

Flexible Load Programs – Session 1

The Opportunity & Aggregators Perspective Product Council – May 17, 2022

CLASSIFICATION LEVEL: PUBLIC





 Overview – Jeff Harris, Chief Transformation Office, NEEA and Geoff Wickes, Senior Product Manager, NEEA

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Flexible Loads, Barriers, Opportunities







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Northwest Opportunity Description:

"Ability to dynamically manage loads to maximize the efficient and economical use of energy to the benefit of the Northwest power system."

> "The more aggressive the electrification initiative, the greater the need for flexibility to meet changing demand and to manage the electrical grid."

Load Flexibility

- EPRI, Seattle City Light Electrification Assessment

Evolution of Demand Response

Demand Response → Load Flexibility

- Focus on peak \rightarrow Multiple conditions & benefits
- Infrequent \rightarrow Often
- A few large loads \rightarrow Millions of devices
- Add-on controls \rightarrow Direct integration into devices
- On/off control \rightarrow Multiple responses, intelligent devices
- Direct customer action \rightarrow Autonomous operation



Key Concepts: Dynamic Load Management



Load Shed: Reducing load based during peak capacity events

Example strategies: dimming lights, raising cooling setpoint, slowing down EV charging, grid emergency

Load Shift: Moving load from periods of high-demand to surplus

 Example strategies: pre-cooling, charging/ discharging batteries, moving EV charging times

Key Concepts (cont.)

Load Shimmy: Dynamic load adjustments within shorter time frames



Example: Gridinteractive water heaters



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Source: LBNL

U.S. Cost-Effective Load Flexibility Potential



Regional Potential:

The NWPCC estimates about 3,721 megawatts of summer load reduction potential and 2,761 megawatts of winter load reduction potential by 2041.

Source: Brattle Group, 2019

Flexible Loads as Balancing Resources?



BPA Balancing Authority Load & Total VER, Hydro, Fossil/Biomass, and Nuclear Generation, Last 7 days 07May2022 - 14May2022 (last updated 13May2022 14:05:35)

Flexible Loads as Balancing Resources?



S Capturing value frequently on small time scale



Source: U.S. Energy Information Administration, based on InterContinental Exchange (ICE) prices as reported by Ventyx. Note: Off-peak is 10 p.m. to 6 a.m. on Monday through Saturday and all hours on Sunday. Mid C is Mid-Columbia, COB is California-Oregon Border, and NOB is Nevada-Oregon Border.

Factors for Flexible Load Success

- Scale-up market adoption
- Aggregate into meaningful, dispatchable load
- **Minimize** impacts on customer comfort and convenience
- Integrate into T&D system operations
- Maintain grid security
- **Protect** customer privacy
- Generate revenue stream that pays for the costs



Narket Barriers

- Incremental costs for communications and system integration operations management equipment
- Reliable and effective communication to enduse devices across all operational time frames
- **Proprietary management systems** that preclude multiple vendors and deployment options
- Lack of value proposition for customers, market actors, and utilities.



Stakeholder Ecosystem



- Each hub has unique drivers/ needs for connectivity/ flexibility
- Individual needs must be balanced with the others
- Analogous to energy efficiency ecosystem



Case Study: Connected Water Heating

NEEA's Experience with Connected Water Heating

Two Case Studies:

- Advanced water heating specification
- BPA/ PGE demonstration project

Key Take-Away:

NEEA has leveraged its core competency of Market Transformation, strong relationships and market expertise to successfully influence the evolution of connected water heating.



Assessing the grid benefits of demand-response enabled HPWHs.

What:

- Coordinated the connection to 278 water heaters in six utilities across the region
- Partnered with BPA, PGE and PNNL on reporting over 600 events in 220-day trail
- Showed that HPWH can shift on average 0.21 kW compared to 0.33 kW with electric resistance over three different seasons (winter, spring and summer)
- Drafted and published a comprehensive report that is referenced in the water heating DR community
- Laid the groundwork for OR and WA requirement that water heaters must be smart grid devices with a standard communication port



How an energy efficiency specification from the Northwest shaped the future for connected water heaters.

What: Alliance Advanced Water Heater Specification created with industry and NW utilities

How:

- Worked with ENERGY STAR to include connectivity in spec and test method
- Leveraged relationships with industry, stakeholders to address barriers

Results and Next Steps:

- Specification provides roadmap for the market: Virtually every HPWH has CTA 2045 Port
- Policy makers leverage foundational MT work: WA and OR require CTA 2045 for every electric and HPWH shipped into the state.
- HPWH Manufacturers buy-in: All manufacturers understand if they want to sell HPWH (water heaters in general) they need to be connected
- Market interest grows: Other industries reaching out to NEEA to understand requirement (commercial water heaters, pool pumps, HVAC, battery chargers, etc.)
- National alignment provides market clarity & Scale: Engagement with California Flex Hub and OpenADR alliance delivers value back to the Northwest.





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e-Radio, Inc.

Dan Nephin, Director, Technology Development

Dan Nephin, Director, Technology Development dnephin@e-radioinc.com May 17th 2022





- Brief intro to e-Radio and EcoPort[™] / CTA-2045 arch and data flow
- Security of solutions
- One way or two way communication options
- Utilities or aggregator tools and commands
- Deploying devices and services
- How to handle dynamic scheduling and Time of Use
- Solutions for targeted distribution challenges

e-Radio Goals

- Show that many proven and secure tools are available today to start deploying EcoPort[™] / CTA-2045 DERs like water heaters, mini-split HVAC, pool pumps
- Inform that the longer we wait to incentivize smart DERs with connectivity included by **default**, equals huge lost opportunities
- The right steps taken now can allow low risk, future proof solutions



- e-Radio founded in 1999, focus on smart cars and highways
- Worked with major auto OEMs to develop radio datacasting
- Since 2005, active in smart grid:
 - early work in California with CEC PIER T24 PCT 2006-8
 - 2008 PCT demo in 2021 in Sacramento
 - 2010 FM Radio based load control switch deployment in mid-west



- Major CTA-2045 work:
 - 2016-2018 BPA PNW smart water heater study largest at the time
 - 2015+ Major Utility FL lab & Tampa/St. Pete field tests: WH, load control switch, EVSE, PCT, Pool Pumps
 - 2020-22 PNNL PNW HVAC: Mitsubishi Mini splits
 - 2022+ California WH w PG&E and AEA on WatterSaver program



- EcoPort[™] / CTA-2045 UCM hardware provider
 - AC form factor (FM radio + Cellular)
 - DC form factor (FM radio + Cellular)
- EcoPort[™] / CTA-2045 UCM cloud, API and integration provider







- CTA-2045 is the Consumer Techn
 standard 2045 "Modular Communications Interface for Energy Management" – defines and specifies physical plug, signals, link layer and app layer
- EcoPort[™] is the brand name for products that are certified to a specific level defined in the CTA-2045 standard and are then listed.
- The OpenADR Alliance is hosting the EcoPort[™] brand and certification: https://www.openadr.org/ecoport-info

e-Radio

EcoPort™ / CTA-2045 Information flow





EcoPort™ / Install – Water Heaters







EcoPort™ / CTA-2045 Benefits

- Open standard, anyone can develop technology and then get certified, no wall-garden and provides a solution to stranded resources
- The UCM universal communication module is installable/swappable by customers – No truck roll!
- SGD focus on water heaters but don't forget electric vehicles, HVAC, PTAC, and Pool pumps
- SGD controller is smart and receives *advisory* information using CTA-2045
- SGD provides grid response but maintains customer comfort



Security of Solutions





- UCM hardware security features, firmware updates, unique ID/certificate,
- Secure TLS on top of secure private communication networks like cellular, no customer Wi-Fi
- UCM simple device, no complicated OS, locked down with no backdoors, no malware

e-Radio

Enhanced Future Security (e-Radio)





- Cloud solutions are security mature, Amazon AWS, Microsoft Azure, Google Cloud Platform, IBM Watson and Cisco are all audited to FEDERAL security compliance standards
- Very important to address the security of the connection between the utility and the aggregator, use two factor for manual access and time limited access tokens for APIs
- Auditing of logs and AI/ML applied to access patterns and action to detect abnormal behavior
- AWHI connectivity group is working on a security white paper

e-Radio

Two Way Communication Options

- Two way offers most control and feedback on granular response. Usually higher cost and complexity with some privacy concerns
- Wi-Fi only works with support and for more savvy users and has security and reliability concerns (ex: 20% attrition)
- Local (no internet) device interaction with Bluetooth/ Zigbee/ Wi-Fi can be useful for certain customer interactions
- **Recommend** private networks like low-cost cellular, but AMI, LoRa or others are possible in some situations
e-Radio Two Way Communication Options

 1 minute data for one particular water heater, with available energy storage (room to run) shown in blue and the power level shown in orange



One Way / Hybrid Communication Options

- Paging used in past with some success, but going away, Satellite lacks deep building penetration
- FM Radio is an option that already has a day-job (music/news)
- Broadcast one-way reaches very large areas and populations extremely efficiently with strong customer privacy
- Cybersecurity attack surface is extremely small
- Drawback is lack of granular feedback for certain programs, though confirmation by meter/SCADA is possible



e-Radio FM Radio + Cellular Hybrid

- Try to achieve the benefits of combined one and two way
- FM Radio for bulk/group messaging and security (two factor, etc) applications
- Cellular available on demand for M&V, confirmations and individualized applications
- FM Radio reduces cellular cost, increases reliability and security

- With a two-way connection active, a number of feedback tools are available:
- "ACKS"/confirmation of message response from the SGD
- Customer overrides, SGD device status (including errors requiring maintenance in some cases!),
- Energy Storage capacity remaining (Wh) and power usage (W)
- These can be aggregated in logical groups or grid addresses as needed for real-time or post-analysis
- Drill down to the individual device if needed to investigate unexpected behavior

- Mature programs with large groups that correspond to grid address (feeder/distribution transformer/substation) allows the best opportunity for addressing distribution issues
- Individual addressing and optimization based on algorithms that use machine learning and other methods are also possible
- Several Software as a Service (SAAS) platforms offer out of the box functionality including peak shaving, dynamic GHG or price signals, optimal load shapes based on real grid conditions, etc.





- Current algorithmic tools usually require two-way connection, but the industry is working toward edge intelligence that will make many of these algorithms achievable locally on the UCM with a one-way connection or with minimal two-way
- This will allow lower cost and increased scalability while minimizing some of the privacy and security concerns with having millions of two-way device connections
- The hybrid approach (one way and two way) solves now and future

- Once you can reach devices, what next? Use EcoPort[™] advantages:
- Load Up (2 levels) to use now, Shed (3 levels) to reduce usage
- EVSE and Pool Pump variable speed can use power level 0-100%
- Customer preferences for more / less response from each device on the same command, Thermostat offset or set point change + more
- WH: Cold water protection and ALL: customer override locally

Utility / Aggregator tools and commands

Example: Florida Winter, HPWH

Critical Peak Event (level 2 shed) message allows deferring of 3kWh until after the morning peak, even with customer comfort in place Blue: energy storage (Wh) Green: CTA-2045 commands Red: Water Heater power (W)



Deploying devices and services

- WA, OR state regulation of CTA-2045 is growing the WH side of equation and has eliminated "dongle-itis". The port is required.
- EcoPort[™] / CTA-2045 advantage is ease of deployment, once smart water heaters exist: mail UCM and customer install!
- UCM manufacturers are working hard to drive down cost and make install easy for willing customers (cellular, FM radio auto install)
- Large incentives work for initial growth, what about scale? Optout programs with a sensible default are recommended



Deploying devices and services







Deploying devices and services

- On the aggregator/UCM cloud side, systems to manage and message large numbers of devices exist today from at least two manufacturers
- With large scale utilities still have the choice to integrate with internal DERMS or third party SAAS (UCM clouds are flexible!)
- API integrations already exist for SAAS solutions today



- With TOU, a good open format example exists: CEC MIDAS
- Built with all of US in mind, flexibility to be used outside Cal
- Support TOU, real time prices, GHG, real time load flexibility
- Provides a common framework to lower costs across all utilities by reducing software customization
- Can use simple or advanced methods convert TOU to EcoPort messages automatically (like the dynamic GHG example below)





Handling Dynamic Scheduling

- Other dynamic scheduling options available **now**
- If carbon reduction is a focus, GHG signals based on existing federal emissions data and balancing authority load data have already been demonstrated
- Out the box, this allows customers to reduce carbon emissions using preference slider or just using a default response
- In addition, other load flex apps exist today that can use the same approach



Handling Dynamic Scheduling

 Actual Mar 1, 2021 marginal emissions GHG signal (orange line) for a California region (SGIP: Self-Generation Incentive Program) with proposed simple overlay of threshold-based commands



Solutions for targeted distribution challenges

- UCMs are individually or grid addressable
- Combine efficiency efforts with load flexibility by replacing ERWH/Gas with smart HPWH with UCM pre-installed
- Get two benefits with one installation / incentive: lower load and time optimization
- EV smart charging is even more impactful to the distribution system
- One CTA-2045 EV charger exists, but utilities and regulators could apply pressure to this industry like WH

Solutions for targeted distribution challenges

- Use SAE J1772, the standard for EV charging in the automotive world to get shedding of load and power level control for spread load
- e-Radio is working on a universal plug and play EV adapter to go in between the charger and car to provide load flexibility
- Works with all past and future level 1 and level 2 equip
- This will provide a bridge of functionality until low cost EVSEs move to an open standard like CTA-2045
- Otherwise every utility must deal with 10s of vehicle telematics APIs



Thank you for your time

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Generac Grid Services



Jonathan "JT" Thompson, Vice President, Enterprise Sales **Doug Gross,** Vice President, Sales & Business Development

Generac Grid Services

NEEA Product Council – Flexible Load Programs

>> Doug Gross, VP, Business Development>> Jonathan "J.T." Thompson, VP, Enterprise Accounts

May 17, 2022





Grid Market Trends at a Tipping Point

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The electric power industry will see significant transformation from decarbonization, digitalization and decentralization



The Genesis of Generac Grid Services



Creating a complete value proposition GENERAC SERVICES

Harness the power of flexibility from grid edge assets wile also creating an asset owner ROI





Unlocking Grid Services Value





Technical

Markets

Capacity, Regulation, Primary, Secondary, Tertiary Reserves, and Emerging Mkts (ex. Energy Imbalance)

Business Model + Service Innovation

- **Differentiated Service Offerings**
- End-Customer Bill/Cost Reduction -**Demand Charge Management**
- New Utility Business Model (s)

Global growth of charging stations

Operational Constraints

- **Coal Plant Retirements**
- **Distribution Grid Mgmt Challenges**



Creating Complete Value from DERs

DERs have the potential to deliver multiple value streams to multiple parties. Software is the enabler







End Customer Value



Representative GGS Customers

1.1 GW Connected

19,900 Assets Connected



Case Study #1: Portland General Electric

Achieving distributed flexibility at scale with a Virtual Power Plant

Solution overview

Scope of services	DERMS and VPP Software
VPPs	17 (266 MW)
Total assets	15,601
Flexibility Programs	Energy Partner C&I DR (>100 Industrial loads)
	Multifamily Water Heater (>3,000)
	SMB T-stat (>150)
	EVSE (~700 commercial + ~2,500 residential)
	ADMS Integration
	Electric Island

Why did PGE choose Generac Grid Services?

Rationale

We've been really impressed with the results of our VPP program to date. We've seen faster integration and enablement of resources, positive customer feedback, increased realization rates, and overall greater value out of the resource. We look forward to futher growth and learnings in the coming years. ?? – PGE

Deployed Adaptors

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- Energy Partner C&I DR: Pelican relay, Pelican KYZ, KMC
- SMB T-stat: Plican T-stat, ecobee
- Multifamily Water Heater: Apricity ARA; Apricity CTA2045, Aquanta

PGE

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- EVSE: AddEnergie FLO, OpenADR VTN (ChargePoint)
- ADMS: OpenADR Ven (ADMS)



Case Study #2: AGL Energy

The world's largest VPP: Working with AGL to capture value from the Australian Spot Marketing since 2018





Leveraging Flexibility – Some Questions

Before pursuing flexibility as a resource, there are some fundamental questions that every utility ought to ask itself...

- What problems are we trying to solve for?
- What existing programs do we already have in place?
- Is there a need to create new programs to better address these problems?
- Do we want to be able to gain visibility of and control over existing DER assets in the field?
- Do we have the wherewithal to tackle such a program ourselves, or do we need to partner?



Our Benefits

State of Washington



- > Leverage Installed base & brand of Generac
 - > Over 73K assets
 - > Approx 200 MWs

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- > Industry Leading software & hardware
- Experienced delivery team for performance & advanced software solutions





Thank you!

Q&A



Platform Architecture



3rd Party Integrations & Partnerships

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Generac Grid Services provides the most extensive partner library in the industry





Please continue to drop your questions into the "Questions Box" and our moderators will bring these forward for discussion.

REMINDER: Session 2 will convene at 1:00 p.m. Details & registration link are in your Outlook invitations.