INTRODUCTION
The falling costs of distributed energy resources such as solar, wind, and battery storage are creating new challenges as the utility model evolves. Where traditional systems mostly saw generation at one end of the system and consumption at the other, utilities are now faced with the challenge of accounting for micro-generation sources across their distribution networks (see Fig 1). However, this also brings unique opportunities for utilities to create programs that help customers invest in, and manage, distributed energy resources (DERs) in a way that also balances the grid.

For most utilities, that does not necessarily have to mean starting from scratch or reinventing their operational environments. New and existing programs for energy efficiency, electrification, demand response, and distributed energy resources can often be augmented, coordinated, and improved to create holistic integrated demand-side management (IDSM) solutions. These solutions can help achieve day-to-day operational goals of several business groups in the utility while aligning tactical and operational objectives across the organization.

Rather than a threat, distributed energy resources can help drive an evolution from legacy programs to advanced asset types, rate programs, and control possibilities. Increasingly, utilities are realizing that opportunity (see Fig 2). And utilities with aging demand response or energy efficiency programs may not actually have to abandon their existing deployments in favor of newer trendy systems. They can often simply apply a specific amount of automation to improve existing systems and meet their objectives.

While there is opportunity across the entire grid to find these synergies, the residential sector holds significant potential for behind-the-meter flexibility as grid technologies meet an ever more dynamic consumer electronics industry, according to Wood Mackenzie’s grid edge practice.

Managing increasing numbers and types of distributed energy resources (DERs) requires a solution that will utilize previous investments and provide for a path to the future as the utility model changes over time. That does not always have to mean a large cut-over to a new platform or “forklift-style” upgrade. Instead, it often means a modular, surgical and scalable platform that can offer outcome-based applications to augment existing utility investments as grid and customer needs evolve.

Although the applications should be surgical, the view should be broad and holistic. DERs impact every part of a utility’s operations, from its long-term generation planning to sub-second grid balancing. Honeywell knows from its work across utility operations that grid operations are just one piece of a truly efficient, optimized and connected energy ecosystem. Because its technology -- ranging from meters to building controls to thermostats -- also sits in homes, buildings and communities across the globe, Honeywell has seen the value firsthand when enterprise-class solutions are deployed based on specific outcomes to the benefit of all stakeholders.

PROGRAM DESIGN: AN EMPHASIS ON OUTCOME

Energy providers must clearly define the problem they are solving for, such as more targeted peak shaving programs, price-based rate support, fast frequency response or enhanced customer experience and enablement. Usually there’s more than one way to achieve that outcome, so carefully considering the technology choices to maximize the assets available for a range of outcomes is key as more and more demand-side technologies participate in grid services (see Fig 3).

Most programs must leverage newer technologies, like battery storage, but there is often still value in legacy
technologies. Less intelligent assets and systems can often be optimized based on the technology mix and desired outcome. Be mindful that you don’t always have to exclude a technology just because it is not as feature-rich as newer options in the portfolio.

**Peak Load Management.**

The primary driver for most utility-deployed DR/DER solutions is the need to mitigate peak loads or balance renewables. However, the technology to achieve those outcomes come in distinct flavors, ranging from precise virtual power plants, to evolving demand response programs.

**Virtual Power Plant.** A virtual power plant (VPP) is a technology utilizing a mix of distributed assets that can be manipulated to deliver a fixed amount of capacity reduction over a set time. Using increasingly common machine learning and “digital twin” modeling, a VPP allows energy providers to more accurately predict system response given a high number of variables such as weather and historical performance data. This allows for events that are flat and predictable and delivers a fixed level of capacity relief throughout a given event. VPP can be also be added to legacy or less advanced head end systems to address very specific non-wires alternative needs such as localized feeder congestion. It’s equally as powerful providing traditional demand-limiting functionality at the grid or campus level.

**Demand response over AMI.** Advanced metering infrastructure is an ideal tool for large deployments of demand response. While not as surgical as a VPP, it allows for broad program support across a territory that can include many asset types including:
- Irrigation
- Water heaters
- HVAC systems
- Pool pumps

Depending on your program needs, AMI network-based solutions can often provide basic and economical control of demand response and DER assets in the field. Where faster and rich telemetry data are required, new, economical cellular options are becoming cost competitive with AMI-based load control.

**Variable Rates/Transactive Energy.**

Transactive energy often conjures ideas of futuristic peer-to-peer energy trading, but it is happening today and is essentially the next evolution in variable rate or time-of-use programs. Transactive energy platforms provide pricing signals to residential, small business and commercial energy users (via the OpenADR protocol) allowing those users to respond to rate blocks or variable pricing rates. Depending on local requirements, participants have several options in a transactive energy program:
- Buy = Consume or charge storage systems
- Sell = Reduce consumption, discharge storage, or switch to co-generation
- Ride through as a last resort

Below is a simplified step-by-step example of a transactive energy bidding process:

1. **Provider sets preliminary energy prices**
   - Long-term or spot pricing
2. **Participants offer buy or sell tenders**
   - Based on pure need, availability, or financial strategy
3. **Provider offers updated pricing based on offered tenders**
   - Could be several iterations

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**FIGURE 3**

Tomorrow’s Decarbonized and Decentralized Power Market

A bi-directional energy network with new technologies and actors at every node reshaping power market planning and operations

Source: Wood Mackenzie
4. Market reaches balance based on price vs. market needs
5. Event settlement
   - Participants can be credited or charged based on contribution
   - Can be inherent in usage and price for the given period
   - Rules can vary by provider
Since participants can either use, reduce, or provide energy at a chosen rate or rate block without actively partaking in the bidding process, financial settlement does not need to involve a complicated baselining and rate period evaluation. Settlement can be inherent in the end users electric bill. Consumers can also be leveraged for real-time grid balancing in a variable supply chain with as little as a communicating thermostat or as much as advanced homes, buildings or factory floors (see Fig 4).

**Fast Frequency Response**
As power grids have more intermittent loads on their system, the need for fast frequency response is becoming critical in some areas. For example, U.K. grid operator National Grid paid $86 million in 2016 for eight lithium-ion battery projects to provide fast frequency response. While mechanical loads can also deliver fast frequency response, batteries are uniquely positioned to provide sub-second response times.

**Customer Engagement**
Customer engagement is a timely topic for utilities, but like so many terms in the industry, it often has different meanings to different groups. When defining customer engagement, it should also be with a specific outcome in mind, whether that’s enrolling more customers in a demand response program, reducing call center volume or helping customers shop for solar PV or Energy Star appliances. In most cases those outcomes will be supported by analytics that create increasingly deeper and more proactive interactions.

**INTEROPERABILITY & PROGRAM EXECUTION**
Interoperability is critical. However, it also has different interpretations and can be used misleadingly. Technology partners should be committed to interoperability that goes far beyond an API. Often two products can be certified to the same standard and not entirely interoperable. This often leads to project chargebacks and expense overruns. Utilities, now more than ever, need to be on the look for the integration “land mines” (often requiring significant development expense for the utility).
Any consideration of vendor interoperability should also come with pointed questions about cybersecurity standards. For instance, Honeywell has chosen to launch their newly platformed Connected Utility enterprise solutions on the AWS platform which enables customers in highly regulated industries to both improve their security posture and manage evolving cybersecurity needs – all without compromising the agility needed to scale their programs.
It should be noted that the cloud service provider provides cloud security while the technology vendor provides application security. Make sure your vendors have dedicated cybersecurity teams. Protecting consumer data is not a side job. It’s the primary job.
When considering DER programs, WoodMac has identified eight steps that are key for managing these assets effectively. While there are many facets to each one, Honeywell has found that leveraging the right data analytics at each step is critical.

**REGISTER**
Analytics should be used to normalize data, and that often involves using third-party data and then validating the results not only with models but with subject matter experts. Software with best-in-class user interface should be used to for customers to seamlessly register DERs. Besides, technology partners, other partners should include retailers and trade channels that can help amplify your program and meet customers where they are.

**MODEL**
Even sophisticated analytics are not perfect. Modeling should be an iterative process that is constantly being improved by addressing not only the quality of the data but the model itself. Modeling should account for not only DER impact on demand, but also the supply side.

**INTERCONNECT**
Depending on the program, analytics can help you uncover end point technologies already available to you, without having to wait for potentially lengthy interconnection processes. Analytics can also help streamline interconnection, providing more a more transparent process and more predictable and reasonable timelines, two factors that cause costly interconnection delays, according to a 2018 report from the Peninsula Advanced Energy Community Initiative.

**MARKET SIGNALS**
Whether assets are responding to frequency response or capacity signals from regional energy markets, delivering the signals within the parameters of the market rules to ensure compliance requires the right partner. Whether pricing signals are coming from regional energy markets or the utility, security is paramount and software must be able to not only deliver accurate pricing but also adhere to strict cybersecurity standards.

**OPTIMIZE**
Optimization should be ongoing, which is possible with today’s suite of analytics. It starts during program marketing, ensuring that outreach is refined throughout registration. Analytics can also provide ongoing optimization of devices depending on the technology mix and desired outcome, ensuring that even less-sophisticated resources are still maximized.

**SETTLEMENT & BILLING**
Speed and accuracy matter when it comes to settlement. In some cases, upgrades may be needed to billing systems to allow for accurate and rapid settlement, as well as analytics in place for call centers or digital platforms to quickly resolve any customer inquiries related to program billing.

**MAINTAIN (& GROW)**
A good program will grow and evolve to meet changing utility needs but also to leverage the quickly changing scope of customer devices, such as the growth of energy storage and voice assistants. For many utilities and regulators, it is an evolution to approach program innovation at a faster speed – but it is possible for IT and operations technology teams, as well as regulators, to adapt faster when armed with actionable data based on artificial intelligence and machine learning.
CONCLUSION
A range of technologies, from energy storage to connected devices in the home to data analytics that leverage artificial intelligence, are allowing utilities to innovate faster than ever before as they move to a cleaner, more decentralized and more distributed energy system.

Adopting novel technologies does not always require a complete overhaul of existing systems or stranding assets that still have value. There can be real benefits to a surgical augmentation of existing utility programs to get more out of them while still planning holistically for future programs.

Here is a list of things to consider when making decisions on updating or creating programs that leverage DERs:

• Forget the acronym. Vendors have a habit of relabeling their solutions based on trends, not advancements in their technology.
• What are you solving for with this particular program? In an ideal world, what other programs would you like to build on? Can they be coordinated? The answer may surprise you.
• What DERs are coming on your system and what impacts are they having? We’ve all seen duck curve graphs at conferences and on webinars. Is that actually your load curve?
• What pricing models do you have in place as adoption curves accelerate or change?
• What does your IT/OT landscape currently look like in terms of available data and analytic capabilities? How will that need to evolve to meet your short and long-term goals?
• What efforts is your organization making to improve data quality and availability?
• What is your organization’s definition of integration and automation? In some smaller use cases, full integration does not have the payback of larger initiatives.
• How flexible is your program design to allow for ongoing optimization?

Honeywell Smart Energy can tailor DSM technology and program support for your organization’s needs. For more information on how Honeywell Smart Energy can help you on the path of transformation, please visit honeywellsmartenergy.com or email smartenergy@honeywell.com.

Program Marketing
Participant outreach, engagement

Enrollment
Participant account creation, asset registration

Asset Deployment
Local boots on the ground, installations, service, support

Asset Management
Constraints management, optimization

Event Management
Event control methods, triggers, dynamic optimization

Event Settlement
Measurement and validation, compensation

Program Optimization
Post event evaluation, participation optimization
OUTCOME-BASED SOLUTIONS FOR DISTRIBUTED ENERGY RESOURCE MANAGEMENT

Mini Brief

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