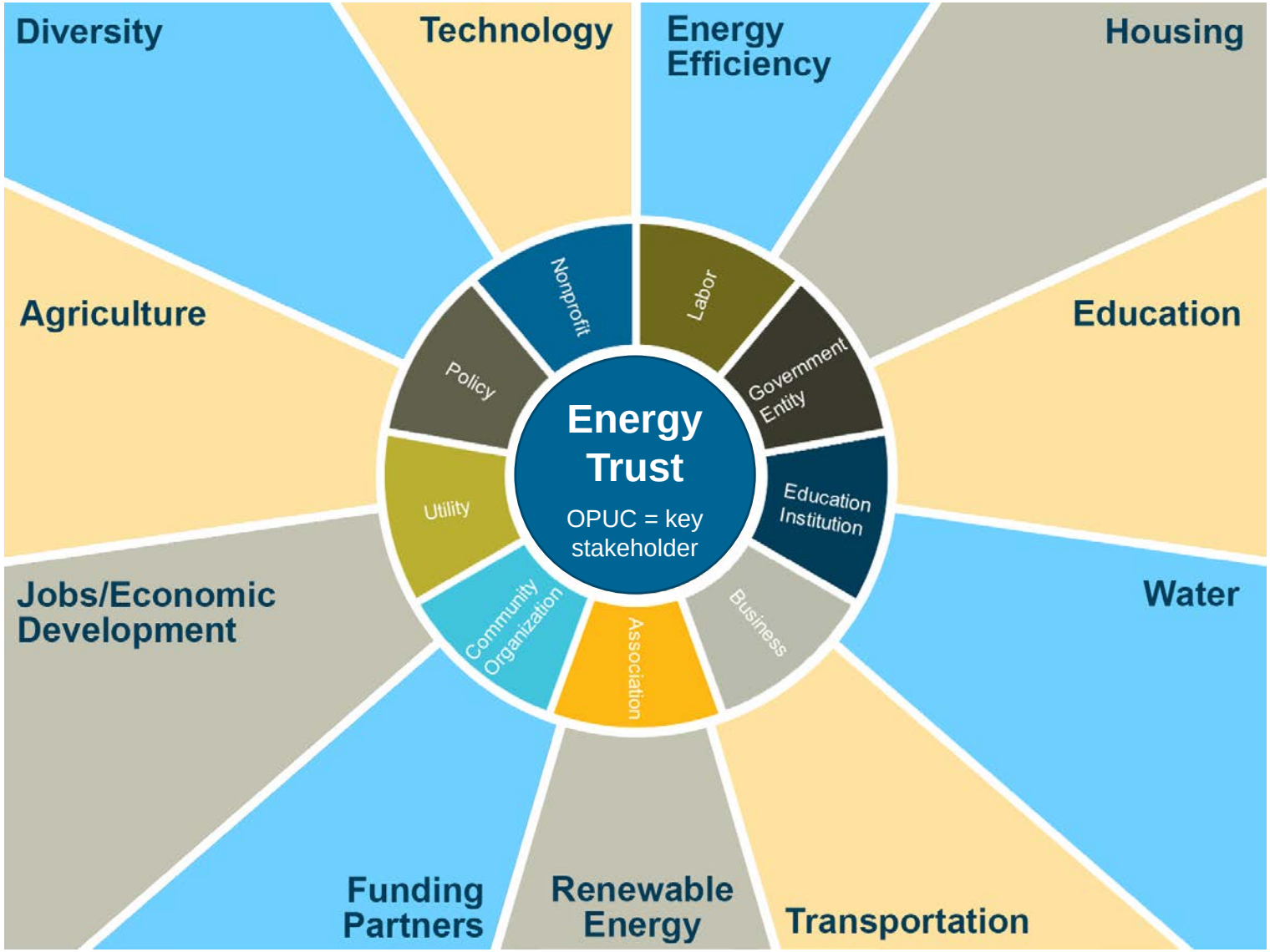
Board Learning Topic

May 2018

EnergyTrust of Oregon


Susan Badger-Jones
Jay Ward
Karen Chase
Statewide:
• Communications & Customer Service
• PMC, PDC, field staff
• Michael Colgrove
• Executive team
Astoria
Cannon Beach
Vernonia
St Helens
Battle Ground
Stevenson
Banks
Vancouver
Camas
Tillamook
Oregon
McMinnville
Lincoln City
Dallas
Salem
Newport
Albany
Corvallis
Sweet Home
Junction City
Eugene
Cottage Grove
Coos Bay
Sutherlin
Coquille
Roseburg
Port Orford
Gold Beach
Grants Pass
Medford
Ashland
Cave Junction
Klamath Falls
Lakevie
Paisley
La Pine
Bend
Redmond
Prineville
Warm Springs
Fossil
Condon
Heppner
John Day
Milton-Freewater
La Grande
Enterprise
Baker City
Vale
Ontario

Relationships Help Us Reach Strategic Goals




CRATER LAKE NATIONAL PARK
Fork
Middle
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Fork
Fork
Bybee
Creek
Campsite
Williams Crater
Hillman Pt
Backbone
Lookout House
The Watchman
Skull Channel
Wizard Island
Fumarole Bay
Governors Bay
Lightning Spring
Campsite
Picnic Area
Discovery Pt
Rim Village
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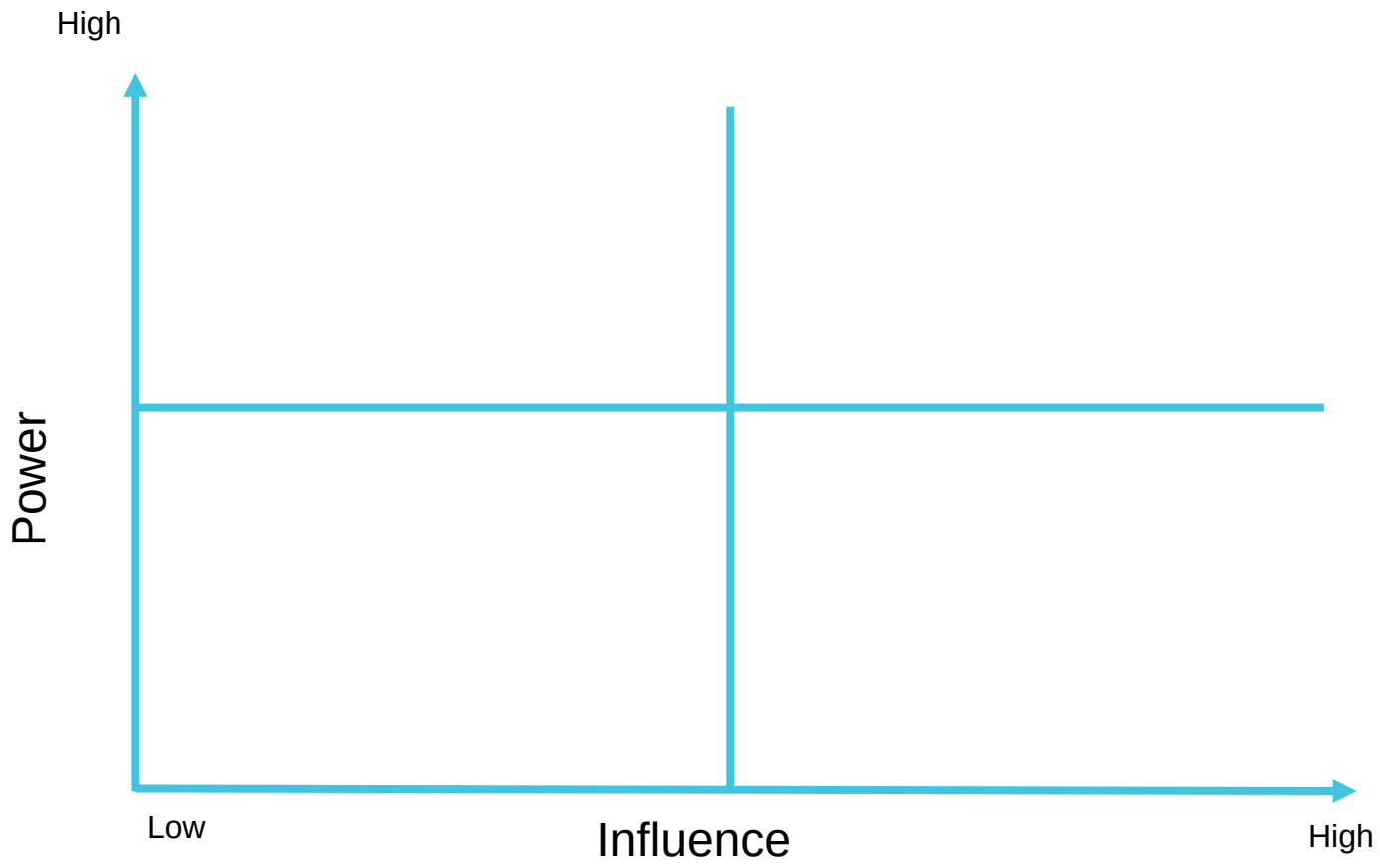
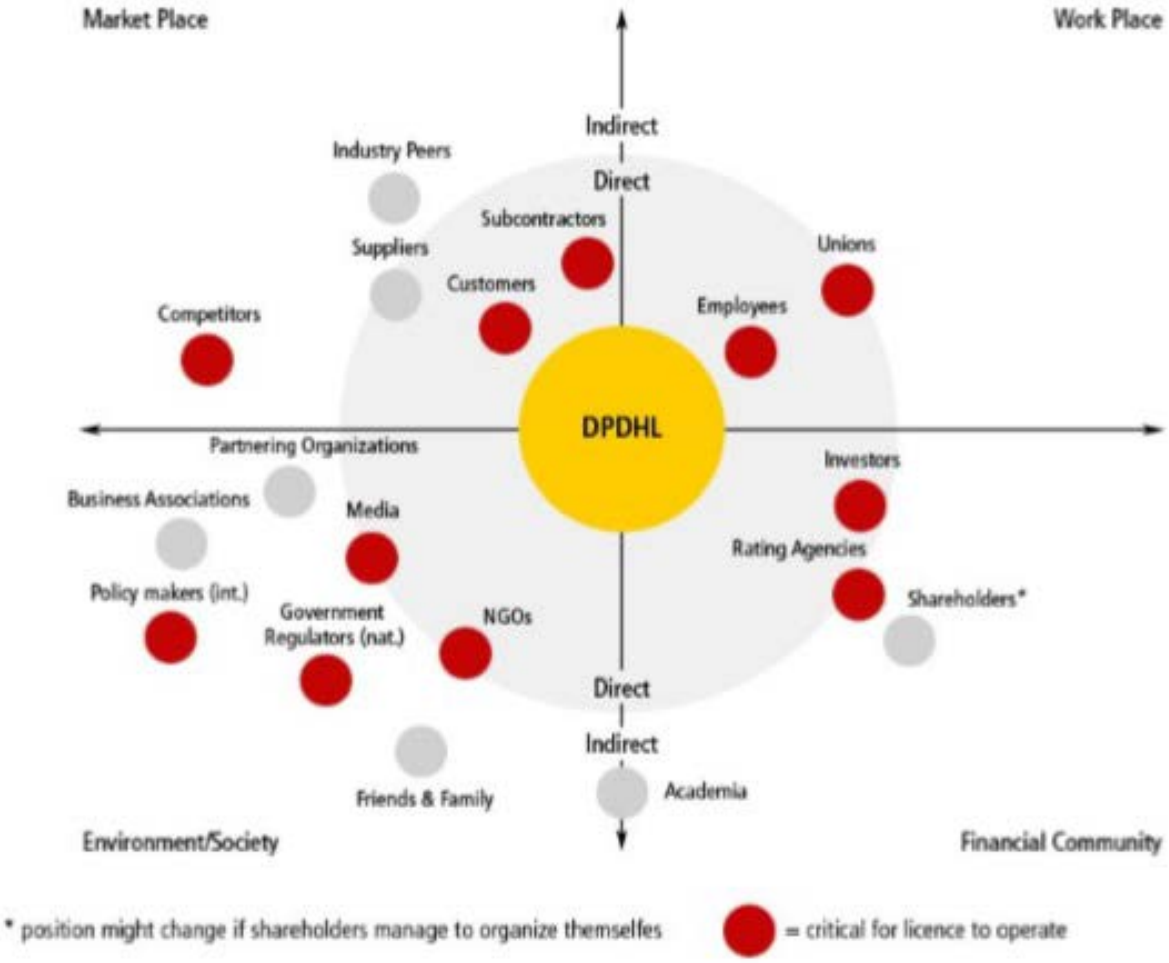
Relationship Mapping Models

Relationship Mapping Examples



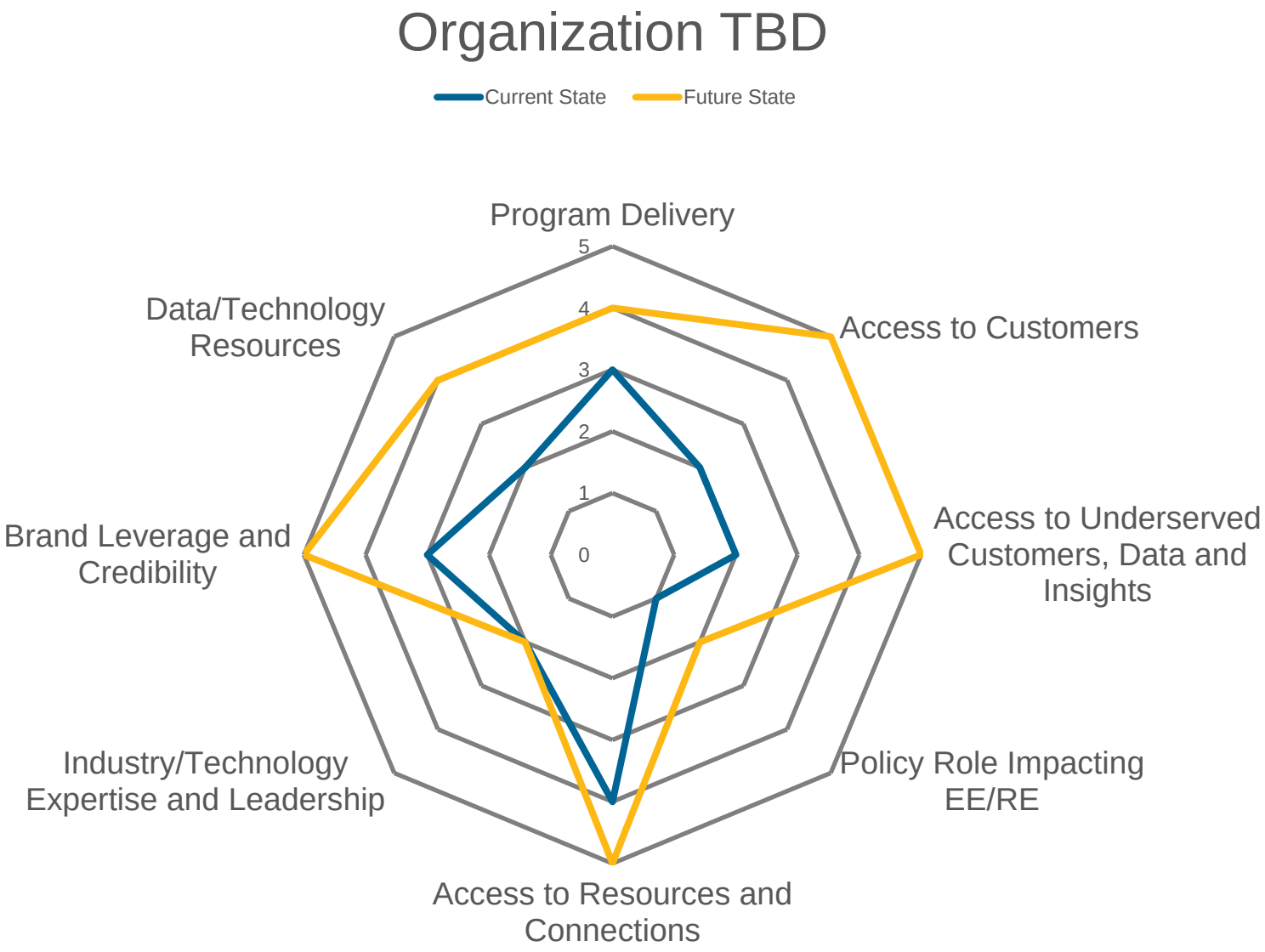
Power/Influence Model

Relationship Mapping Examples

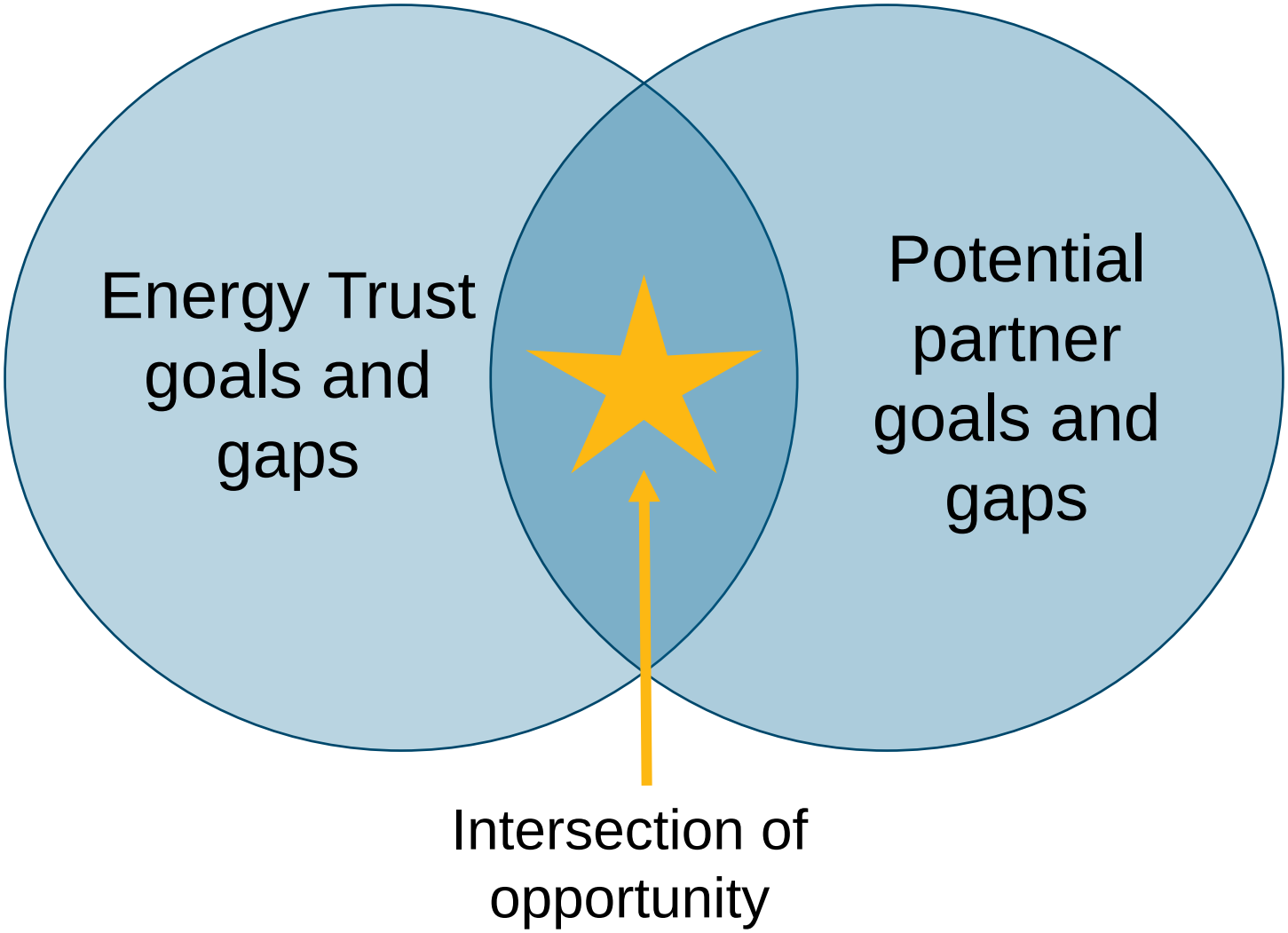


Direct/Indirect Model

Relationship Mapping: Energy Trust



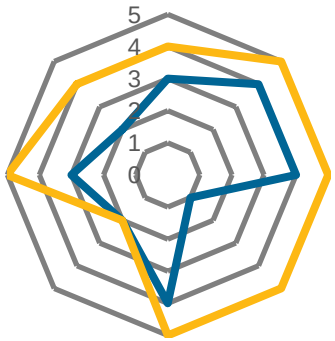
Relationships Should Be Mutually Beneficial

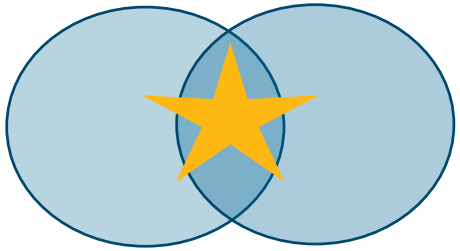


Assessing Intersection of Opportunity

- Business goals and Key Performance Indicators
- Mission
- Priorities
- Gaps
- Existing resources to support partnerships
- Potential level of investment
- Duration of engagement
- Potential risks

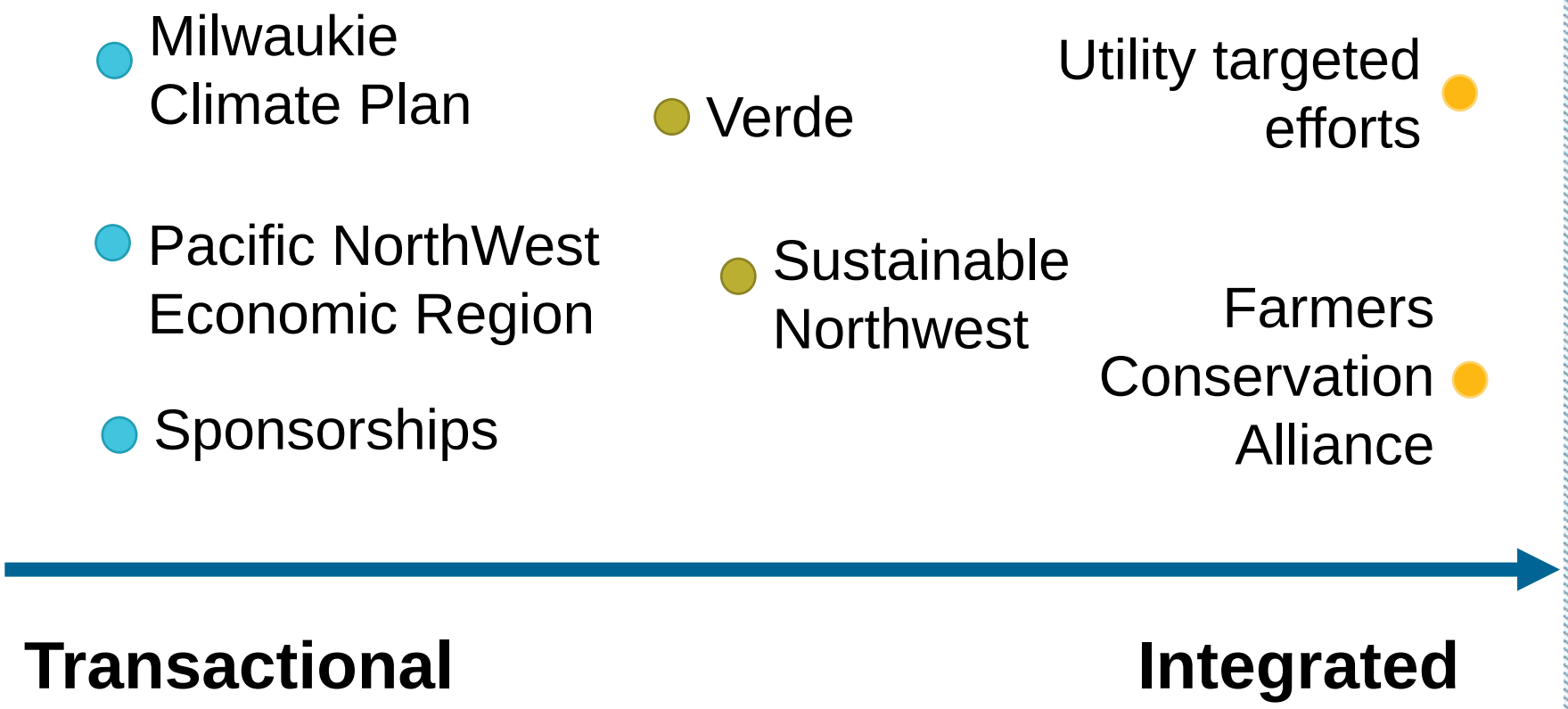
Example Relationship





Assess intersection of goals and gaps

Relationship Continuum

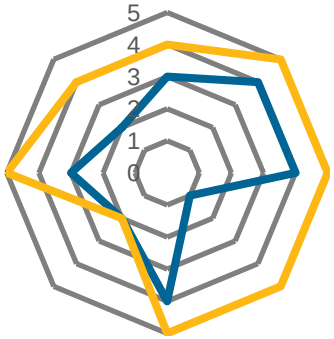


Considerations for Strategic Planning

- Identify relationships that warrant deeper analysis based on goals
- Engage current and new stakeholders to understand their interests and challenges
- Apply relationship mapping and analysis to relationships of strategic value

Questions to Consider

- Do the 8 mapping criteria resonate as most relevant for us, when assessing potential relationships?
- Are there other criteria we should consider? Are there areas that need more depth or focus?
- As we contemplate the next strategic plan, do any new criteria come into focus?



Criteria:

- ❑ Program delivery
- ❑ Access to customers
- ❑ Access to underserved customers, data & insights
- ❑ Policy role/impact on energy efficiency & renewable energy
- ❑ Access to resources & connections
- ❑ Industry/tech expertise & leadership
- ❑ Brand leverage & credibility
- ❑ Data & technology resources

Thank you

Amber Cole

Communications &
Customer Service Director

Jay Ward

Senior Community Relations
Manager

Becky Engel

Senior Communications
Manager (Contractor)

EnergyTrust of Oregon