DOCKETED	
Docket Number:	21-ESR-01
Project Title:	Energy System Reliability
TN #:	247833
Document Title:	Trane Technologies Comments on RFI Clean Energy Resources for Reliability”
Description:	N/A
Filer:	System
Organization:	Trane Technologies
Submitter Role:	Public
Submission Date:	11/30/2022 3:23:06 PM
Docketed Date:	11/30/2022

Comment Received From: Michael Sean Day
Submitted On: 11/30/2022
Docket Number: 21-ESR-01

Comments of Trane Technologies on â€œ21-ESR-01 RFI Clean Energy Resources for Reliabilityâ€

Additional submitted attachment is included below.

Michael Day
Advanced Energy Program Lead
Trane Technologies
4145 Delmar Avenue, Rocklin CA 95677
(916) 660-3464
Michael.Day@trane.com

Commissioner Siva Gunda

Vice Chair, California Energy Commission

715 P Street, Sacramento, Calif. 95814-5512

Submitted via online portal

RE: Docket Number 21-ESR-01Request for Information Clean Energy Resources for Reliability. Trane® is a global energy solutions leader with over a century of experience. Trane appreciates the opportunity to comment on this important proceeding, and to contribute a potential scoring framework and rationale to the conversation.

1) **Are the categories (indicated in Tables 1, 2 and 3) appropriately representing how the CEC should be evaluating resources?** In general yes, but with some modification and or clarifications.
   a. **Pumped Hydro.** A lower limit of 30 MW does not represent the current state of the art. For the new class of modular/super closed loop, there are multiple projects under development from 5-20 MW. In addition, to gain the benefit of the much faster interconnection process available through programs such as the Wholesale Distribution Tariff (WDT) or Rule 21, developers will often keep the maximum power output at 20 MW or below.
   b. **Water/Wastewater Treatment & Pumping Controls.** Water and Wastewater offer tremendous capability to shift load, but it should be remembered that because of the primacy of the process flow safety considerations, the ability to deliver a differential grid impact is mediated by the presence or lack of specific infrastructure. As was shown at the Laguna Subregional Wastewater Treatment Plant EPIC Project (CEC – 500- 2019 – 063), load shifting is dependent on having the needed infrastructure, such as the Flow Equalization Basin used in that project. Similarly, bringing useful load flexibility to specific locations may entail adding very long-lived energy storage infrastructure such as tanks or FEBs in addition to controls. When appropriately supported
   c. **Thermal Energy Storage (TES).** TES is not exclusively (or at least need not exclusively be) solely a Permanent Load Shift (PLS) type of asset. TES can be used in a dispatched mode to provide a ramping product. Stratified chilled water TES variants that are currently optimized for steady state flow across an entire peak period due to existing tariff structures can often instead be dispatched to provide a higher level of curtailment for shorter periods with relatively minimal physical changes, representing a sizable marginal short-term capacity capability that is different from the norm of PLS operation.
   d. **Supply/Demand Resources.** Municipal water systems in areas with usable elevation differentials can be modified with additional tankage to provide both a generation component (water flowing through a hydro-turbine) and a curtailment (mass flow and pressurization transferred to tanked resources, temporarily reducing pumping and treatment energy.

2) **Are there resources that should be added to or removed from the preliminary list under each of the categories (shown in Tables 1,2,and 3)?**
   a. **Storage/Gas-Fired Generation.** Given that production from digester and landfills are very steady state across time most Renewable Gas (RNG) is used as it is produced, as a base load resource. However there are projects currently under development in California which will collect and store the gas for use as a peaking asset.
   b. **Pumped Hydro < 30MW.** As noted above, this arbitrary cut off does not comport with the state of the art
   c. **Storage infrastructure integrated into water/wastewater**
   d. **Potable water as a Supply/Demand resource**

3) **Are there other attributes that should be considered, in addition to the ones listed in Table 4? If so, should those be considered for the qualitative and/or quantitative evaluation?**
   a. **Expected Useful Life.** Different energy technologies have vastly different expected useful lives. At one end of the spectrum are electrochemical batteries, which, when regularly used, typically have expected useful lives measured in years. At the other end of the spectrum are Hydro-electric turbines, that have expected useful lives measured in decades, with numerous examples of hydro plants in operation for over 100 years. It is absolutely in the interest of the public that limited funding be spent on assets that have a longer useful life. For example, if two projects were otherwise identical, but one had an expected useful life and a second project had an expected useful life ten times as long, it appears obvious that the longer-lived project is of greater benefit to both the local community and to California as a whole.
   b. **Toxic materials risk.** The environmental impact risks of different energy storage technologies are not the same; some energy storage technologies have effectively zero toxic risk, while others have the potential for catastrophic environmental impacts in case of an accident. In addition, there are long-term disposal risks that toxic containing storage technologies face that non-toxic containing storage technologies do not.
   c. **Economic benefits of highly leveraged projects.** An ancillary benefit of the DEBA and CERIP is the ability to promote economic activity, particularly in Disadvantaged Communities. Some projects will need complete or near complete funding from the Program, while others will only need a portion of their project cost to be funded by the Program in order to attain financial viability. In general, projects that use a greater proportion of non-DEBA/CERIP funding are of greater value to society in that they drive a larger amount of economic activity for each MIP dollar that they receive. This “leverage” can make the economic impacts of projects with a low percentage of DEBA/CERIP funds much larger than projects that depend entirely on MIP funds. This impact is even more important during times of reduced economic activity.
   d. **Domestic Content.** Projects containing higher levels of domestic content overall should be evaluated higher than projects having lower levels.
   e. **Local Labor.** Not all energy storage systems are equal in terms of the amount of local skilled labor that they employ in construction. At one end of the spectrum are pre-manufactured system modules that are set in place, while at the other end of the spectrum are “stick built” approaches that use local labor to construct an entire system from components. Local labor to install pre-manufactured or build systems on site should be weighed equally.

f. **Multi-benefit Facilities.** Some forms of energy storage infrastructure projects can provide additional resilience to communities through functions like the provision of fire-flow, potable water, or wastewater holding. Multi-Benefit Facilities should receive greater weight than those that do not provide additional community capabilities.

g. **Cost Effectiveness.** More cost-effective projects are better for the program than less cost-effective projects in that a greater societal resilience impact is produced for the limited number of dollars available. Note that while Cost Effectiveness is related to both Expected Useful Life and Leverage, it is separate from both. A system could have a very long useful life but not be cost effective, and a system could also be very cost effective but not develop the leverage that would generate more jobs and tax revenues. By having Cost Effectiveness as a separate multiplier each attribute can be appropriately scored

4) How should the attributes be weighted relative to each other? Should some attributes be weighted more than others?

A system similar to that used to evaluate Grant Funding Opportunities would seem best suited for larger IFOM /Community proposals. This system allows multiple attributes to be evaluated individually and to be given a score, but allows weight to be given in accordance with the needs of public policy. Other attributes can then be used to modify the weighted score.

a. Readiness. Pass/Fail. Proposed technologies should be Technology Readiness Level 7 or above, but with the proviso that technologies that are well-understood and widely deployed (TRL 9) but are being used in a novel way should be considered as being at the higher level

b. **Permitting.** (Calculated Score/ Weight 1X)**.** Projects with streamlined permitting processes preferred, but within the Large IFOM category. A 1 year permitting process would be slow for an individual residential Battery Energy Storage System, but would be extremely fast for a 30 MW/120 MW-Hr project providing community resilience. Preferred scoring would be on a sliding scale, with 12 months and below receiving 10 points, >48 months receiving zero points, and any time between the two being proportional. Estimated permitting process should include all processes: CEQA, NEPA, land use, Clean Water Act, Air Quality, etc.

c. **Interconnection.** (Calculated Score/ Weight 2X) Projects utilizing a streamlined interconnection processes preferred, but compared to peers within the Large IFOM category. A 6-month interconnection process would be slow for an individual residential Battery Energy Storage System but would be extremely fast for a 30 MW/120 MW-Hr project providing community resilience. Preferred scoring would be on a sliding scale, with 6 months and below receiving 10 points, >54 months receiving zero points, and any time between the two being proportional. Estimated interconnection process should include discussion of process used and recent examples from similar projects.

d. Supply Chain. (Multiplier**).** Domestic/"friend-shored" content does not only provide jobs, it also reduces the risk of a project failing to be installed in time. Score as a multiplier, with four categories: Off-shore, Friend-shore, US, and California. The percentage of content by cost for each category would be given a multiplier: Off-shore (non-allies of the US) x 0, Friend-shore (US Allies) x 0.8, US manufacturers x 1.0 or manufactured/built from components in California (where at least 50% of the labor in in California) x 1.25.

Example. A Large IFOM project of $100M uses $5M of equipment from non-allies, $12M from manufacturers in Allied countries, $37 million from US Manufacturers, and $46 million from system components manufactured in California.

Non-Ally	**$5M x 0**	**= 0**
US Ally	**$12M x 0.8**	**= 9.6M**
US Manufacture	**$37M x 1.0**	**= 37M**
California Manufacture	**$46M x 1.25**	**= 57.5M**
	Total	**= 104.1**

104.1M/100M = 1.041 Supply Chain multiplier

This approach combines a reasonable preference for secure supply chains with an additional preference for manufacturing that results in California jobs, and a weight that is similar to other programs.

e. **Customer Acceptance.** (Tiered points, Weight 1X). For Large IFOM projects local governments and community interest groups cannot always approve a project, but opposition of local governments and or groups virtually guarantees a minimum of a protracted development process. Show local government and community group acceptance. Of 10 possible points, 5 points for local government, and 1 point per local interest group support letter.

f. **Cleanliness.** (Calculated points, Weight 2X). Reliability best serves the longer-term interest of the State when it is renewably recharged, and local recharge both avoids losses and improves resilience. Sliding scale, with 20 points for 100% co-located renewable generation responsible for 100% of recharge, 10 points for 100% non-co-located renewable recharge, each ramping down to 0% for non-renewably recharged.

g. **Dispatchability.** (Pass/Fail) To have maximum use to society an asset needs to be able to be dispatchable to help with meeting peak load. For Large IFOM projects this would mean Automated Generation Controls installed, mandatory daily reporting of state of charge and anticipated hourly production/storage to either CAISO if used in a merchant power design, or to a Scheduling Coordinator if sold under a long-term agreement. It can reasonably be assumed that limited duration assets will be used when market prices are highest and are thus in alignment with the peak hours of any given day.

h. **Policy Alignment.** There are multiple policy aspects that are effectively addressed in this proposed scoring rubric, including toxic substances, use of skilled labor, equity, decarbonization, and Costs effectiveness (via Expected Useful Life) just to name a few.

i. **Equity.** (Calculated points/ Weight 2.5X). Equity is best served by preferring environmentally friendly installations in locations where they can provide benefits to underserved populations. For Large IFOM projects a points system could be used that counts all of the population of a Historically Disadvantaged Community (by Census Tract) served by a given installation and gives 1 point per 100 individuals served.

Example: a Large IFOM project provides resilience to a water system and electrical resilience to a smaller portion of a community. The water system serves 4 Census tracts, 3 of which are identified as historically disadvantaged[1]. The populations[2] of the 3 disadvantaged CTs are 875, 1125, and 930, for a total of 2,930, or 29.3 points. The electrical service powers a community microgrid serving only the first CT, providing electrical resilience to an additional 875 individuals in a Historically Disadvantaged Community, for an additional 8.75 points. The total Equity points from this installation would be 38.05.

Note 1. One important point to make is that the economically disadvantaged communities that would most benefit from LDES are rarely those that show up as the most affected communities when using the CalEnviroScore tool. CalEnviroScore is an important tool and quite useful in some contexts, but identifying locations at risk for de-energization and thus in need of energy resilience is not what it was optimized for. As just a single example, of the just over 8,000 census tracts in California, fewer than 40 are also listed as High Fire Threat District classifications 2 or 3, and it is HFTD 2 and 3 where the vast majority of California's de-energization events occur.

Note 2. To the extent that a proposed system funded under either the DEBA or CERIP programs is helping an entire community through protecting communal critical infrastructure, then the benefits should be recognized on a community-wide basis. For example, a County Emergency Operations Center provides benefit to an entire county, and should be credited with serving that entire community, as scored for HDCs as mentioned above, while a Firs Station would only be credited as serving the population of the CTs covered. For hospitals the area covered could be all CTs where paramedics or ambulances would first go to that facility.

Scoring for Attributes not originally listed.

j. **Expected Useful Life**. (Multiplier). Establish the Expected Useful Life of the baseline technology and create a proportionate multiplier against this reference. For example, NREL's Annual Technology Baseline document considers Utility Scale Batteries of 4 hour duration to have a 15 Year expected useful life[3]. If a wastewater Flow Equalization Basin had an expected useful life of 30 years, then it would have a multiplier of 2. Weight 1X

k. **Toxic materials risk.** (1/x Multiplier). Considering the history of placing toxic energy facilities in Disadvantaged Communities across time in California, the scoring for toxic risk should account for both potential toxicity of the energy storage material and Social Vulnerability Index of the intended installation location. This is particularly true for energy storage systems that are flammable and contain toxic products such as sulfuric acid or fluorine compounds. One possible equation would be to take the probable evacuation area and use the census tract data and the Social Vulnerability Index[4] (at the Census Tract level) to produce a multiplier.

$1/(Pop_{EA}$ X .005 X SVI), where

[1] The Federal Department of Transportation provides a useful GIS tool listing Historically Disadvantaged Communities. https://usdot.maps.arcgis.com/apps/dashboards/d6f90dfcc8b44525b04c7ce748a3674a

[2] A GIS tool to access populations od specific Census Tracts is available at https://mtgis-portal.geo.census.gov/arcgis/apps/MapSeries/index.html?appid=2566121a73de463995ed2b2fd7ff6eb7

[3] OEDI: 2022 Annual Technology Baseline (ATB) Cost and Performance Data for Electricity Generation Technologies (openei.org)

[4] The CDC SVI interactive map, with SVI scores to the Census Tract level is available at CDC/ATSDR Social Vulnerability Index (SVI) | Place and Health | ATSDR

i. **Pop_{EA} = Population of the Evacuation Area as defined by local emergency authority**
ii. **.001 = a coefficient, such that 1 point is generated per 1,000 evacuees**
iii. **SVI = Mean Social Vulnerability Index of all Census Tracts included in EA**

Example 1. A 20 MW-hr lead-acid battery installation containing Sulfuric Acid is proposed. The local fire authority determines that in a worst-case fire event, a 1 mile mandatory evacuation would be initiated. The 2 Census Tracts included in the Evacuation area have a combined population of 3280 individuals, and the mean SVI is 0.882.

1 / (3,280 x .005 x .882) = 1/2.89296 = a final Toxic Materials multiplier of .345667.

The result is that, because of a combination of a large number of potentially affected individuals and a relatively high SVI, the project would probably not be competitive for a DEBA or CERIP grant. This would advance equity by guiding installations towards locations with either a lower affected population, a lower SVI, or preferably both.

Example 2. A community adds two new water tanks to their municipal water system. This allows both the storage of potable water in a far upper tank to allow power generation when needed, emptying into a lower gravity feed tank. The gravity feed tank has sufficient (when combined with the upper tank) volume and piping to allow the existing wells, pumps, and treatment plant to be completely curtailed for 4 hours. This new installation is able to produce a combined grid impact (generation + curtailment) of 4 MW for 5 hours, or 20 MW-Hrs.

The installation has Lithium-Ion Battery Energy Storage Systems at both the upper and lower tanks to provide emergency power for controls, valve operation, and generator exciter field energization. Upon review however, the local fire authority determines that due to the combination of small amount of material and the remote hilltop locations of the installations, no evacuations would likely be needed in the case of a battery fire. In this case the Toxic Materials Risk multiplier would be 1, or no change to the score.

l. **Economic benefits of highly leveraged projects. (**Multiplier). Projects that require only a marginal amount of funding to reach viability are preferred in that they maximize economic activity from a limited pool of funds and are also more likely to occur. A ratio of total project cost / requested funds would produce a multiplier that gave a greater advantage to projects with higher levels of leverage, but to keep this variable reasonable the multiplier would be halved.

Example. A project with a total cost of $92M requests an incentive of $30M to reach financial viability. The raw multiplier in this case would be 3.07, and the final Economic Leverage multiplier would be 1.533

m. **Domestic Content.** Covered by the proposed Supply Chain multiplier.

n. Local Labor. (Multiplier) For large IFOM projects, an estimated number of man-hours of skilled trade workforce required for local installation would be included with each application, as well as the number of MW-H of energy, resulting in a ratio of MH/MW-H for each project. Only MH spent on construction related activities would be included. Upon receiving these applications, the Commission would sum all manhours and MW-H of all submitted projects to determine a mean MH/MW for the program. Each project's individual ratio then would be converted to a multiplier as a percentage of the mean ratio.

Example. Project P would deliver 120 MW-H of storage, and would require 120,000 Manhours to install, or 1,000 MH/MW-H. The mean for all projects proposed to the CEC comes to 735 MH/MW. Project P would receive a Local Labor Multiplier of 1.35

o. **Multi-benefit Facilities.** (Calculated points/Weight 1x) Equation derived score. Multi-benefit facilities, such as those that provide potable water, wastewater, or fire flow resilience in addition to electrical energy storage bring a benefit to all communities where they are installed. The scoring would be identical to that outlined for calculating Equity in Section i. above, with two differences. First multi-benefit facility scoring would apply to the entire population served, not just Historically Disadvantaged Communities. Second, points would be awarded per 500 individuals served. This would not constitute double counting however, as the additional points from Equity, although scored similarly, would be a boost in scoring only available to projects that deliver benefits to Historically Disadvantaged Communities.

Example: a Large IFOM project provides resilience to a water system and electrical resilience to a smaller portion of a community. The water system serves 4 Census tracts. The populations of the 4 CTs are 1137, 875, 1125, and 930, for a total of 4,067, or 8.134 points. The electrical service powers a community microgrid serving only the first and second CT, providing electrical resilience to an additional 1,137 and 875 individuals respectively, for total of 2,012 individuals served electrically, and an additional 8.75 points. The total Multi-benefit points from this installation would be 12.158.

p. **Cost Effectiveness** (Multiplier) The metric for this should be the ratio between the levelized cost per MW-hr of the Proposed system and the levelized cost per MW-hr of a reference system. For the Proposed System the ratio would be the total amount of grant dollars requested divided by the number of lifetime MW-hr of storage. The reference system would be the 2022 PV+ Storage Class 6 Moderate Cost Levelized Cost of Energy, or $49/MW-Hr.[5]

Example. A municipality is requesting $30 million for a Water system PV + Storage modification that can generate 15,000 MW-hrs a year from stored energy, and the tank has an expected useful life of 50 years.

Requested Funds	$30 million
MW-Hr/Year	15,000
Expected Useful Life	50 Years

[5] NREL LCOE PV + Battery

LCOE – Proposed	$40/MW-Hr
LCOE – Reference	$49/MW-Hr
Cost Effectiveness Multiplier	**1.225**

Large IFOM Example Scoring and Weighting

Readiness.	(Pass/Fail)			**Pass**
Dispatchability.	(Pass/Fail)			**Pass**
		Score	**Weight**	**Net Score**
Permitting.	(Calculated Score/ Weight 1X)	10	1	10.00
Interconnection.	(Calculated Score/ Weight 2X)	10	2	20.00
Customer Acceptance.	(Tiered points, Weight 1X)	10	1	10.00
Cleanliness.	(Calculated points Weight 2X)	20	2	40.00
Equity.	(Calculated points/ Weight 3X)	38.05	2	76.10
Multi-benefit Facilities.	(Calculated points/Weight 1x)	12.158	1	12.16
			Points Subtotal	**168.26**
Supply Chain.	(Multiplier)			1.04
Expected Useful Life.	(Multiplier)			2.00
Toxic materials risk.	(1/x Multiplier)			1.00
Economic Leverage	(Multiplier)			1.53
Local Labor.	(Multiplier)			1.35
Cost Effectiveness.	(Multiplier)			1.23
			Multiplier Total	5.28
			Final Modified Score	**888.11**

Feedback Questions

1) Please provide a general overview of the resource, including the following:

a. **Resource category (e.g., supply, demand).** Storage Enhanced Critical Infrastructure (SECI) encompasses a broad range of applications that can be a Supply, Demand or hybrid Supply/Demand resource while retaining the ability to serve municipal needs. A fire-flow system with a high and low tank can be equipped with pumps and hydro-turbines, effectively becoming a form of pumped storage hydro (Supply) that is integrated into an asset needed by a community for fire resilience. A Flow Equalization Basin at a wastewater treatment plant, or expanded gravity fed tankage for a municipal water system allows decoupling of instantaneous energy (Demand), without a reduction in service or threats to required operational standards. Potable water systems with reasonable elevation differentials can also be modified with 2-tank systems that allow both electrical generation (supply) and extended curtailment (Demand) and thus would qualify as combination Supply/Demand resources.

b. Resource type (e.g., solar). The most common renewable energy source used in SECI is Solar PV due to technological maturity, ease of installation, and annual production reliability. Where appropriate for a wastewater system, Renewable Natural Gas can be harvested from anaerobic digesters as a base energy source and combined with energy storage, with the added benefit of removing a potent GHG (methane) from what would otherwise be direct escape to the atmosphere. The combination of storage with baseload RNG generation can often improve the economics of an energy project to viability/near viability where baseload energy values would not, increases the on-peak impact of the resource, and significantly improves critical infrastructure resilience.

c. Resource scale (e.g., utility, distributed)? Just as the underlying Critical Infrastructure public works can vary in size from tiny to enormous, SECI installations can run from the tens of kWh needed for a small municipal well to the tens, hundreds, or even thousands of MWs needed for massive water conveyance systems. Given the right topography, geologic conditions, land ownership, and other important considerations technology exists to convert much if not most of this load from Critical Works Infrastructure to Storage Enhanced Critical Works Infrastructure. In terms of size it is often noted that water infrastructure represents over 10% of all energy use in California. Even if only 20% were converted to Storage Enhanced Critical Works Infrastructure by 2035, that represents over 5,000 GW-hrs/year of storage.

2) How does the resource compare to conventional generation in terms of greenhouse gas and priority pollutant emissions? If the SECI resources being built are recharged with local renewables, then they are a zero carbon offset for grid energy. If the resources built rely on grid power for recharge than they are still a probable net GHG improvement. Because energy prices largely follow the embedded carbon of resources entering the market, by acting rationally and recharging with low cost power and dispatching stored energy when prices are high, even SECI resources that are grid charged will likely contribute to reduced GHG due to the arbitrage between low carbon and high carbon hours.

3) How does the resource support reliability (e.g., supply, permanent load reduction, net peak reduction, or emergency asset?) (List all that apply.). SECI resources contribute in various ways depending upon the needs of the operators, the capabilities of the system installed, and the situation at hand. These systems can be of any of the types listed, and can at times have multiple operating modes.

Example. A Municipal Water system adds a PV + 2 Tank gravity system to produce energy for sale and reduce water plant costs. In Normal Operation the system is designed to eliminate on-peak demand charges of the water treatment plant by discharging at a steady 5 MW for 5 hours, with a 1 hour reserve. However, the system was designed with piping, generators, and interconnection capability such that it could generate 15 MW for 2 hours in an emergency. Because the local Load Serving Entity is anticipating a severe heat event during hours 15 to 18, they ask the facility to depart from normal operation on a given day. In this case the system would put out 10 MW for 180 minutes.

a. **How can the resource be used as an incremental on-call resource during emergencies?** See example above.

4) How many new MWs and MWhs can the resource provide per year, taking into account resource characteristics and known barriers between now and 2035? SECIs are a largely untapped resource. In addition to the Water infrastructure opportunities mentioned above, SECIs focused on fire flow are another area ripe for expansion. For ease and speed of interconnection, systems are typically in the 20-40MW range, providing a daily-use/grid connected PV + Storage Resource, emergency fire flow asset, and Community/Critical Infrastructure microgrid in a single infrastructure installation. Sadly, the spectre of an economically disadvantaged community facing a combination of regular loss of electricity, having a high fire threat, and a large hill next to the community is not an uncommon one. Trane alone has a goal of bringing our packaged solution to two dozen communities or more by the end of 2024, and there are hundreds of communities beyond that which need a solution of this type.

a. How is that different if used incrementally as an emergency asset during an extreme heat event? As with the water system example above, the maximum discharge rate is typically somewhat higher than what would be needed for powering a microgrid, so the output of a grid-integrated system . This capability allows a Distribution System Operator to allocate the dispatch of the system as needed for system stability in an emergency, particularly when the asset is equipped with Automated generation controls and data on renewable production and state of charge are also continuously available. Another option, in extremis, is for the community to go into island mode, relying on the stored energy to keep the lights on, and freeing transmission and generation capacity to serve other loads.

5) What is the levelized cost for the resource in $/MW-yr. and $/MWh-yr. from 2023 to 2035? Because of the broad spectrum of facilities covered within the SECI category, the range of costs is quite broad. However, the combination of comparatively modest first cost, partial payment through market operations/bill reduction meaning that only a portion of the project cost needs DEBA/CERIP subsidy to reach financial viability, and extremely long Expected Useful Life means that Levelized Cost is usually going to be well below national averages for competing technologies.

Example. The Poe Mountain/North Lakeport project is under development by Trane for the County of Lake and was approved by the Board of Supervisors to take to investors on October 25th 2022. The project is a combination Solar PV + modular closed currently estimated at $143M total installed cost. The system as currently designed has 90 MW-H of daily storage, is expected to deliver >27,000 MW-hr per year from storage, and the tanks and turbines have an Expected Useful Life of >40 years[6].

Even with the additional costs associated with providing both fire and electrical resilience, due to a combination of high local energy value and recent changes in the tax code this project is self-funding and will not be seeking a DEBA or CERIP grant. However, not all locations have the same combination of low first cost and high locational marginal energy value that this project displays. The below table lists how this project would compare to standard cost baselines if a partial DEBA/CERIP subsidy were requested.

DEBA Funds	$20 Million
Energy/Year	27,000 MW-Hr/Year
EUL	40 Years
LCOE	$14.81/MW-H/Year

5) **What is the average length of time from ordering or purchasing the resource to operation? How long does that typically take in today's market? What conditions must be met to deploy the technology rapidly? (e.g., transmission interconnection, building electrification or upgrades, etc.)** One of the distinguishing characteristics of SECIs compared to other assets of comparable capacity and duration is the rapidity of potential deployment. For water/wastewater systems simply adding

[6] **"Dynamic maintenance planning of a hydro-turbine in operational life cycle"**, Li, Arzaghi,Abbassi, et. al, Reliability Engineering & System Safety, Volume 204, December 2020 https://www.sciencedirect.com/science/article/abs/pii/S095183202030630X#preview-section-references

tankage and controls, the design period can be as little as a few months, and municipalities often already own the land where the expanded tankage would go. While the CEQA process must still play out, the issues are usually simple to review when adding capacity to existing systems. For larger IFOM systems such as the Poe Mountain project being pursued by Trane and Lake County, elements of the design allow much faster permitting compared to traditional projects of similar size.

a) Use of closed-roof tanks and groundwater for initial fill largely excludes the project from permitting burdens under the Clean Water Act
b) The system design is non-jurisdictional to the Federal Energy Regulatory Commission (FERC), resulting in a reduction in review time from range of 10-20 years down to 4-6 months.
c) By using the Wholesale Distribution Tariff process, keeping voltage at 12 KV, and power output to any one substation at 20 MW or less, the interconnection process is estimated be 24-26 weeks through PG&E, as opposed to a much longer process for larger or Transmission interconnected projects that need to go through the CAISO study process
d) Because the hydro-turbo generators generate at the same voltage as the substation that they are discharging to (12 KV), there is no need for very long-lead transformers

Like all construction projects, the design described involves trade-offs. In this case the Poe Mountain design trades additional first cost for reduced permitting time and increased fire and electrical resilience. For a Poe Mountain type project, permitting is estimated at approximately 12 months, with the longest lead item (hydro-turbines) of less than 6 months. Construction is estimated to take 12-15 months to Commercial Operation Date. While this can seem long compared to the time compared to installing a battery pack at a home, it is remarkably fast for a Large IFOM project that brings multiple levels of community resilience, 100% renewable recharge, private funding, and a very long expected useful life.

6) For an emerging technology, when will it be ready for deployment, and at what scale?
For all of the abundant opportunity available in the segment, SECIs rely on very well understood and mature technologies with decades of successful design, construction, and operational. Engineers and construction professionals well understand the costs and challenges of constructing and installing items like large tanks, pipes, turbines, etc.

7) **Is the target customer primarily residential, commercial, agricultural or industrial?**
For Large IFOM, the target customer is Municipal, developed under Public-Private Partnerships.

8) **What are the key non-financial barriers to the development and implementation of this resource (including, but not limited to, permitting, interconnection, supply chain, customer acceptance, and alignment with policy goals)?** There are any number of technical issues that can befall a single proposed SECI-type project, from discovering endangered species habitat at critical locations, to soil conditions, to the available elevation just to name a few. The primary barrier at this point though is probably novelty. Absent an operating example to point to, and the complex nature of electric market financing/revenues, a relatively large educational lift is required with communities early in the process to ensure that the costs, benefits, and risks are appropriately understood by both local officials and the public. The good news is that this education, while laborious and on a relatively esoteric subject, has also proven to be nearly uniform in being able to bring communities on board

during the development process to date. History has shown that this type of "early adopter reluctance", while perfectly natural, will also probably fade as successful projects come on line.

9) **What are the key financial barriers to the development and implementation of this resource?**
The primary challenge for SECI type projects is that resilience elements, while certainly beneficial to local communities and lower in cost than a stand-alone resilience asset of the same characteristics, add considerable non-revenue generating cost to a project. In the case of the Poe Mountain project adding the enhanced firefighting capabilities, improved Community electrical resilience and substantially improved Critical Infrastructure electrical resilience will increase the cost of the project by roughly 50% compared to a project optimized solely for grid revenue. In some cases (like Poe Mountain/North Lakeport), the combination of high local energy value, moderate construction cost, and the recently improved tax equity of projects of this type under the Inflation Reduction Act of 2022 means that a project can reach financial viability even with the additional 50% cost burden attendant to being a multi-benefit facility. The absence of a clear path to early payment for capacity by off-takers due to issues surrounding recognition of deliverability is also a financial hinderance.

This is where programs like DEBA and CERIP can be of greatest use. By buying down a portion of the capital cost of multi-benefit projects like Poe Mountain, projects that are not quite financially viable can move to viability. The benefits of a marginal cost buydown are many, and a wisely designed DEBA/CERIP program structure will enable many projects to become a reality that could not have done so without it

10) **What types of benefits or impacts is the resource anticipated to have on low income and disadvantaged communities, and tribes, if any in terms of development and deployment?**
De-energization events and mandatory evacuations hit low-income communities the hardest for the simple reason that they have less money to start with. For residents in a wealthy community a 36 hour blackout is an inconvenience, an adventure, or an excuse to go try a new hotel; for a low-income single mother of 2 toddlers with less than $1,000 in her bank account, losing shifts at the restaurant and paying for a hotel could be a financially existential event. For a well-to-do family whose garage freezer loses power for 3 days during a mandatory evacuation, the angst over losing last-year's halibut from the Alaska Trip and Elk from the trip to Idaho is a real shame; for a Social Security pensioner living paycheck to paycheck, losing her frozen/bought on sale hamburger could mean a choice between food insecurity and paying for medication. When these impacts fall on communities that are not only economically disadvantaged today but have historically been so for decades, then not only is the burden of this harm an even greater affront to the concept of equity, but there are even fewer economic resources available to rely on to bounce back. In every conceivable way, power outages and mandatory evacuations, while absolutely needed for overall public safety, just as absolutely impose a greater burden on the Economically Disadvantaged than they do on the more prosperous amongst us.

This is the potential promise of a well-designed DEBA/CERIP program, a vision of the transformative community impacts that grants under this program can have. While allowing a competitive process to get the overall capacity that our State needs as a whole, we can place a thumb on the scale and give a preference in this program for projects where they are needed most, and helping entire communities is an important element of this. The SGIP program provided very high incentives to residential customers, but with the notable exception of projects for low-income homeowners working with programs like the Golden State Finance Authority revolving loan fund[7], most funds did not go to low-income homeowners. Whether the reason was pre-existing commercial relationships with previous purchasers of Solar PV, the increased ability of higher-income Californians to utilize the tax equity benefits of a n installation, the inability of renters to upgrade rental properties, or the ability to pay for a $20,000 Battery Energy Storage System upfront and await partial reimbursement months later, the result is that most of installations funded under SGIP did not go to those most in need. The problems in bringing the benefits of energy storage to residents in low-income communities still exist, as do the issues around the cost of acquisition of individual customers, issues with electrical service in places like manufactured housing communities and multi-family housing units that are unable to handle the installation of BTM energy storage systems without resorting to even more expensive service upgrades, and many others.

Large IFOM energy storage installations that can power Community Microgrids solve these issues, particularly when delivered by local governments through Storage Enhanced Critical Infrastructure multi-benefit installations. Because we have very good granular data on Historically Disadvantaged communities, developers can be guided to developing projects in these areas through program design, and the Program can guide installations in these locations. Covering entire economically disadvantaged communities with Large IFOM installations that can form microgrids eliminates issues like customer acquisition, inability to await repayment, inadequate existing electric infrastructure, or the split incentive issue inherent in rental properties that have plagued programs with similar goals in the past. The technologies that can be used in SECI installations are extremely mature, easy to price, and easy to predict in terms of performance, in addition to be extremely long-lived. Finally, if we have already decided that we are going to help deploy energy resources, it makes all the sense in the world to deploy those resources in areas that need the most help, and where delivering multiple long-term benefits will have the greatest local impact as well.

Program Design Questions

1) **What size of resource and what types of customers should the program target?**
   While there are arguments in favor of separate programs to address both smaller BTM projects and Large IFOM projects, prioritizing Large IFOM projects developed in partnership with local governments in Historically disadvantaged communities seems the best way to meet the multiple different policy goals of the program at the same time.

2) **What types of incentive structures and amounts are needed to accelerate the development and deployment of this resource?**
   Because of the wide variety of potential project types, and the varying degree to which individual projects will even need supplemental funding to meet financial viability, the best

[7] This small but highly successful bridge finance program was approved by the CEC to allow GSFA to utilize accumulated collected ARRA funds to help stimulate utilization of the residential SGIP program by a greater socio-economic cross-section of the population. The program has facilitated over 1,000 installations, many to low-income homeowners who could not have afforded a system without the program, including to families with medically vulnerable individuals with electrically powered medical equipment.

approach is a weighted scoring system whereby developers and local governments propose the incentive levels that they need for a given project, and provide other important data on the proposed project as well. This will allow a quantitative analysis of competing projects, with projects with the best combination of characteristics naturally rising to the top.

3) **What types of conditionalities and measurement and verification requirements should the program include to ensure funded resources participate and deliver during emergency events?** Large IFOM SECI projects should be conditional on two items: contracting with a California Load Serving Entity for regular scheduling in the CAISO market during “blue sky” conditions, and development with the local Distribution Service Organization of an operation agreement for use during “Dark Sky” conditions.

4) **In general, please provide any specific proposal or recommendation on the design and implementation of the DEBA program.**

   Please see the draft scoring worksheet and individual line-item derivations presented above.

Please feel to reach out for further discussion should any of the proposed concepts or the rationale behind them appear to warrant further discussion.

Sincerely,

Michael Day

Michael Day
Advanced Energy Program Lead
Trane Technologies