



# NARUC

National Association of Regulatory Utility Commissioners

## Considering Interoperability for Electric Vehicle Charging: A Commission Case Study



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This document was developed as a companion piece to NARUC's Smart Grid Interoperability: Prompts for State Regulators to Engage Utilities (February 2020) and Smart Grid Interoperability Learning Modules. Readers can find these additional resources at [www.naruc.org/cpi-1/energy-infrastructure-modernization/smart-grid/](http://www.naruc.org/cpi-1/energy-infrastructure-modernization/smart-grid/).

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## Summary

As adoption of electric vehicles (EVs) increases across the United States and charging equipment to power vehicles is installed, the electricity system, states, utilities, EV manufacturers, EV supply equipment (EVSE) manufacturers, and stakeholders are grappling with how to ensure smooth integration of these resources. Interoperability ensures that communication, coordination, and integration of devices, such as electric vehicle supply equipment (EVSE), are integrated efficiently and effectively.

In July 2021, as part of an ongoing initiative, the Connecticut Public Utilities Regulatory Authority (PURA) established a statewide, zero-emission EV program. In this program, utilities were tasked with developing requests for proposals (RFPs) targeted at prospective EVSE providers. To aide in the development of these RFPs, the National Association of Regulatory Utility Commissioners (NARUC) and Plugged in Strategies, with support from the U.S. National Institute of Standards and Technology (NIST), consulted with the PURA to facilitate an EVSE interoperability stakeholder working group.

Using the NARUC 2020 report [Smart Grid Interoperability: Prompts for State Regulators to Engage Utilities](#) as a guide, participants in the working group workshops identified a series of recommended key considerations for inclusion in the Connecticut vehicle charging program. The results and discussions of the working group were shared with the PURA on October 1, 2021, which resulted in guidance to Connecticut's electric distribution utilities on the RFPs to EVSE vendors that included certain interoperability requirements.

This case study report summarizes the process and findings from the workshop series and maps the Commission's approach to the Prompts for Regulators resource. Other states might learn from this example as they face similar questions in the future.

## Support for Utility Regulators in Considering Interoperability

In April 2020, NARUC released the report, [Smart Grid Interoperability: Prompts for State Regulators to Engage Utilities](#), to help utility regulators better understand the role of interoperability in reviewing utility proposals, and the types of processes and questions to use in that review process.<sup>1</sup> While interoperability is often thought of as a technology problem, interoperability also requires organizational support. The document identified five steps for a regulator to take to address interoperability questions when reviewing utility proposals—which include both technical and organizational approaches.

**Step 0 - Internal Questions for Regulators to Ask Themselves.** This step is designed to allow regulators to take an account of their current capabilities to ask about interoperability, understand the responses, and be prepared to act.

**Step 1 - Identify Business Case and Benefits of Interoperability.** This step helps regulators look for key components of interoperability in any utility proposal. This is where a regulator would ask how interoperability is defined and identify any benefits of interoperability.

**Step 2 - Ensure New Equipment/Investments Work with Legacy Equipment/Investments.** In this step, regulators would look at how new investments are designed to work with legacy investments. For example, this might include how communications between new EVSE and legacy utility metering and communication systems can occur to generate a correct customer bill under an EV rate.

**Step 3 - Ensure Investments Today Support Investments Tomorrow.** Similar to step 2, but looking into the future, this step addresses how investments being considered today work with future investments. This approach may be called futureproofing.

**Step 4 - Profile Development.** Once a regulator—with the utility and its stakeholders—has determined a need for standards and interoperability, a valuable step can be creating an interoperability profile to harmonize pieces from multiple standards. A profile allows an entity to take a standard (or set of standards) that contains multiple options and create a profile that leverages some of those options and organizes them into one logical framework.

The questions identified in the report, [Smart Grid Interoperability: Prompts for State Regulators to Engage Utilities](#), are not all-encompassing but can be used by a Commission to organize their topics and questions of interest.

In Connecticut, the PURA initiated a proceeding to consider policies that will support the development of EV adoption and infrastructure across the state. On July 14, 2021, the PURA issued a decision that identified interoperability as an important consideration for EVs because multiple companies produce vehicles, will offer EV charging equipment, and might offer services related to the adoption and charging of various types of EVs.<sup>2</sup> The utility will also play a significant role in the adoption of EVs by ensuring adequate infrastructure is in place to handle EV charging and adopting rate designs that support EV charging infrastructure in balance with the grid. This case study highlights why and how CT considered interoperability in its EV recent decision making and how other states can use the Prompts for State Regulators report to do the same in their jurisdictions.

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1 Smart Grid Interoperability: Prompts for State Regulators to Engage Utilities, NARUC (April 2020). <https://pubs.naruc.org/pub/28950636-155D-0A36-313C-73CCEA2D32C1>

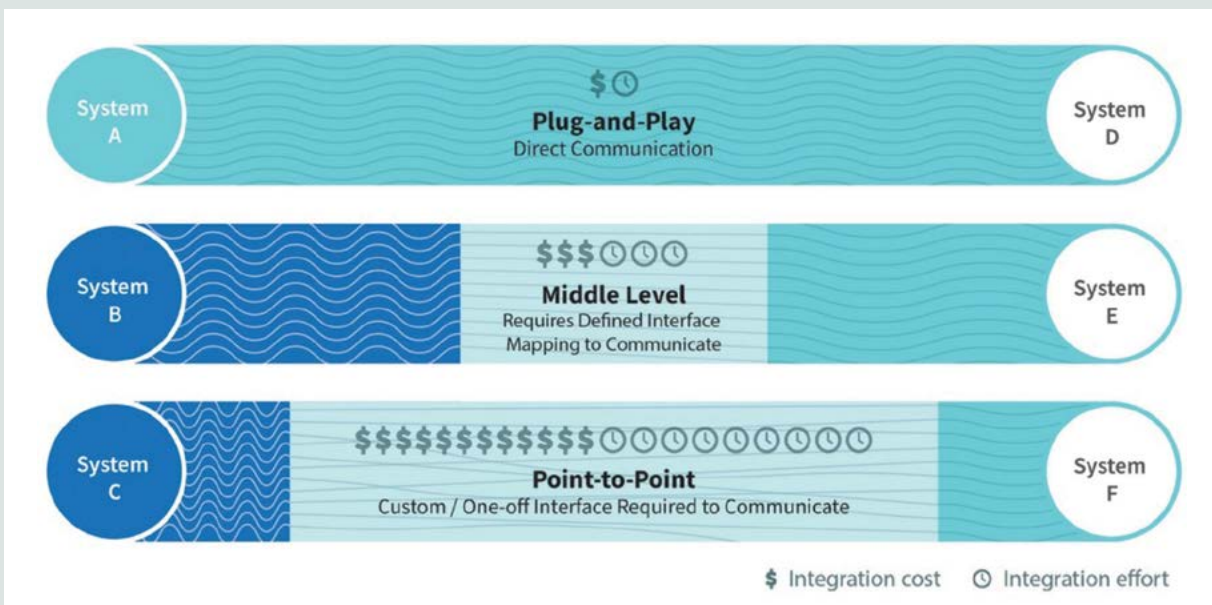
2 PURA Investigation into Distribution System Planning of the Electric Distribution Companies – Zero Emission Vehicles, Decision, Docket No. 17-12-03RE04 (July 14, 2021), [http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/eb6c28c81c508b208525875200799494/\\$FILE/171203RE04-071421.pdf](http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/eb6c28c81c508b208525875200799494/$FILE/171203RE04-071421.pdf)

## Interoperability

To understand the role and impacts of interoperability, especially for a regulatory body, it is necessary to define interoperability, so all participants understand what the term means. As defined by NIST, interoperability is:

“The capability of two or more networks, systems, devices, applications, or components to work together, and to exchange and readily use information — securely, effectively, and with little or no inconvenience to the user. The smart grid will be a system of interoperable systems; that is, different systems will be able to exchange meaningful, actionable information in support of the safe, secure, efficient, and reliable operations of the grid. As the number of devices and systems used on the electrical grid continue to multiply, the interoperability requirements become more complex and the path to achieving interoperability becomes more challenging.”<sup>3</sup>

**Figure 1. Levels of Interoperability - National Institute of Standards and Technology**



As noted in **Figure 1**, interoperability occurs across a spectrum.<sup>4</sup> A less interoperable system, requiring “point-to-point” integration, incurs greater cost as more and customized interfaces are needed to integrate disparate systems; as systems become more interoperable, costs go down and result in a more seamless “plug-and-play” scenario.

3 “NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 4.0,” NIST, NIST Special Publication 1108r4, at 3 (February 2021). <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1108r4.pdf>

4 Presentation of Avi Gopstein at 30 (August 4, 2021). [http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/d1a365d1414fd07e852587520079952c/\\$FILE/CT\\_PURA\\_Workshop\\_Interoperability\\_August\\_9\\_2021.pdf](http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/d1a365d1414fd07e852587520079952c/$FILE/CT_PURA_Workshop_Interoperability_August_9_2021.pdf)

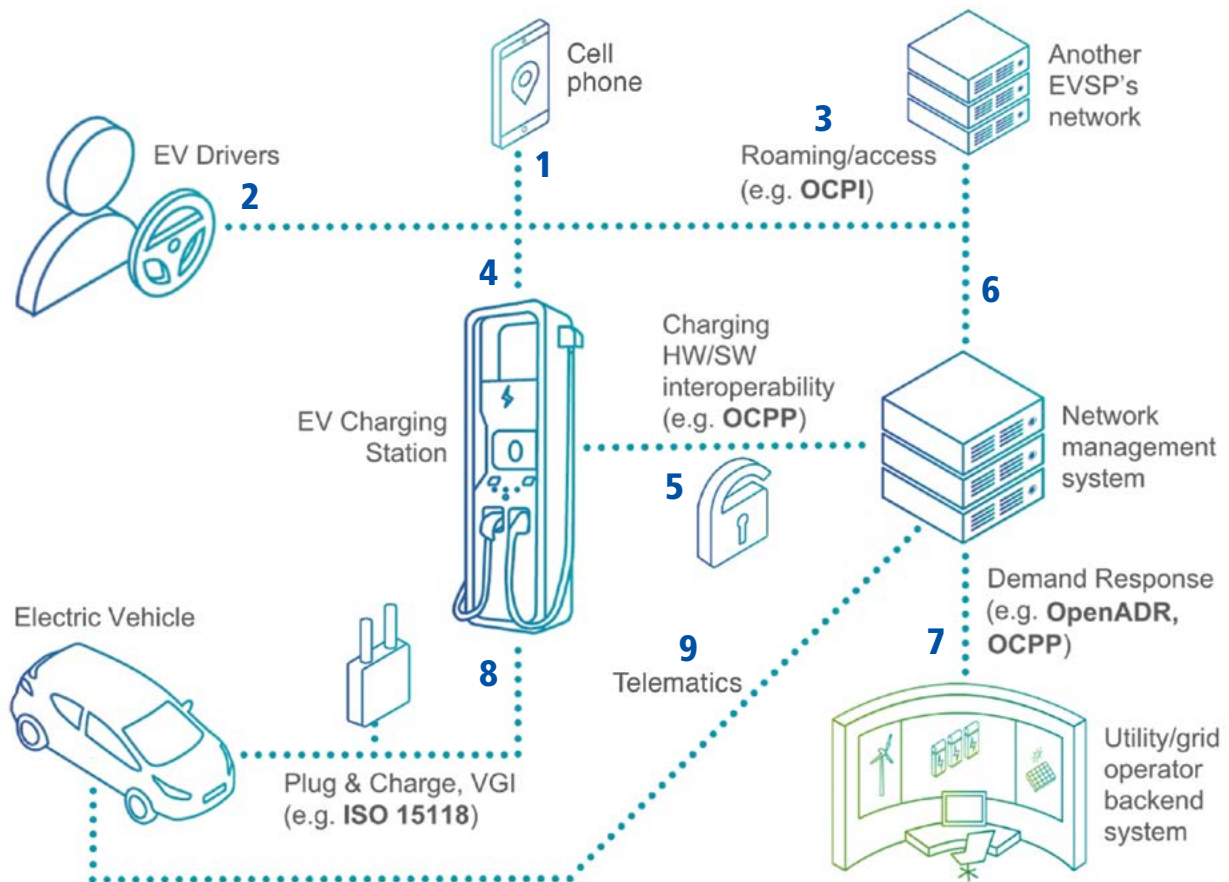
## Interoperability and Electric Vehicle Charging

For the EV industry, concerns about interoperability flow across several interfaces: utility to EVSE; EVSE to EV; EVSE to customer; customer to utility.

**Figure 2**, modified from Shell Recharge Solutions (formerly Greenlots),<sup>5</sup> identifies nine interfaces, with each interface a combination of multiple standards, data and communication needs, and actions. It also provides an example of where a regulator may have a direct impact, an indirect impact, and no impact at all. The interfaces are:

1. Driver to mobile device
2. Driver to EVSE
3. Mobile device to electric vehicle service provider (EVSP) network
4. Mobile device to EVSE
5. EVSE to network
6. Network to network
7. Utility network to network
8. Car to EVSE
9. Car to utility network

**Figure 2. Points of Interoperability with EVSE – Shell Recharge Solutions (formerly Greenlots)**



The last interface, car to utility network, uses vehicle telematics to receive messages directly from the utility, and bypassing the EVSE, is an emerging use case. Such communications that leverage a vehicle's telematics may include communications through an app that could interface directly with utility systems.

For the regulator, this image can be used to identify the areas where it may have some authority, such as communications between the utility system and with other EV networks, including the EVSE.

<sup>5</sup> Presentation of Greenlots at 4 (August 9, 2021). [http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/d1a365d1414fd07e852587520079952c/\\$FILE/CT%20PURA%20Workshop%20Interoperability%20August%209%202021.pdf](http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/d1a365d1414fd07e852587520079952c/$FILE/CT%20PURA%20Workshop%20Interoperability%20August%209%202021.pdf)

## Connecticut PURA's Equitable Modern Grid Initiative and July 2021 EV Decision

On October 2, 2019, the Connecticut Public Utilities Regulatory Authority (PURA) issued an order to reopen several proceedings to consider a variety of distribution-related policy considerations, including electric vehicles (EVs), that are integral to meeting the objectives of the PURA in its Equitable Modern Grid initiative.<sup>6</sup> The purpose of the EV proceeding, Docket No. 17-12-03RE04, as described by the PURA, is “to enable Connecticut’s commitment to the ten state Memorandum of Understanding (MOU) to collectively deploy 3.3 million [zero emission vehicles (ZEVs)] among the participating states by 2025.”<sup>7</sup> In particular, understanding how EVs will be deployed and integrated into Connecticut’s electric grid was identified as a key component of meeting the Equitable Modern Grid framework. (See Appendix A for more information about the procedural history of Connecticut’s Equitable Modern Grid Initiative, which led to the July 2021 decision.)

Specifically, development of EVs in Connecticut should: “(1) support (or remove barriers) to the growth of Connecticut’s green economy; (2) enable a cost-effective, economy-wide transition to a decarbonized future; (3) enhance customer access to a more resilient, reliable, and secure commodity; and (4) advance the ongoing energy affordability dialogue in the State, particularly in underserved communities.”<sup>8</sup> To meet these goals, the PURA issued EV-related program guidelines and requirements for its utilities to implement, including implementation of time of use rates, rebates for charging equipment, administration of a make-ready program, and ensuring that underserved communities are part of this opportunity.

On July 14, 2021, the PURA issued an order in Docket No. 17-12-03RE04.<sup>9</sup> In that order, the PURA established a statewide, zero-emission EV program to be implemented by its electric distribution companies (EDC), Eversource, and United Illuminating. Among the policies adopted in this order was one directed towards a program to fund EV supply equipment (EVSE) to help facilitate the growth of EV charging infrastructure. The utilities were directed to develop a request for proposals (RFP) from EVSE providers to determine eligibility of equipment for funding under the program. To help the EV industry and utilities in Connecticut inform the development of that RFP, the PURA directed that a series of workshops take place “to inform the EDCs’ EVSE procurement processes and standards, including the development of an RFP and any other program guidance documents.”<sup>10</sup>

The July 2021 decision adopted a zero-emission EV program available to all customers and customer classes of the EDCs. The EDCs, therefore, were directed to develop the program and program rules and submit them to the PURA for approval. In addition, the PURA identified the topic of interoperability for the EV market for additional discussion.

As the PURA noted in the July 2021 order, “statewide deployment of EV charging infrastructure poses numerous interoperability considerations that require further examination, including, but not limited to, multiple charging plug types, emerging technological advancements such as wireless charging technologies and onboard telematics capabilities to facilitate managed charging, charger and utility infrastructure

6 PURA Investigation into Distribution System Planning of the Electric Distribution Companies, Interim Decision, Docket No. 17-12-03 (October 2, 2019) (Interim Decision), [http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/0e5fc32986954bf78525875200798b44/\\$FILE/171203-100219%20InterimDecision.pdf](http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/0e5fc32986954bf78525875200798b44/$FILE/171203-100219%20InterimDecision.pdf)

7 Interim Decision at 4. On October 24, 2013, the governors of California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island, and Vermont signed a memorandum of understanding (MOU) committing to coordinated action to ensure the successful implementation of their state zero-emission vehicle (ZEV) programs. Collectively these states are committed to having at least 3.3 million ZEVs operating on their roadways by 2025. More information at: <https://www.nescaum.org/documents/multi-state-zev-action-plan.pdf>.

8 Interim Decision at 4-5.

9 PURA Investigation into Distribution System Planning of the Electric Distribution Companies – Zero Emission Vehicles, Decision, Docket No. 17-12-03RE04 (July 14, 2021) (Decision).

10 Decision at 37.



communications systems and interfaces, and payment options.”<sup>11</sup> To address concerns around interoperability, the PURA identified the need for a working group to discuss the interoperability needs to implement its EV guidance. In particular, the PURA noted that the working group sessions are to “investigate interoperability as it relates to open access, payment methods, and charger to network, network to network, and vehicle to network communications to inform baseline standards and protocols for EV charging stations. The resulting EVSE procurement specifications shall contemplate the following criteria, including:

- “Applicable standards for networked Level 2 EVSEs and [Direct Current Fast Chargers (DCFCs)], including methods for collecting and providing charging network data to the EDCs;
- Adherence to the OCPP, Open Charge Point Interface (OCPI), ISO 15118, and/or the Open Automated Demand Response (OpenADR 2.0b);
- Applicable testing and certification processes;
- Demonstrated compliance with the Americans with Disabilities Act;
- Multiple payment mechanisms in compliance with Conn. Gen. Stat. § 16- 19ggg and any other applicable statutes or regulations;
- Requirements and protocols to ensure consumer protection, pricing transparency, and customer service support; and
- Minimum charging capacity for eligible Level 2 chargers and DCFCs.”<sup>12</sup>

With support from the National Institute on Standards and Technology (NIST), the National Association of Regulatory Utility Commissioners (NARUC) and its subcontractor Plugged In Strategies provided assistance to the Connecticut Public Utilities Regulatory Authority (PURA) on the topic of interoperability and EVs by facilitating five virtual workshops in August 2021. The workshops were held to ensure that the utility RFPs incorporated interoperability rather than relying on proprietary standards or closed procedures, as well as to educate stakeholders on the application of interoperability to EV development.

## The Working Group and Workshop Process

In its July 2021 order, the PURA adopted EVSE procurement guidelines for its EDCs. To support the guidelines, PURA directed the EDCs to issue a RFP “to develop a list of approved EVSE vendors, makes, and models” to satisfy each program designed as adopted by the PURA in this decision.<sup>13</sup> This RFP and list was to be submitted to the PURA by October 15, 2021 for their final review before the EDCs could implement the policies adopted in the decision. The RFPs were to consider lessons and experiences already learned by the EDCs in their work in Connecticut and from their affiliate utilities in other states. In addition, the development of a working group report by Plugged In Strategies was to inform the EDCs in the development of their RFPs.<sup>14</sup> To help the utilities in that task, the PURA assembled a working group (by open notice and invitation to the public) that held wide-ranging conversations across several topics explained below. Participants included the EDCs, EVSE providers, consumer advocates, EV manufacturers, and environmental and other non-profits. The conversations focused on understanding electric vehicle-charger-grid interfaces, the role of the utility, the role of the customer, and the role of the EVSE and marketplace to help determine the roles and responsibilities for interoperability. The PURA and stakeholders were trying to find a balance between leading the market and technology to futureproof investments while ensuring ease of use, lowering barriers to entry, and reducing customer costs.

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11 *Id.*

12 *Id.*

13 Decision at 36-37.

14 “Investigating Interoperability for Electric Vehicles: A Case Study from Connecticut,” NARUC, on behalf of the Connecticut Public Utilities Regulatory Authority (October 4, 2021) (Interoperability Case Study). [http://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/efc86a82714dbf5785258764005b3409/\\$FILE/NARUC%20CT%20Case%20Study%20on%20EV%20Interoperability-submission.pdf](http://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/efc86a82714dbf5785258764005b3409/$FILE/NARUC%20CT%20Case%20Study%20on%20EV%20Interoperability-submission.pdf)

Five workshops were held in August 2021, organized by Plugged In Strategies and NARUC, to support the PURA in better understanding the interoperability concerns, use cases, and needs to support EV adoption in Connecticut. The working group report was submitted to the PURA on October 1, 2021.

The focus of all workshop conversations was to better understand, identify, and describe the importance of interoperability to the development of an EV marketplace in Connecticut. In the context of the PURA order, the workshops specifically provided stakeholders an opportunity to discuss how interoperability will be addressed by the utilities in their RFPs. Participants, including EVSE providers and car manufacturers, were given opportunities to share perspectives throughout the workshops regarding where interoperability guidance was needed, how to ensure that all customers can participate, how to build a system that accommodates all types of EVs, but also to caution against one-size-fits-all approaches and provide opportunities for the market to address some needs. For example, an item identified in the PURA order related to payment mechanisms (e.g., credit cards and phone apps) at the EVSE. Discussions during the workshops sought to find a balance between ensuring all EV owners can utilize an EVSE, but that requirements do not unnecessarily increase the costs of the EVSE.

In addition, workshop participants explored the different use cases (examples) for how interoperability will enable adoption of EVs. Example use cases include:

- Different interoperability needs for Level 2 charging compared to direct current fast charging (DCFC);
- Differences in interoperability needs for a utility managed charging program versus one run by a third-party provider;
- Different approaches to ensuring backwards compatibility and futureproofing;
- Different data needs for identifying locations to site several types of EVSEs (especially for large and multiple DCFC equipment)
- Rate design impacts from the EVSE and utilization rates;
- Types of communications and network settings needed to integrate EVSE into utility planning and operational functions, and, potentially to dispatch those EVSE in response to local or grid need; and
- Messages needed to be provided to customers to ensure they understand what they are getting.

The PURA helped narrow some of these thorny topics by providing an initial set of criteria, but as the conversations in the working groups continued, several other topics were identified for PURA and utility consideration. A fruitful conversation was enabled by allowing stakeholders the opportunity to present their own perspectives, as well as hear from in-state and out-of-state groups that provided comparisons and other solutions. Finally, the process endeavored to collect an initial list of standards that may be relevant to initial and future EV deployment in Connecticut as a starting point.

## Overview of the Workshops

### A. Organization of Workshops

The five scheduled workshops were designed to function as educational opportunities for stakeholders to learn more about interoperability, bring in presenters to discuss experiences with interoperability, and to engage workshop participants on how to apply interoperability in the development of the EDC's RFP. Each workshop included time for participants to ask questions, engage with each other, and offer opinions and suggestions for going forward on interoperability. These workshops were open to the public and officially noticed by the PURA.<sup>15</sup>

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15 PURA Investigation into Distribution System Planning of the Electric Distribution Companies – Zero Emission Vehicles, Notice of Electric Vehicle Supply Equipment (EVSE) Interoperability Working Group Technical Meetings, Docket No. 17-12-03RE04 (July 19, 2021). [http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/22d6da7b8d4253a285258752007994b6/\\$FILE/17-12-03RE04%20Notice%20of%20Interoperability%20Working%20Group%20Technical%20Meetings.pdf](http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/22d6da7b8d4253a285258752007994b6/$FILE/17-12-03RE04%20Notice%20of%20Interoperability%20Working%20Group%20Technical%20Meetings.pdf)

Participants in the workshops included the EDCs, EVSE providers, consumer advocates, EV manufacturers, and environmental and other non-profits.

The organization of the workshops were informed by materials previously prepared by NARUC for its member state agencies, materials prepared by NIST on interoperability and interoperability as it applies to the EV market, and related efforts from Connecticut and around the country. The workshops resulted in guidance for the PURA to use in their review of the EDCs' draft RFPs, including questions to ask to ensure sufficient support for the PURA's findings.<sup>16</sup>

Workshop organizers originally intended to sequence the workshops in a way that started at a high level (i.e., what is interoperability), then each subsequent workshop would focus on a particular topic designed to get deeper into the application of interoperability for EVs. In practice, the conversations of the participants helped inform subsequent workshops as new topics were addressed and time was allotted for participants to discuss those new topics. For example, the topic of metrics was an item of interest identified by participants that was not initially identified by the facilitators but was agreed to be a key component of understanding how interoperability is implemented by the EDCs.

## B. Workshop Topics

A high-level overview of each workshop is provided below. For more details, presentations and notes from each workshop can be found in the meeting materials linked in the footnotes.

**Workshop 1** was held on August 4, 2021.<sup>17</sup> This was the initial workshop and featured introductory remarks from PURA Chair Marissa Gillet, an overview of the effort from Plugged In Strategies, and an introduction to interoperability from Avi Gopstein from NIST. Mr. Gopstein's presentation covered the following topics:

- NIST Smart Grid Interoperability Framework, Version 4;
- Benefits of interoperability;
- Smart Grid Framework concepts and tools;
- Testing and certification and interoperability profiles; and
- Introduction to EV interoperability profile for managed charging.

**Workshop 2** was held on August 9, 2021.<sup>18</sup> This workshop featured presentations from the Connecticut Department of Energy and Environmental Protection (DEEP), ChargePoint, Greenlots, and BMW. There were also discussions with stakeholders to identify important priority topics, which included data, communications, metrics, and use cases.

**Workshop 3** was held on August 12, 2021.<sup>19</sup> For this workshop, the utilities started the conversation with a presentation on how they are considering interoperability in the development of their programs, pursuant to the July 2021 decision. There were also presentations from the Electric Power Research Institute (EPRI) and UL, which described some research projects around the country, technical questions around interoperability, and the testing and certification landscape for the EV market. After the presentations, stakeholders continued their discussion on priorities, identifying metrics, messaging, and futureproofing as particularly important.

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16 Interoperability Case Study.

17 <http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/66971338433d3b308525875200799535?OpenDocument>

18 <http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/d1a365d1414fd07e852587520079952c?OpenDocument>

19 <http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/ac8d092d6cf8c515852587520079953b?OpenDocument>

**Workshop 4** was held on August 18, 2021.<sup>20</sup> Speakers for this workshop included Cuong Nguyen from NIST, who discussed activity at the Smart Energy Power Alliance (SEPA) to develop an EV interoperability profile. There was a panel discussion with Tesla, Connecticut Green Bank, and the Office of Consumer Counsel. During this session, participants also identified an initial set of recommendations and finalized an initial set of standards.

**Workshop 5** was held on August 24, 2021.<sup>21</sup> This was the final workshop and featured one outside speaker, Kristi Fleischmann Groncki from BGE, who discussed BGE's experience with interoperability and implementation of a utility EV procurement program. This workshop also included stakeholder conversations regarding interoperability criteria as identified in the July 2021 order, ongoing conversations on use cases, and discussion of the outline of the facilitator report.

## Key Considerations Identified by CT Working Group Members

During the working group meetings, the facilitators sought to allow stakeholders to engage with each other through a set of questions and topics identified in each meeting agenda. As a result of the workshops, stakeholders raised several key considerations regarding interoperability in Connecticut. These topics emerged as the areas in most need of discussion, collaboration, and potential future regulatory action. We expect that other states would share some or all these concerns, along with others not mentioned here.

### Consideration 1: Relevant Use Cases

Throughout the conversation during the working group meetings, it became apparent that interoperability impacts on EV deployment could not be applied in the abstract; rather, it was important to identify use cases and then address the interoperability needs for each use case. As identified above in **Figure 2**, there are different interfaces between different parties. Identifying those use cases and then applying them to the particular situation of a given jurisdiction can be a helpful way to parse the technological needs and the appropriate standards to focus on for EV adoption.

In the PURA conversation, participants identified two main use cases: utility-owned EVSE and non-utility-owned EVSE. Each use case includes considerations related to its implementation. For example, for the non-utility owned EVSE use case, participants identified the following considerations:

- EVSE location (e.g., available grid capacity, equity and environmental justice concerns);
- Target application or use (e.g., residential, commercial, multi-family, fleet, etc.); and
- Charger power level (e.g., Level 2 vs. DCFC).

The interoperability needs and requirements may be different depending on these considerations. For example, the need for interoperability standards related to customer payment may be relevant to EVSE in commercial or public locations but not to those supporting fleet charging. Some of these considerations may also be applicable to other use cases. Having a jurisdiction engage in the development of use cases and identifying those most relevant to the situation at hand will help stakeholders and the regulator understand interoperability needs.

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20 <http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/cd8b0491662048e2852587520079955c?OpenDocument>

21 <http://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/5c23875e79d9ab6a8525875200799575?OpenDocument>

## Consideration 2: Data and Communication Needs

After Connecticut working group members identified use cases, they considered the data and communication needs to support those use cases. For data, there was a recognition that it is an increasingly foundational component of the modern electricity grid and a vital component to enable innovative market products and services, including integration of EVs into the system.

The data needs will depend on the use case. Utility-owned equipment will have different data and communication needs than third-party or site-host owned DCFC, for example. Working group members did not agree on specific data needs, but requested further attention from the utilities and regulators in the future.<sup>22</sup>

For communication, without the ability to communicate in a timely manner and to share the data, it will be extremely hard for third-party or site-host owned EVSE to participate and be responsive to grid needs. Also, depending on the use case, the latency of the communications may be different. Further, clarity on communications protocols will be important to provide the customer with rate and cost information, how the EVSE will communicate with the car and utility networks to provide needed and actionable information, and what type of equipment is available at a given location.

## Consideration 3: Metrics

The topic of metrics was brought up by working group members, even though the original focus of the effort had been on the immediate need of standards and requirements for a utility RFP to support an EV procurement document. Stakeholders determined that having standards and guidance would be of less use if there were no ways to measure the utility's progress towards meeting that guidance or implementing those standards. Specifically, stakeholders began to ask questions around how the PURA, stakeholders, or the public would know if the utility was implementing its program in an interoperable manner.

One set of metrics discussed by participants relates to the performance of equipment, which may be helpful with tracking interoperability, and is also likely to be more important to the PURA as a measurement of EV adoption. Equipment performance metrics considered by stakeholders included:

- Monitoring kWh dispensed on an hourly basis;
- Collecting information on uptake rates of the EVSE;
- Customer experience with EVSE and the utility program;
- Tracking the time of day that charging occurs; and
- Utilization factors for the EVSE.

In addition, a more fundamental metric was discussed by stakeholders: how to measure interoperability. Should that measurement be focused on quantitative components, such as number of devices using a particular standard, or should it be more qualitative and based on equipment performance? As it applies to the utility RFPs, ways to measure interoperability could include:

- Listing of eligible equipment and chargers;
- Availability of data in a common format;
- Utilization factor from a performance perspective;
- Creating reliability and availability performance standards; and
- Network uptime rates.

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<sup>22</sup> Workshop Report at 11.

While this process did not provide any comprehensive metrics to measure either interoperability or the EDCs' adherence to interoperability requirements, it was recognized that such an effort may be useful to monitor utility performance and interoperability of these investments.

#### **Consideration 4: Futureproofing**

A traditional benefit of interoperability is that it can help futureproof investments. In essence, the idea of futureproofing is that by planning which components are upgradable, the implementer (i.e., utility) would structure the interoperability and use of that equipment to maximize the upgradable portions so when the next iteration of a technology is available, a smaller portion of that system can be upgraded without needing to replace the entirety of the investment (e.g., being able to upgrade software via Wi-Fi). As discussed during the PURA workshops, futureproofing can help with planning obsolescence of specific technology so that investments can be made into equipment when appropriate. Stakeholders determined that PURA should consider being more specific in delineating responsibilities and expectations around futureproofing in the review of utility filings to ensure futureproofing is carefully considered in utility plans and filings.

Notably, stakeholders suggested that the PURA consider requiring the utilities to:

- Appropriately include futureproofing as a requirement for any utility investment or procurement of assets;
- Identify when equipment will need to be replaced or upgraded;
- Share what technologies require only a software upgrade;
- Explain how they will monitor equipment to know when an upgrade or change to technology is needed;
- Address standardizing information exchanges and interoperability to support futureproofing; and
- Ensure there is appropriate testing and certification of equipment to maintain confidence that the technology is certified to the standard.

A regulator could establish these as a requirement for any new and future investments, make them a condition of approval of any investment, or these could be components of discovery requests to the utility. Understanding how the utility intends to futureproof investments is an important financial consideration; if an investment is not appropriately futureproofed or does not address futureproofing, then it may be obsolete before it fully depreciates, which would then negatively impact the interoperability of that investment. As such, utility customers may not receive the full benefits of the investment and may have to pay for any replacement costs.

#### **Consideration 5: Identification of Standards**

From the start of the working group process, there was an effort to collect an initial set of standards that may be used by the utility or the market to promote EV adoption and to integrate with the electric grid. The list is not exhaustive but is an initial set of standards developed by attendees for the PURA and utilities to consider in their planning effort. The standards identified are listed below, including:

- Open Charge Point Protocol
- Open Charge Point Interface (OCPI)
- ISO 15118
- Open Automated Demand Response (OpenADR 2.0b)
- IEEE 2030.5
- IEEE 2030.1.1TM-2015 (CHAdeMO) – DC fast charging protocol
- IEC 61850 – Communication networks and systems for utility automation
- IEEE 1815 – Distributed network protocol 3 (DNP3)
- SAE J1772 – EV and PHEV charging standard

- SunSpec Modbus
- ENERGY STAR
- Applicable cybersecurity and payment standards

Included in this discussion is whether the PURA should mandate compliance to certain standards. Two specific standards were the subject of debate:

- Whether ISO 15118 should be mandated in Connecticut for communications with EVSEs?<sup>23</sup>
- Should the use of a proprietary connector standard be eligible for the EDC EVSE program and rebates? Put another way, can the commission effectively exclude specific companies' proprietary EVSE equipment from ratepayer-funded programs because it is not interoperable?

Discussions ranged from whether a standard was mature enough to be mandated (i.e., does it have robust testing and certification requirements and has it been thoroughly vetted by standards development organizations) and to what extent proprietary standards should be considered for public funding. Considering the still growing nature of the EV market and EVSE providers, regulators are generally being deliberate and measured in determining mandates and use of proprietary standards.

### Applying Connecticut's Example to Other States

By leveraging the practices and questions identified in the NARUC Prompts for Regulators, a regulator can better organize its internal processes, including identification of its own capabilities and where assistance is needed, how to organize a proceeding, and what it hopes to get out of the process.

In the case of Connecticut, by establishing this workshop process, the PURA was able to bring together participants to discuss the topic of interoperability and how to ensure the EV marketplace in Connecticut continues to grow. By establishing a multi-stakeholder and multi-step process to explore relevant issues, Connecticut participants were able to sort through many broad topics related to interoperability and EV charging to identify a smaller subset of key considerations most relevant for their jurisdiction.

However, it was also clear that work is still left to do as certain standards do not yet have full buy-in from all participants, and there is a need to ensure that what is implemented today will work with what comes tomorrow.

Two key questions for the Connecticut PURA and other regulators in similar situations are:

- When should a regulator act and solve a dispute between parties regarding standards and technology choices or not act and let the market and participants figure it out?
- How does a regulator continue to maintain flexibility in practice and implementation, while also recognizing that that flexibility may not be promoting interoperability?

As the Connecticut process shows, having a clear and concise organization for a proceeding can help the regulator pace out its process, ensure robust opportunities for utilities and stakeholders to raise topics and educate attendees, and allow time for rumination on topics and questions. This approach can culminate in the release of a straw proposal or other document that attempts to provide an initial perspective on the topic from the regulator, which provides parties with an understanding of the topics and potential solutions as identified by the regulator. Receiving comments on a straw proposal provides opportunities for the public to comment on additional questions or concerns, which can help the regulatory decision-making process.

The Connecticut EV docket initially did not include interoperability as a topic of interest, but as the PURA heard from more participants through their process (see Appendix, **Figure A1**), concerns from participants

<sup>23</sup> ISO 15118 is an international standard that outlines the digital communication protocol that an EV and an EVSE should use to recharge the EV's high-voltage battery.

about interoperability were eventually identified by the PURA as a topic for additional discussion. As such, an open stakeholder process can provide other important findings, such as identifying an issue a regulator did not know they needed to address.

Whatever process a regulatory body chooses to follow, having buy-in to the process from the regulator and stakeholders will lay the groundwork for a successful effort. A way to get that buy-in is to have a clear and delineated process so that all attendees understand their role and responsibilities. For example, everyone will have an opportunity to comment on topics, raise their own questions, and provide feedback to the regulator on process, initial findings, and stakeholder meetings and workshops.

EVs are still a new topic for regulators to consider and determining where the regulator fits in this marketplace is important for each jurisdiction. The process developed in the NARUC Prompts for Regulators, and implemented in Connecticut, can help other states' regulators understand their role, their potential actions, the limits and reach of their actions, and provide a foundation for EV deployment.

## **Leveraging the Prompts for Regulators: Step-by-Step**

PURA's EV docket and the Equitable Modern Grid initiative was initiated to educate the PURA staff and stakeholders about the importance of interoperability and help them identify important questions and factors to consider in their decision-making. The Equitable Modern Grid initiative, which includes the EV docket, was initiated to allow the PURA and stakeholders to spend time investigating policies, goals, and potential investments for a future electric grid. This included developing a model process for each sub-docket of the initiative, such as the EV docket, which would guide the PURA's public participation and record development. The process outlined by the PURA, which follows the process identified by the Prompts for Regulators, starts with Step 0, which is the accumulation stage where the PURA and stakeholders start to gather and identify things they know and learn about things they might not know, through Step 4, which identifies potential interoperability solutions.

### **Step 0 – Internal Questions for Regulators**

As described above, Step 0 is a foundational step for each commission to first understand their capabilities, needs, and opportunities for education to understand the issues in front of the commission. By developing the process for the proceedings opened as part of the Equitable Modern Grid initiative, the PURA was able to use working groups and "Technical Solutions Days" to have utilities, stakeholders, and other experts provide information about the issues for each proceeding. In the EV proceeding, these solutions days allowed for utilities to update the PURA on their plans and experiences with EV charging infrastructure planning and promotion, EVSE providers to discuss their solutions and needs, and other groups to talk about needs and lessons learned. By having such meetings, the PURA was able to identify a broader set of actions that are needed to support EV deployment in Connecticut, including the importance of standards to support the state goals. This allowed the PURA to identify staff needs and what additional support is needed for the PURA to issue guidance and requirements on their utilities to meet Connecticut's EV goals and targets.

These technical solutions days also identified areas of need for the PURA regarding the more technical components of EV promotion. Notably, what role does interoperability play in supporting EV growth? What are the available standards for EV development? How should the PURA consider its role in enhancing interoperability consistent with the policy goals for the state?

To address these questions, the PURA created a working group to identify those relevant and applicable standards that would be needed to support its policy goals, and to enable compliance with specific regulatory and statutory requirements.



## Step 1 – Identify Business Case and Benefits of Interoperability

In the July 2021 order, the PURA directed the EDCs to develop a request for proposals for vendors that will be used to implement the EDCs EV charging program. To successfully implement that requirement, the PURA identified interoperability as an important topic to include in the development of the EDCs' RFP as a mechanism to ensure that the charging program is successful.<sup>24</sup> Another way to state the PURA's finding is that without interoperability being addressed up front, there may be conflicts or inconsistencies in application of the PURA's guidance. Such inconsistencies would not result in a successful deployment as it may result in suboptimal EV deployments, reinforce existing preferences, and increase costs. This serves as the PURA's recognition of the benefits of interoperability and the business case for which interoperability should be considered.

The working group effort began by introducing working group participants to several of the foundational components of Step 1, including defining interoperability by leveraging existing definitions from NIST and providing opportunities for participants and outside speakers to discuss the benefits of interoperability.

In addition, the development of use cases provided examples for the working group participants to explore the business case and benefits of interoperability. For example, as shown in **Figure 2**, identifying the interfaces to enable the customer to charge their EV describes nine independent sets of communication touchpoints that build upon the other interfaces; often, each interface has its own set of standards and requirements. Applying those interfaces to use cases can then help identify the standards, the responsibility, and appropriate actions to be taken by those who will enable an EV owner to successfully charge their vehicle. Indeed, without including interoperability in that development, there runs a risk of harming the business case for EV deployment as costs and customer complaints increase.

## Step 2 – Working with Legacy Equipment

Not all components of Step 2 applied to Connecticut's discussion on EV program interoperability because a portion of the effort will occur outside the utility control (as seen in **Figure 2**). In this case, the conversation focused on what is within the control of the utility, such as how to communicate with utility systems from the EVSE and other networks and the data needs from the EVSE or EV to the utility to support EV-specific rate designs.

In addition, the utility RFP can include requirements that non-utility entities incorporate interoperability standards and considerations in their equipment and interactions with the utility. Specifically, the PURA required the EDCs to issue an RFP for vendor equipment, and the working group expanded on the requirements and identified a set of relevant standards to support the EDCs' RFP development. The experience of working group participants in other states and jurisdictions, including the EDCs, was valuable in understanding how standards evolve, applying lessons learned on application of standards, including necessary internal changes,

**Note:** Understanding how things will work with each other today (backwards compatibility) and tomorrow (futureproofing) is a necessary conversation for both Step 2 and Step 3.

- In Step 2, backwards compatibility means that what is installed or applied today will work with what is already in place. Ensuring that the utility, vendor, or other party understands how their various systems work and how it will be interoperable with standards is vital to ensuring interoperability and using the standards themselves.
- For Step 3, that means that whatever is installed today will work with tomorrow's systems.

Standards are a way to minimize the costs and enable the system being installed to work well immediately and into the future.

<sup>24</sup> ISO 15118 is an international standard that outlines the digital communication protocol that an EV and an EVSE should use to recharge the EV's high-voltage battery.

and implementing a successful transition path. Having conversations in an open session, such as a working group process and including examples and experiences from other locations, can also supplement the conversation to ensure that the investments and policies will work with legacy equipment.

### Step 3 – Working with Technology in the Future

Enabling a marketplace for EV adoption and EVSE deployment is a key policy goal for Connecticut and the PURA. To accomplish this, it is important that technologies and standards being implemented today have persistence and durability. This means that if a utility or other entity installs a piece of technology, it should be expected to not only work with what is already in place, but will work with future investments, for at least a certain period of time (i.e., planned obsolescence).

By establishing a set of minimum procurement specifications and criteria, the PURA created an expectation that whatever is installed must include a known set of performance requirements, and testing and certification processes. This approach further sets the expectation that utilities who will be running the procurement and communicating with a set of EVSEs and vendors to develop and deploy equipment must be capable of performing to certain requirements. For example, the PURA required that the EDC procurement specifications ensure compliance with the Americans with Disabilities Act and Connecticut statutes requiring multiple payment mechanisms.<sup>25</sup> In other words, not only must any equipment eligible under the utility RFP be interoperable to a set of standards, but they must also have minimum functionalities to support access to the EVSE and ability to pay for electricity consumed.

A way for the PURA to identify the reach of their role in overseeing utility application of interoperability is through the development of use cases. Some portion of this ecosystem will be beyond the reach of the PURA (see **Figure 2**), so the PURA's ability to ensure that technology being installed today will work with future technology is limited by their authority. Through the development of use cases, it will then be possible to identify the appropriate roles, responsibilities, and interfaces where interoperability will be impacted and where minimum procurement specifications can be applied.

### Step 4 – Profile Development

An interoperability profile is a combination of components of one or more standards to create a common implementation of one or more standards. Standards typically come with implementation options to support a diverse set of technologies and applications that can be compliant with the standard. At low levels of adoption and utilization, such disparities may not have significant impact on interoperability, but having such options does not enable interoperability.

#### Interoperability Profile Example

An example of a profile is one created by the Sunspec Alliance to promote advanced inverter capabilities under IEEE 1547-2018. In this case, IEEE 1547-2018 acts as the foundational standard for interconnection and enablement of advanced inverter functionality, but to maintain its flexibility, 1547-2018 allows for a variety of options for information model and communications. This means that an application could be compliant with the standard but not be interoperable. As solar adoption advanced in California, there became a need to develop a profile to ensure that interoperability was maintained. This was initiated by the California Public Utilities Commission and California Energy Commission to develop the technical requirements for interconnection (Rule 21) then applied by Sunspec to do testing and certification against its profile to ensure interoperability.

<sup>25</sup> Decision at 37.

Compliance to a standard does not ensure interoperability, so mechanisms are needed to ensure that an entity implementing a standard is doing so in a way that is interoperable with local systems. Development of a profile is a means by which this can be achieved.<sup>26</sup> Such an effort is typically initiated when there is a need to do so, such as when adoption rates of a technology are sufficient that having a profile will facilitate interoperability.

While the working group did have discussions on the use and role of a profile, development of a profile appears to be premature for Connecticut. This is due to the low adoption level of EVs in Connecticut, and ongoing discussions regarding applicability and adoption of certain standards.

Connecticut and other states will soon be able to leverage and apply a managed charging profile that will take parts of several standards and package it into one profile that vendors and others can then implement and be tested and certified against. The Smart Electric Power Alliance (SEPA) has been facilitating an industry working group to develop this profile for widespread use.

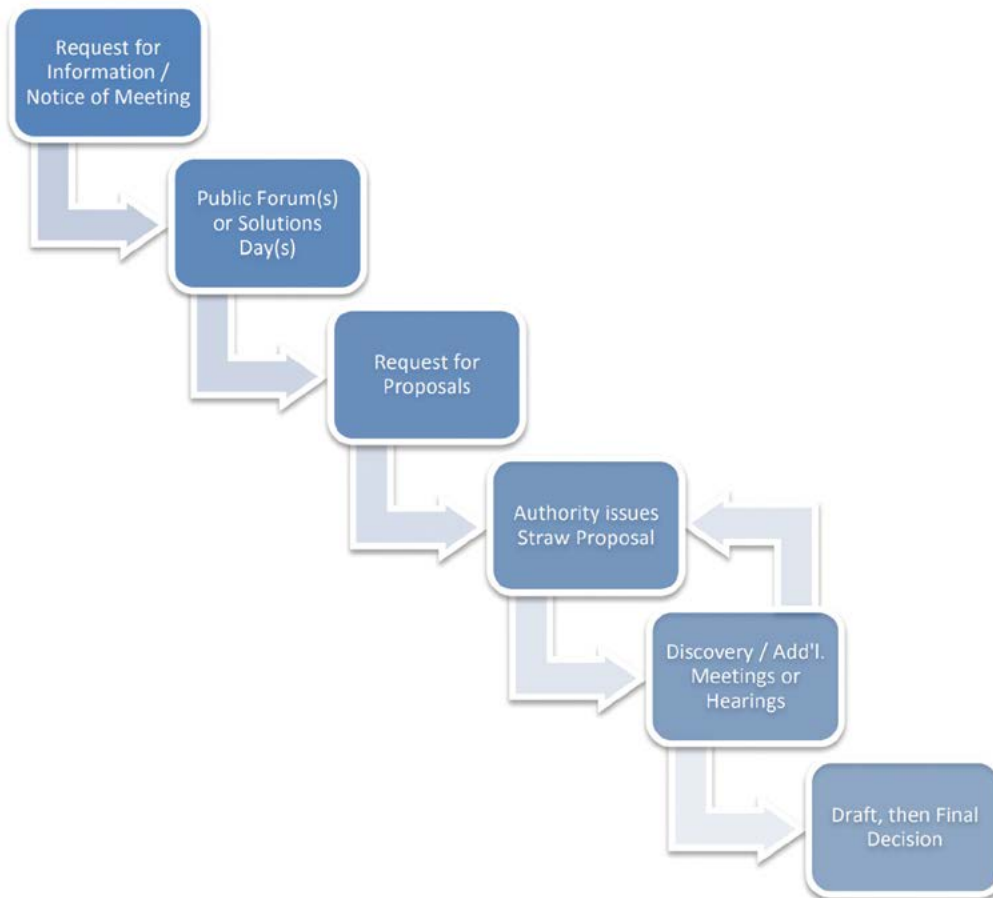
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<sup>26</sup> <https://sepapower.org/knowledge/interoperability-profiles-a-better-way-to-buy-grid-technology/>

## APPENDIX A: Brief Procedural History of Connecticut’s Equitable Modern Grid Initiative and EV Sub-Docket

As described in its 2019 order initiating the Equitable Modern Grid initiative, the PURA described a process that each of the sub-dockets would follow. Each sub-docket represented a specific issue. For example, Docket No. 17-12-03RE02 addresses Advanced Metering Infrastructure and Docket No. 17-12-03RE04 focused on EVs. The PURA planned to open 11 different sub-dockets starting in 2019. To help the PURA organize each sub-docket, the PURA identified the following procedural process<sup>27</sup>:

Figure A1. PURA’s Procedural Process for Reopened Proceedings<sup>28</sup>



This process allows the PURA to identify a topic, be it non-wires solutions, AMI, or EVs, hear from parties and other stakeholders in public forum(s), issue a straw proposal that creates a marker for topics and comments to drive the proceeding forward, hold additional hearings and workshops on the straw proposal, and then issue a final decision. This was the process used by the PURA for consideration of EV issues.

- On October 8, 2019, the Authority issued a Notice of Proceeding conducting this uncontested proceeding pursuant to Conn. Gen. Stat. §§ 16-11, 16-19eee, 16-19fff, 16-19ggg, and 16-244i.
- On November 18, 2019, the Authority issued a revised Notice of Request for Presentations and Information and Notice of Solutions Day. The Authority held a “Solutions Day” Technical Meeting on November 22, 2019, at its offices, Ten Franklin Square, New Britain, Connecticut.

<sup>27</sup> Interim Decision at 8.

<sup>28</sup> Decision, Docket No. 17-12-03RE04 (July 14, 2021).

- On November 27, 2019, the Authority issued a revised Notice of Request for Presentations and Information and second Notice of Solutions Day.
- The Authority held a second Solutions Day Technical Meeting on December 20, 2019, at its offices.
- On, March 31, 2020, the Authority issued a draft Request for Program Design (RFPD) proposals as a Notice of Request for Written Comments. On May 6, 2020, the Authority issued a final RFPD, with a deadline for docket participants and interested stakeholders to provide responsive proposals and to submit written comments by July 31, 2020. In response, the Authority received twelve (12) program design proposals.
- On January 6, 2021, the Authority issued its Notice of Issuance of Straw Electric Vehicle Program Design (Straw Proposal) and Request for Written Comments. In response, the Authority received twenty (20) sets of written comments.
- On January 26, 2021, the Authority issued a Notice of Technical Meeting, and on February 5, 2021, the Authority held a Technical Meeting, via Zoom teleconference, to discuss the Straw Proposal and the comments received, including presentations on suggested modifications and/or additions by stakeholders. Subsequently, the Authority issued interrogatories to various docket participants on February 11, 2021. On February 19, 2021, the Authority issued a Notice of Hearing, and on March 5, 2021, the Authority held a hearing meeting via Zoom teleconference.
- On or before April 5, 2021, the Authority received twelve (12) sets of Briefs in this proceeding.
- The Authority issued a Proposed Final Decision on June 9, 2021, and provided an opportunity for Participants to file Written Exceptions and to present Oral Argument. The Authority held Oral Arguments on July 6, 2021.
- The Final Decision was issued on July 14, 2021.<sup>29</sup>

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<sup>29</sup> Decision at 1-2.



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