Puget Sound Energy Resource Planning Advisory Group (RPAG) meeting

Meeting Summary

Wednesday, April 17, 2024 | 12:00 – 3:00 p.m.

Meeting purpose and topics

Below are the meeting topics of this Resource Planning Advisory Group (RPAG) meeting:

- Present public feedback summary from March 12, 2024 RPAG meeting
- Discuss the 2024 electric vehicle forecast
- Present a demand response update
- Present conservation potential assessment results

Agenda

Time	Agenda Item	Presenter
12:00 p.m. – 12:05 p.m. *5 min*	**Introduction and agenda review** • Safety moment • Introductions • Agenda review and meeting purpose	**Sophie Glass,** Facilitator, Triangle Associates
12:05 p.m. – 12:10 p.m. *10 min*	**Feedback summary** • Feedback from March 12, 2024 RPAG meeting	**Philip Popoff,** Director, Resource Planning Analytics, PSE
12:10 p.m. – 12:55 p.m. *45 min*	**Electric vehicle forecast** • Background • Methodology • Analysis • Q&A	**Lorin Molander,** Manager Load Forecasting and Analysis, PSE **Gavin Aiello**, Guidehouse
12:55 p.m. – 1:25 p.m. *30 min*	**Demand response programs** • Timeline • Flex programs • Virtual power plant (VPP) • Flex events • Business demand response	**Jeff Tripp,** Manager, Strategic Program Initiatives, PSE **Tom Smith,** Product Development Manager, Residential Demand Response
1:30 p.m. – 2:50 p.m. *80 min*	**Conservation potential assessment results** • Timeline and overview • Energy efficiency	**Aquila Velonis**, Cadmus Group

Time	Agenda Item	Presenter
	• Natural gas energy efficiency • Demand response potential • Rooftop solar potential	
2:50 p.m. - 3:00 p.m. *10 min*	**Next steps and public comment opportunity**	**Sophie Glass,** Facilitator, Triangle Associates
4:00 p.m.	**Adjourn**	**Sophie Glass,** Facilitator, Triangle Associates

The full meeting materials, including the agenda, and presentation are available online under the April 17, 2024 meeting heading on the IRP website.

Action items

Below is a summary of actions from the April 17, 2024, RPAG meeting.

What	Who	When
Confirm in the Feedback Report whether there is a value for the cost of energy that makes sense to be implemented in the Conservation Potential Assessment	Cadmus and PSE	Complete
Confirm in the Feedback Report whether the F22 forecast was used in the 2023 Electric IRP report	PSE	Complete

Introduction and agenda review

Sophie Glass, facilitator, provided an overview of the agenda for the meeting and welcomed RPAG members (see “RPAG members in attendance” on the last page for a list of RPAG members who joined this meeting).

Feedback summary

Philip Popoff, PSE, provided a summary of the public feedback from the previous March 12 RPAG meeting.

During the March 12 RPAG meeting, PSE heard a desire from the public to reflect the social cost of greenhouse gas emissions (SCGHG) in the 2025 IRP in two ways. Based on this feedback, PSE will continue to model the SCGHG as both a dispatch cost and an externality in their analysis. Additionally, the public requested that PSE model ELCCs for hybrid systems. Feedback from RPAG members included addressing transmission constraints in the 2025 IRP, requesting additional information about the expiration of the PG&E exchange, and clarification

from the Utilities and Transportation Commission staff regarding modeling approaches for SCGHG.

Electric vehicle forecast

Lorin Molander, PSE, introduced PSE's electric vehicle (EV) forecast. In January 2024, PSE presented the demand forecast before demand-side resources (DSR). Today PSE is providing an update to that presentation with the most recent EV information they have. Additionally, based on RPAG request, Guidehouse will be providing a deep dive into how PSE calculates its EV forecast.

PSE showed a chart with the winter peak demand before DSR with the new EV forecast demonstrating how much EVs contribute to peak demand.

This section of the meeting ranges from the inform to consult levels of the IAP2 (International Association for Public Participation spectrum).

Gavin Aiello, Guidehouse, provided an overview of the agenda for the presentation on PSE's F24 EV forecast.

Guidehouse performed a forecast of EV adoption for light, medium, and heavy-duty vehicles (LMHDV) from 2033-2050 within Washington state and PSE's service territory across three adoption and three managed charging scenarios. The adoption scenarios address the uncertainty associated with vehicle adoption and their associated energy requirements. Guidehouse additionally projected charging needs, load impacts to support vehicles, and a managed charging analysis that develops average daily weekend and weekday load shapes associated with the charging of the vehicles. As part of this managed charging analysis, Guidehouse developed scenarios for unmanaged charging, business as usual, and managed charging across their aggressive, base, and conservative scenarios.

Guidehouse has supported PSE in EV forecasting since 2019. Each year, Guidehouse iterates its forecasts while refining its methodology. Updates to this year's methodology included light-duty vehicles (LDV), medium and heavy-duty vehicles (MHDV), managed charging forecast, and additional vehicle classes in the MHDV segment.

Guidehouse shared results of the base scenario EV adoption and load impacts. Guidehouse shared three graphs highlighting EV peak before losses, energy need, and EV population to demonstrate the significant forecasted EV growth and energy need. By 2050, 2.6 million EVs are forecasted in PSE's service area, representing 71% of the total vehicle population, requiring 9.2k gigawatt hour (GWh) of energy with an annual EV peak before losses are forecasted to hit 1,800 MWs. In 2050, light-duty EVs are expected to represent 97% of the total EV population but based on policies like the Advanced Clean Trucks (ACT) Guidehouse expects to see

significant adoption and MHDVs as well. The EV peak load associated with EV charging occurs between 7:00- 8:00 PM for most years and is driven by residential charging for LDVs and depot charging for MHDVs.

Guidehouse presented on current market trends for EVs. In 2023, EVs have had a 50% growth in sales compared to 2022. This was driven primarily by favorable federal and state policies such as the Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Act (IRA), PA limits on tailpipe emissions, WA Advanced Clean Cars II, WA Advanced Clean Trucks, and the WA Clean Fuel Standard. Original Equipment Manufacturer (OEM) EV investments and goals have additionally contributed to the growth of EVs. For example, by the end of 2022, OEMs including Toyota Nissan, and Volkswagen announced over 1.2 trillion dollars in investments for EVs. Additionally, General Motors (GM), Ford, and Hyundai set EV sales targets of 50% of new vehicles sold by 2030. However, despite this growth in sales, there is some lingering uncertainty which has led to slower sales in the fourth quarter of 2023. EV market headwinds driven by concerns over industry job loss, infrastructure, and lower customer demand have led to monthly year-over-year (YoY) EV sales growth falling to approximately 30% for the last quarter of 2023. Examples of this include a pushback and slowdown on EV policies such as United Auto Workers and auto dealers petitioning President Biden to slow down EV transitions due to concerns of job loss and readiness. Additionally, some zero-emission vehicle (ZEV) states such as Connecticut have reversed positions on sales mandates. There have also been OEM delays in EV transitions such as Ford postponing the building of their 12-billion-dollar EV battery plant in Kentucky, Rivian pausing the building of their 5-billion-dollar factory in Georgia, and GM delaying construction of their EV drive plant in Ohio and reducing their 2024 EV production targets.

Guidehouse shared statistics of EV sales and national/state EV forecast benchmarks. In Washington state specifically, over the past three years, EV sales have grown by over 50% with a growth of 63% from 2022-2023. Research from other entities like the WA Department of Ecology also confirms strong adoption of EVs in their forecasts.

Guidehouse shared their five key takeaways on EV forecasting.

1. EV adoption and associated energy requirements in PSE's service area are expected to grow significantly. An average of 330 GWh per year of the load is estimated to be added to the PSE system (2023-2050) due to EV adoption.
2. Policy-defined sales targets have the greatest impact. The assumption that WA will hit sales targets established under the ACC and ACT drives very high EV adoption, but it is not certain whether these targets will be achieved.
3. The magnitude of the energy requirements associated with EVs may vary. While EVs will introduce a substantial amount of energy to the PSE system, uncertainty regarding the success of sales targets, vehicle miles traveled (VMT) associated with EVs, and fuel efficiency lead to a wide range of how much energy will be needed.

4. There is uncertainty in LDV forecasts related to home charging. As more individuals without access to home charging adopt EVs, dependence on the workplace and public market charging will likely grow.
5. There is uncertainty in MHDV forecasts related to unknown market behavior. As a nascent market, it is still unclear what the charging needs and behavior may be for large vehicles such as long-haul trucks as duty-cycle, battery efficiency, and use of depot versus en-route charging are not yet well established.

Guidehouse provided an overview of their Vehicle Analytics and Simulation Tool (Vast) Suite which was used for PSE's EV load forecasting. This robust system dynamics model captures the key dynamics that go into vehicle adoption, EV charging needs, and EV load impacts.

Guidehouse used a chart to define their conservative, base, and aggressive scenarios and highlight how they differ regarding incentives, vehicle costs, fuel prices, consumer awareness and acceptance, regulations, MHD trucks, and vehicles miles traveled.

Guidehouse shared the results of the EV forecasts. They showed three graphs representing plug-in electric vehicles (PEV) population, energy, and annual EV peak before losses for the three scenarios. The graph shows minimal differences between the base and aggressive scenarios, where the ACC and ACT are similarly implemented. However, in the conservative scenario, where the policy targets are removed, the PEV significantly decreased by 51%. When looking at energy, there is a noticeable difference between the base and aggressive scenarios. The energy requirement under the aggressive scenario increased by 39% as compared to the base scenario. This was primarily driven by a 30% increase in vehicle miles traveled (VMT). In the conservative scenario, the energy requirement decreased by 76% compared to the base scenario in 2050 due to substantial decreases in the PEV population and the 30% decrease in VMT. Similarly to the energy requirement, annual EV peak before losses is also impacted by the 30% VMT adjustment and the decrease in PEV population leading to a 40% increase in 2050 under the aggressive scenario and a 75% decrease in 2050 under the conservative scenario.

Guidehouse presented how EVs are charged during the day. Guidehouse shared the load shapes of the weekday load in megawatts (MW) over 2030, 2040, and 2050 for the aggressive, base, and conservative scenarios. Guidehouse included corridor charging which represents en-route charging for long haul trucks in their load shape graphs. By 2050, the average EV load before losses during the PSE evening peak from 5:00 to 8:00 p.m. is forecasted to reach 409 MWs under the conservative scenario and 2,382 MWs under the aggressive scenario. This data is similar to the trajectory of peak loads where the aggressive scenario is about 30-40% higher than the base and the aggressive scenario is about 70% higher.

Guidehouse shared how these load-shape graphs change under the managed charging scenario. Under business as usual (BAU) and unmanaged charging where there is a gradually increasing uptake on managed charging there is a noticeable shift in the peak. In the

unmanaged charging scenario, the peak occurs from 7:00 to 8:00 p.m. Meanwhile, in the BAU and managed charging scenarios the peak occurs later from 8:00 to 9:00 p.m.

Guidehouse compared the F23 to the F24 EV forecast. There is a substantial projected decrease of 41% in the total energy needs and 56% annual EV peak load in F24 compared to F23. This decrease is predominantly driven by MHDV. The F24 EV forecast incorporates refinements to the VMT assumptions for the semi-truck and delivery truck classes. Additionally, the F24 EV forecast introduced long-haul and short-haul vehicles as two new vehicle classes which were previously captured under the semi-truck category to increase precision in modeling. Comparing the F23 and F24 load shapes demonstrates how corridor and charging access flatten the load shape. Ultimately, despite uncertainty regarding timing and magnitude, EVs will be adopted with the support of the ACT and ACC.

Guidehouse and PSE answered questions from RPAG members:

- RPAG member: Typically, when there is a regulatory or legal requirement, PSE assumes it will be met. I am confused about the discussion of market conditions. Could you speak to the delta with the assumed level of uptake and how the required standards align with approaches taken elsewhere in the IRP?
    - Guidehouse response: In the modeling of the base and aggressive scenarios, Guidehouse assumed the Advanced Clean Cars and Advanced Clean Trucks sales mandates would be met. In the conservative scenario, Guidehouse assumed the targets would not be hit. As one of the national leaders of EV adoption, WA is very aggressive in its adoption and Guidehouse expects the targets to be met for Advanced Clean Cars. There is a lot of uncertainty around MHDV making it difficult to predict whether the Advanced Clean Trucks target will be met.
- RPAG member: What is the empirical basis of your claim that home charging takes place between 7:00 - 8:00 pm?
    - Guidehouse response: We used residential charging data from National Renewable Energy Laboratory (NREL) to inform our residential load shapes. Here are some studies we have used to validate that assumption.
        - https://www.nrel.gov/news/program/2020/how-might-electric-vehicles-affect-electric-loads.html
        - https://www.nature.com/articles/s41560-022-01105-7
        - https://afdc.energy.gov/files/u/publication/ev_emissions_impact.pdf
- RPAG member: Is there any data suggesting that when EV adoption is higher people drive more miles in vehicles?
    - Guidehouse response: There are limited studies on this topic. We still see people having anxiety regarding the range of EVs. Anecdotally people with EVs don't go

on long road trips. Typically, EVs are driven 5-10% less VMT than internal combustion engine vehicle (ICE) counterparts. This is different for MHDV.
    - PSE response: PSE's Up-and-Go program is evaluating this. We have found that customers report no significant increase in driving from before EV adoption.
- RPAG member: Is the F23 EV forecast the one that was used in the 2023 electric IRP progress report?
    - PSE response: PSE believes the F22 forecast was used in the forecast but will double-check and follow up.
        - *PSE confirmed post-meeting that the F22 forecast was used in the 2023 Electric Progress Report.*

PSE requested feedback from RPAG members on how PSE should navigate the uncertainty with EVs. Should PSE plan for high medium or low levels of EVs in their modeling?

- RPAG member response: Tom Ackman from the Northwest Power Council said, "you don't want to be short for sure, you don't want to be really long, but you should always be a little bit long." I think that is the right perspective when we look at the pace of EV load growth. While we can build new resources faster than we could before, there remains an issue of transmission access. The biggest challenge for EVs is demand response flexibility. People do not want complications around costs and availability. There are still lots of deployment issues for people who live in places where it is difficult to charge, such as people in multifamily dwellings. PSE has a real opportunity to build customer relationships and meet their reliability needs. The challenge is not in the numbers of EVs but in the readiness for adoption.
    - PSE response: I agree with what you are saying about managing the relationship with customers. PSE is really excited about moving forward with our Integrated System Plan (ISP) and vehicle to everything (V2X). We will be sharing more about this in a future presentation.
- RPAG member: The Power Council faces similar challenges in dealing with EV uncertainty. The Power Council addresses this by looking at a range of different futures. This allows us to see if similar resources show up across different strategies. I recommend PSE spend extra time to run additional scenarios.
    - Guidehouse response: Two of the biggest concerns for EVs are home charging and long-haul charging. Research around this is still emerging but in five years we will have access to more data and information. Given this timing, there is value in reassessing EV modeling in the future once more research is available.

Demand response programs

Jeff Tripp and Tom Smith, PSE, presented on PSE's demand response (DR) program. This section of the webinar falls under the informing level of the IAP2 spectrum. PSE provided a

timeline of PSE's work on its demand response program. PSE first started piloting DR in 2008 with commercial and industrial pilots. From 2009 to 2011, PSE had a robust residential pilot with customers. However, there was not a capacity need for DR demonstrated in the Conservation Potential Assessment (CPA) or IRP until 2021 when PSE identified a DR capacity need of 23.66 MW by 2025. Following this, PSE filed its first Clean Energy Implementation Plan (CEIP) and opened bids for approximately 24 MW. Concurrently in the fourth quarter of 2021, PSE bid for a virtual power plant to provide the infrastructure needed to dispatch DR events as well as other distributed energy resources (DERs). After PSE issued a request for proposals (RPP), PSE reached a settlement in its general rate case that set a target of 40 MW in 2024 as a performance incentive mechanism. In 2022, PSE selected from proposals that came in for DER in 2022, went to contract with those in 2023, and started running programs. At the same time, PSE was piloting their virtual power plant, which became fully implemented in September 2023. Most recently, PSE refiled an updated CEIP with an amended DR target of 86 MW by 2025.

PSE has just completed its first season of DR programs. To get here, PSE started shortlisting and contracting from 2021 to 2022. In 2023 PSE started running and launching DR programs such as an opt-out behavioral response program named Flex Events, a Flex Smart thermostat program, a business demand response program, and Flex Rewards, an opt-in behavioral demand response program. Additionally, PSE is excited to be launching a Flex Smart water heating program soon.

PSE defined its flex programs and highlighted their differences. Flex Smart and Flex EV is a program where customers receive rewards for enrolling smart devices in automatic energy reductions such as thermostats, EVs, and EV chargers. PSE adds about 12,000 customers per year to this program. Flex Rewards is a program that does not require any smart devices where customers receive rewards for manually reducing their energy usage. PSE adds about 16,000 customers a year to this program.

Flex Events is an opt-out program reaching about 500,000 customers to notify and provide tips on how to reduce their energy usage. Of those 500,000 customers, there is a minimum thirty percent named community penetration target. Lastly, Business DR is a facility and partner-dependent program where businesses receive payments for participating in personalized energy reduction plans. PSE adds about fifty customers per year.

PSE provided an overview of its virtual power plant demand response dispatch in the winter. Last year, PSE had a target of 5 megawatts, and successfully overshot both their forecast and enrollment targets. PSE is trending upwards to reach its 2024 MW target. Using an Ecobee flex event load curve provides a snapshot of the load shed by considering the baseline load and actual load.

PSE demonstrated the efficacy of its DR program by showing the load curve of a cold storage customer flex event. In the business demand response, PSE has multiple partners including

Americold, Walgreens, Trident Seafoods, Target, E&E Foods, Michaels, Keurig, Overlake Christian Church, Lineage, AMC Theaters, and Dr. Pepper.

PSE's electric vehicle supply equipment (EVSE) and EV telematics program went live on March 7th. This program communicates to cars over Wi-Fi to accommodate people who do not have DR-compatible EV chargers. PSE currently has 540 EV participants and is tracking to more than double this within the next month. PSE is also pairing its PSE marketplace with DR pre-enrollment to build in additional value streams for customers to maximize their benefits and rebate earnings.

PSE answered questions from RPAG members:

- RPAG member: In the Flex Events, do customers receive notifications inviting them to opt in to other compensated DR programs?
  - PSE response: We treat Flex Events customers like an entry-level program. If customers want to be compensated for participation, we create call to action in our emails and messaging to provide routes for people to do so.
- RPAG member: Is Flex Event the only program with a minimum penetration designation for named communities?
  - PSE Response: The reason PSE has this designation for Flex Events is because PSE was able to build it into the program design. PSE is working with marketing and vendors for the other opt-in programs to still meet that minimum or exceed it with the other programs.
- RPAG member: How is the performance of these programs? What have you learned and how will that inform the IRP?
  - PSE response: We will discuss this in the following slides.
- RPAG member: Is PSE seeing any difference in opt-out rates for different program types or appliance types? How is this early data informing PSE's IRP assumptions?
  - PSE response: Opt-out numbers are surprisingly low. On average the opt-out rate per event is about 1%. This is based on historical usage because Original Equipment Manufacturers (OEMs) do not report to PSE. On a wider scale, PSE has a less than 1% opt-out on enrollment. These statistics demonstrate that participants are effectively enrolling and enjoying the program. Due to low opt-out figures, it is hard to apply this to IRP forecasting.
- RPAG member: Given that these programs seem to be performing better than expected, does PSE have any long-term strategic plan to grow a flexible load portfolio, like PGE's (Portland General Electric) flexible load plan?
  - PSE response: Yes, this is ongoing work. We are specifically tackling this in our Integrated Resource Plan by wrapping our energy supply around a customer strategy.

- RPAG member: Most of these events are load-sharing events, are there other shorter time durations but more frequent types of DR?
    - PSE Response: Yes, but not currently. Right now, it would be hard to get rapid response results from DR because the current program design attempts to give a 21-hour heads up on upcoming DR events to help customers and businesses plan. Technology is evolving, and we might have a minute-by-minute DR program in the future.

2025 IRP Conservation Potential Assessment

Aquila Velonis, Cadmus, presented on natural gas, EV, and DR potential in the Conservation Potential Assessment (CPA). This section of the presentation ranges from the inform to consult categories of the IAP2 spectrum.

Cadmus shared a high-level timeline from July 2023 to April 2024 of the CPA tasks. Currently, Cadmus has completed the base case characterization and is modeling the electrification potential and conducting the scenario analysis.

There are eight key themes in the CPA. Research and impacts of the Inflation Reduction Act (IRA) along with program research are two new themes that were added in this CPA. Resources, fuels, underserved communities, climate change, codes and standards/non-energy impacts and scenario analysis, locational analysis & IRP bundles were all themes previously included in the prior CPA. This presentation only contains reference case potential. This means that the potential is relative to PSE's base forecast and the energy efficiency potential results do not include electrification impacts. The potential results represent the achievable technical potential not the economic potential and all the results are shown at the generator unless otherwise specified.

Cadmus provided an overview of its energy efficiency methodology. The technical potential assumes that all the technical feasible resource opportunities can be captured regardless of their cost or market barriers. Technical potential represents the total energy efficiency potential within PSE's service area while only accounting for technical constraints. Achievable technical potential is the portion of technical potential that can be achieved during the studies forecast while taking into account market barriers. Both technical potential and achievable technical potential are included in CPA modeling. The IRP uses achievable economic potential, which is the portion of achievable technical potential that is cost-effective.

There are six steps for estimating conservation potential.

1. Compiling measure data
2. Developing an end-use baseline forest
3. Calculating the technical potential

4. Calculating achievable technical potential
5. Calculating the levelized costs
6. Developing supply curves for IRP modeling

Cadmus is estimating the technical and achievable electric and natural gas 2026-2050 energy efficiency potential for PSE's residential, commercial, and industrial sectors, including street lighting and indoor agriculture. Cadmus shared a list of eight notable inclusions to the study that are included in the reference case results. New to the study is the incorporation of the 2029 gas furnace standard published in December 2023. All new construction is considered as electric with no natural gas load or potential within the residential new constriction segment. Cadmus additionally included climate change by incorporating weather impacts on end-use consumptions over time. The study also incorporates updates to non-energy impacts based on PSE's business cases including a range of Non-Energy Impacts (NEIs) such as health, safety, comfort, and productivity. The study characterizes the potential for underserved communities based on PSE's assessment of vulnerable populations. Cadmus leveraged this data from the 2023 CPA using CETA and CEIP as starting points and aligning it with geographic areas for high-impact communities and vulnerable populations. Cadmus found that the vulnerable population data best aligns with the CPA geographical areas and that vulnerable populations were best suited as the primary identifier for the study. Cadmus additionally revisited the ramp rate based on program research.

Cadmus shared results from the electric energy efficiency potential representing the cumulative 2050 achievable technical potential. These results do not include the economic potential. The residential and non-nonresidential sectors make up 512 aMW. Over half of the potential comes from the residential sector. Cadmus highlighted that there are fewer short-term retrofit measures available for residential than in the commercial sector. In comparing these results to the 2023 CPA, there is a noticeable decrease of 1% in the 10-year total potential and of 4% decrease in the 25-year potential. Looking at the levelized cost bundles from the 2023, the CPA shows that the current study has more expensive energy efficiency compared to the prior CPA. Additionally, the current study has updated in-line loss and global cost inputs.

Cadmus presented sector-specific results. For the residential electric energy efficiency potential, the potential for vulnerable populations is 35% of the total residential achievable potential. Space and water heating end uses comprise 63% of total residential achievable technical potential and new potential accelerates over time due to all-electric codes where heat pump equipment is required. Cadmus shared a list of the top residential electric measures and noted that heat pump technologies make up the majority of top measures. Cadmus highlighted some of the changes from the 2023 CPA. For example, Cadmus incorporated the most recent PSE business case updates, real-time pricing (RTP) updates, added cold climate heat pump measures, and accounted for recent PSE program accomplishments through 2025. Cadmus shared a summary of the top electric industry industrial members. Cadmus noted that this is a

very diverse list and that street lighting increased from the prior CPA partially driven by the addition of a new streetlighting control measure.

Cadmus presented the results from the natural gas energy efficiency potential representing the cumulative 2050 achievable technical potential. Roughly 63% of the 2050 potential is coming from the residential sector which is primarily composed of water heating upgrades and weatherization improvements. There is a substantial 35% decrease in the 10-year total potential and a 34% decrease in the 25-year total potential when compared to the 2023 CPA. There is a similar lower cost potential in the lower cost bundles across the current and 2023 CPA. However, there is less overall potential in the most recent CPA due to the 2029 furnace standard impacting the more expensive bins with equipment measures. Additionally, there are updates to economic assumptions such as line loss and global input costs.

Cadmus presented sector-specific results for the natural gas energy efficiency potential. The potential for the vulnerable populations is 25% of the total residential achievable potential (19 MM Therm). Space heating and water heating make up most of the achievable potential. Other end uses such as dryers, cooking, and pools are minimal. Almost all residential potential is within single-family homes and there is no new construction potential. Cadmus shared a list of the top natural gas residential measures. Water heaters and thermostats represent the top measures. Some changes from the 2023 CPA include a lower overall potential due to no growth in the gas load forecast and multiple update measures. These new measures include no new construction potential, less potential for gas furnaces, PSE business case updates, and Regional Technical Forum (RTF) updates for selected measures. Additionally, there were updates to economic assumptions such as line loss and global input costs along with ramp rate updates. In the commercial sector, approximately 80% of the natural gas potential fell within the sectors of offices, education, and restaurants. Gas heating is the most notable end-use in the commercial sector. The industrial customer load is relatively low compared to commercial and is mostly composed of process heating. Cadmus shared a list of the top natural gas commercial and industrial measures. Top commercial measures include building optimization, commissioning, and energy management systems. Weatherization and window replacements also ranked high. On the industrial side, top measures include process heating and space heating. Most of these measures would be treated within custom projects in PSE's projects. Overall, there is much less construction potential available compared to the 2023 CPA with some limited growth in the commercial sector in some of the segments for natural gas. Commercial changes from the 2023 CPA are similar to the previous sectors. These changes include PSE business case updates, RTF updates for selected measures, ramp rate updates, program accomplishments through 2025 and updates to global cost inputs.

Cadmus and PSE answered questions from RPAG members:

- RPAG member: When discussing ramp rates and achievability factors, is it true these measures are likely to occur but just farther in the future?
    - Cadmus response: We primarily looked at ramp rates and not maximum achievability factors in our study. We focused on the rate of adoption, especially in the near term in a ten-year cycle.
- RPAG member: How did you decide on a 50-50 split for the share between efficiency tier for select technologies?
    - Cadmus response: We looked at historical program data. We were concerned that the share of cold climate heat pumps would be too small and not reflect the future of cold climate heat pumps. The marketplace of cool climate heat pumps is still growing.
- RPAG member: Are cool climate heat pumps more expensive than standard? Is there an over-inflation of the cost measure?
    - Cadmus response: Each measure is looked at individually in terms of levelized costs. Our model works by going to the highest efficiency tier. If we let the model run without any sharing it would all go to cool climate heat pumps. You are right that the levelized costs for cold climate heat pumps determine where they are allocated in the bundles. We have seen that the IRA and federal tax credits reduce that impact on the levelized costs for cold climate heat pumps compared to the lowest tier piece of equipment.
- RPAG member: If the ramp rate increased for IRA incentives does that increase or decrease the potential?
    - Cadmus response: It does not change the final result only the rate at which you get to those specific potential changes. IRA speeds up the early years of adoption. In the sectors where IRA funding is applicable, you see faster adoption.
- RPAG member: Does increasing appliance standards decrease utility potential?
    - Cadmus response: Yes, utility programs can still support IRA and customers that are adopting energy efficiency measures. Heat pumps are still voluntary.

Next steps

- April 23, 2024: Public Webinar on resource alternatives for energy storage
- April 24, 2024: feedback report closes for Apr. 17, 2024 meeting

Public comment

The public comments shared during this meeting can be viewed online in the feedback report posted under the April 17, 2024 heading on the PSE website.

Attendees[1](alphabetical by first name)

1. Adela Arguello
2. Bill Westre
3. Brandon Green
4. Brigette Burwell
5. Chris Goelz
6. Claire Richards
7. Colin Munson
8. Daniel Marshall
9. Diana Aguilar
10. Don Marsh
11. James Adcock
12. Jeffrey Barrett
13. Jesse Scharf
14. John Robbins
15. Leona Haley
16. Lori Hermanson
17. Marcus Sellers-Vaughn
18. Marilyn Subala
19. Mark Klein
20. Matt Larson
21. Meghan Anderson
22. Orijit Ghoshal
23. Paul Koenig
24. Pete Stoppani
25. Peter Besenovsky
26. Quinn Weber
27. Rafael Molano
28. Randy Hardy
29. Sofya Atitsogbe
30. Taylor Nickel
31. Thomas Kraemer
32. Tracey Eixenberger
33. Virginia Lohr

RPAG members in attendance

1. Aliza Seelig
2. Dan Kirschner
3. Ezra Hausman
4. Fred Heutte
5. Froylan Sifuentes
6. Jennifer Snyder
7. Jim Dennison
8. Katie Chamberlain
9. Megan Larkin
10. Sommer Moser
11. Stephanie Chase

Presenters

1. Aquila Velonis, Cadmus Group
2. Gavin Aiello, Guidehouse
3. Jeff Tripp, PSE
4. Lorin Molander, PSE
5. Phillip Popoff, PSE
6. Tom Smith, PSE

Other PSE staff

1. Brett Rendina
2. Meredith Mathis

[1] These numbers do not include viewers on PSE's YouTube livestream

3. Ray Outlaw
4. Kara Durbin

Facilitation staff

1. Emilie Pilchowski
2. Pauline Mogilevsky
3. Sophie Glass
4. Will Henderson