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Form Energy Comments on Preliminary Draft Utility Scale Renewable Generation Research Roadmap

Additional submitted attachment is included below.

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Docket Unit
California Energy Commission
1516 Ninth Street, MS 4
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Subject: Form Energy Comments on the Preliminary Draft Utility-Scale Renewable Energy Generation Research Roadmap, Docket #19-ERDD-01

Form Energy appreciates the opportunity to comment on the California Energy Commission's (CEC) Preliminary Draft Utility-Scale Renewable Energy Generation Research Roadmap (Roadmap). Form Energy supports the Roadmap's focus on grid integration technologies and energy storage systems, but we believe that important research and demonstration needs remain to be addressed. Our comments recommend additional initiatives and refinements that are necessary to fill gaps that are currently limiting California's ability to maximize the value of existing and new renewable energy resources.

Form Energy recommends the following refinements to the Roadmap:

1. The Grid Integration Technologies Investment Category Should Include Three Additional Initiatives:
    a. Demonstrate Non-Wires Alternatives to Extend Existing Transmission Capacity and Integrate Renewables
    b. Demonstrate Zero-Carbon Solutions to Provide Multi-Day Grid Resilience in the Event of Transmission Contingencies
    c. Improve Capacity Expansion Modeling Tools to Optimize Multi-Day Energy Storage Needs
2. Include Demonstration and Deployment as Objectives of Existing Initiative 10.1 to Support Long Duration Energy Storage Systems

1. The Grid Integration Technologies Investment Category Should Include Three Additional Initiatives.

The Roadmap accurately characterizes why grid integration technologies are necessary to meet California's goal to achieve 100% renewable and zero-carbon electricity by 2045. It correctly identifies that California needs "a new type of grid infrastructure development to balance the growing number of renewable energy resources with the decreasing number of conventional

energy resources."[1] Additionally, it highlights the role that effective planning can play in meeting decarbonization goals by optimizing existing transmission and identifying needs for new transmission infrastructure improvements.

The sole initiative planned to address these needs — the advancement of high-temperature low-sag conductors — seems reasonable, but additional initiatives are warranted and equally promising. At present, the Roadmap does not include any proposals to demonstrate non-wires transmission solutions that can reduce new transmission needs and improve the dispatchability of renewable resources; nor does it address opportunities to improve grid resilience or modeling and resource planning.

a. Demonstrate Non-Wires Alternatives to Extend Existing Transmission Capacity and Integrate Renewables

The Roadmap should include a new initiative that demonstrates the ability of non-wires alternatives — long duration energy storage in particular — to extend existing transmission capacity and improve the dispatchability of renewable energy resources. Renewable curtailment is fundamentally driven by a mismatch between the times when renewable energy is available and the time when energy is in demand. Although proposed Initiative 9.1, addressing the advancement of high-temperature, low-sag conductors, can help mitigate transmission constraints and a degree of renewable curtailment, it cannot address the growing mismatch between supply and demand, which can last days to weeks in the case of wind, and months to seasons for solar.

Emerging long-duration energy storage systems have the potential to affordably manage renewable curtailment, as well as defer or avoid new transmission needs. They can enable long-term reshaping of low-cost, intermittent renewable resources into predictable, dispatchable generation profiles that are compatible with existing grid transmission infrastructure at high levels of renewable penetration, and can do so at a levelized cost of electricity that is competitive with thermal generation.

Although Form Energy's focus is on developing a new form of battery energy storage with durations >24-hrs and costs an order of magnitude lower cost than lithium-ion storage, the Roadmap should focus broadly on demonstrating non-wires solutions with the ability to address all three grid integration barriers the Roadmap identifies: 1) improving the dispatchability of renewables; 2) improving the performance of existing transmission assets; and 3) lowering overall system costs. Unlike wires solutions to integrating renewables, energy storage resources and other distributed energy resources (DERs) can generate energy, capacity and ancillary service revenues in the electric market, which can make them lower cost than traditional transmission investments.

[1] Roadmap at 50.

We recommend that this new initiative establish a goal to deploy non-wires solutions to make renewables firmed and dispatchable at a cost competitive with natural gas generation. This initiative should be designed to deploy demonstration projects within five years.

b. Demonstrate Zero-Carbon Solutions to Provide Multi-Day Grid Resilience in the Event of Transmission or Distribution Contingencies

Grid resilience is a pressing need among California communities served by limited transmission and distribution lines where a single point of failure could result in prolonged blackouts. The electric utilities' plans to proactively de-energize transmission and distribution lines during high wildfire risk conditions only increase the energy reliability risks these communities face and their needs to improve grid resilience. Although grid resilience is one of the four grid integration technology areas the Roadmap identifies,[2] the Roadmap does not include an initiative aimed at meaningfully improving grid resilience.

Form Energy recommends that the Roadmap include a new initiative focused on demonstrating zero-carbon technologies that can improve grid resilience in the event of multi-day transmission or distribution system contingencies, including pro-active de-energization to prevent wildfires. The CEC has funded microgrid demonstrations in the past that are designed to improve grid resilience by allowing customers to operate islanded from the grid. Form Energy recommends that the CEC build upon this work to demonstrate new zero-carbon solutions capable of providing multiple days to weeks of reliable electricity in communities at risk of extended grid outages if transmission or distribution contingencies occur.

Eligible zero-carbon technologies should have the potential to provide multi-day reliability equivalent to diesel or other fossil-fueled backup generators at a cost that is cheaper than the alternative of expanding or hardening existing transmission and distribution assets. These projects should be deployed within five years.

c. Improve Capacity Expansion Modeling Tools to Optimize Multi-Day Energy Storage Needs

The Legislature has established Integrated Resource Planning (IRP) as the process by which California will identify the least-cost pathway to a decarbonized electric sector.[3] Capacity expansion modeling is a necessary and central feature of IRP in California and elsewhere: it allows grid planners to identify what least-cost resource portfolios can meet state goals under a range of conditions. California's ability to reduce electric sector emissions and maintain reliability at least cost therefore depends in large part on how well these modeling tools can accurately identify grid needs and select the best resources to meet them.

[2] *Id*
[3] Public Utilities Code § 454.52 and 9621.

The California Public Utilities Commission (CPUC) has relied to date on an open-source modeling tool that has several known short-comings,[4] which reflect common design choices to minimize model complexity and runtime. These deficiencies include the following: 1) modeling a limited number of representative days of load and renewable generation, rather than a full year at hourly resolution; 2) conducting resource optimization over a single-day optimization horizon, rather than a full year at hourly resolution; and 3) an inability to stochastically model renewable energy generation profiles. These deficiencies are not specific to the CPUC's chosen tool, RESOLVE; they are present in other tools too. Nevertheless, our experience is that these deficiencies can and must be overcome in order to model high-penetration renewable grids with sufficient accuracy to achieve reliability goals at least cost.

In grids with low penetrations of renewables, these modeling deficiencies pose limited problems. However, as renewable penetrations increase, and as grid planners aim for fully-decarbonized grids, these deficiencies will cause major blind spots that can threaten grid reliability and mask technology solutions capable of minimizing overall renewable resource needs, transmission needs, and system costs.

For example, a capacity expansion modeling tool that only uses representative days of renewable energy generation will fail to capture the effects that multi-day weather events have on renewable energy output. Several studies have identified multi-day lulls in renewable energy output as a driver of significant reliability risk and cost as renewable penetrations increase.[5] Grids with high percentages of renewables must be able to manage these risks and costs, but they cannot do so if the impacts of multi-day weather events are not modeled.

Additionally, capacity expansion modeling tools that only have a single-day optimization horizon will never be able to identify needs for >24-hr long-duration energy storage. This is because they cannot track the benefit of maintaining stored energy in reserve from day to day, or season to season; nor can they track the risk that multi-day lulls in renewable energy output may result in the grid having insufficient headroom to recharge short-duration energy storage from one day to the next. As energy storage technologies emerge that can shift excess renewable energy across weeks and months, public domain capacity expansion modeling tools must keep pace so that grid operators can develop resource portfolios that are optimized over a full year.

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[4] *See* the CPUC's Proposed Inputs & Assumptions: 2019-2020 Integrated Resource Planning, at A-37, available at http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M245/K545/245545781.PDF.

[5] *See* for example: 1) CEC, Deep Decarbonization in a High Renewables Future available at https://www.ethree.com/wp-content/uploads/2018/06/Deep_Decarbonization_in_a_High_Renewables_Future_CEC-500-2018-012-1.pdf; 2) Eurelectric, Decarbonization Pathways, available at https://cdn.eurelectric.org/media/3558/decarbonisation-pathways-all-slideslinks-29112018-h-4484BB0C.pdf; and 3) E3, Resource Adequacy in the Pacific Northwest, available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

Lastly, public domain capacity expansion models should be able to stochastically model typical and atypical weather years and their effects on renewable energy output. As renewable penetrations increase and climate change worsens, extreme weather events will have outsize impact on grid reliability, because they will affect both generation and load. Capacity expansion modeling should be able to account for the risks of extreme weather years.

This new initiative should be a near-term priority with a goal to publish a public domain modeling tool, including user guides, within 1-2 years.

2. **Include Demonstration and Deployment as Objectives of Existing Initiative 10.1 to Support Long Duration Energy Storage Systems**

Form Energy supports the Roadmap's proposed Initiative 10.1: Support Research into Long Duration Energy Storage Systems. However, we recommend that the Roadmap expand this initiative to include a priority to *demonstrate* and *deploy* long-duration energy storage systems, as well as to conduct research into those systems. Although research funding to support technology improvements will always be needed, the largest existing gap is a lack of funding to demonstrate these technologies at the grid scale (>1 MW in capacity). This initiative should have a goal to deploy grid-scale demonstration projects within five years.

Conclusion

Form Energy looks forward to continuing to work with the CEC on these important issues. Thank you for this opportunity to provide public comments.

Sincerely,

/s/ Jason Houck

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