Assessment of Potential Alternatives for Local Peaking Capacity in the Entergy New Orleans Service Area

Prepared by Strategen Consulting for: Alliance for Affordable Energy & Clean Energy Group. February 2019

Background

Entergy New Orleans (ENO) has recently sought approval from the New Orleans Council to build the New Orleans Power Station (NOPS), comprised of either a new 226 MW peaking natural gas-fired combustion turbine (MHPSA), or alternatively 128 MW of gas-fired reciprocating engines (Wartsila) at the Michoud site. ENO's original Application and Supplemental and Amending Application outline ENO's assessment of need for local generation and provide analysis of potential alternatives. While comprehensive in many ways, Strategen finds that ENO's analysis overlooks certain options. Most importantly, ENO did not conduct a serious analysis of battery storage or solar PV + storage as alternatives for meeting ENO's need. ENO's Applications each included only a single reference to storage resources in relation to their use for intermittent resources:

> "However, without cost-effective storage, which does not exist at this time, it is not possible to utilize intermittent resources to meet ENO's capacity reserve needs and, in turn, ensure reliable service to customers."[1]

In this briefing, Strategen provides up-to-date information on the status of grid connected battery storage projects. We report on the cost-effectiveness and value of recent or proposed storage projects. Additionally, we provide a comparison of a comparable storage project to the ENO-proposed NOPS gas peaker facility (MHPSA) and Alternative Peaker (Wartsila).[2]

Recent Energy Storage Project Examples

The market for grid-connected energy storage devices has evolved considerably over the last few years. Globally, there is now a significant number of commercial, large-scale battery storage projects that are online, under construction, or are contracted to be built. Below are a few examples of some of these recent projects:

Standalone Storage Project Examples:

- In June 2018, Pacific Gas & Electric (PG&E) entered long-term contracts for over 567 MW of battery storage resources including:
  - A 300 MW, 4-hour duration battery
  - A 75 MW, 4-hour duration battery
  - A 182.4 MW, 4-hour duration battery

  In its filing to the Public Utilities Commission, the PG&E determined that the storage solutions were cost-effective as an alternative to extending a "Reliability Must-Run" contract with a gas plant that would otherwise be needed for local reliability.[3]

[1] Council of the City of New Orleans, Docket No. UD-16-02, *Supplemental and Amending Application of Entergy New Orleans, Inc. For Approval to Construct New Orleans Power Station*, at page 19.
[2] Strategen recognizes that some of the information provided in this briefing may not have been available to ENO at the time of its Application or Supplemental Application. However, Strategen has included these materials in the interest of bringing the most current information to the Council's attention.
[3] http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M229/K550/229550723.PDF

- In 2016, Southern California Edison and San Diego Gas & Electric conducted an expedited solicitation for battery storage projects to address local grid reliability issues related to a gas leak the Aliso Canyon gas storage facility. As a result, three large-scale storage projects totaling 70 MW were brought online in less than 1 year.[4]
- In May 2018, Salt River Project (Arizona's largest electric utility) entered a 20-year contract for a 10 MW, 4-hour duration battery to provide peaking capacity during periods of high demand.[5]
- In November 2017, the MW Hornsdale Power Reserve project was energized in South Australia. This 100 MW battery built by Tesla Inc. has provided frequency regulation services that have helped stabilize the grid as well as provide load shifting.[6]

Solar + Storage Project Examples:

- In January 2019, Minnesota electric cooperative Connexus began commercial operation of a 10 MW solar + 15 MW battery storage facility. The coop found the project to be cost effective with an expected payback of 7-8 years due to demand savings.[7]
- In December 2018, the Nevada Public Utility Commission approved three solar + storage PPAs proposed by NV Energy, all for 2021 delivery:[8]
    - A 101 MW solar + 25 MW battery (4-hour) facility with a PPA price of $26.50/MWh
    - A 200 MW solar + 50 MW battery (4-hour) facility with a PPA price of $26.51/MWh
    - A 100 MW solar + 25 MW battery (4-hour) facility with a PPA price of $29.96/MWh
- In 2017, Xcel Energy in Colorado conducted an All-Source Solicitation for new resources and received several bids for hybrid solar + storage resource. The median bid PPA price received for this type of resource was $38/MWh.[9] Notably, the solar + storage projects in Nevada and Colorado have a significantly lower levelized cost of energy (LCOE) than the alternatives considered by ENO.[10]
- In New England, the company Sunrun (which provides customer-sited distributed solar and battery storage) recently won a 20 MW bid in the forward capacity auction for ISO New England, which operates the electric grid in six Northeastern states. That auction results demonstrate the ISO's expectation that Sunrun will be able to deploy enough solar and storage to provide 20 MW of reliable grid capacity by 2022.[11]

Cost Comparison: NOPS Peaker versus Standalone Storage

Gross Capital Cost Comparison

There are several ways to evaluate the costs of new energy resources. One simple method is to compare the installed cost on a $/kW basis. In its Supplemental Application, ENO provided a cost comparison for five different natural gas peaker options. The installed costs for these ranged from

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[4] https://www.greentechmedia.com/articles/read/aliso-canyon-emergency-batteries-officially-up-and-running-from-tesla-green#gs.HJykJYKB
[5] https://www.srpnet.com/newsroom/releases/053018.aspx
[6] https://en.wikipedia.org/wiki/Hornsdale_Wind_Farm#Hornsdale_Power_Reserve
[7] https://www.utilitydive.com/news/minnesota-co-op-breaks-ground-on-first-major-storage-projects-in-state/529512/
[8] http://pucweb1.state.nv.us/PDF/AxImages/DOCKETS_2015_THRU_PRESENT/2018-6/30441.pdf
[9] https://www.dora.state.co.us/pls/efi/efi_p2_v2_demo.show_document?p_dms_document_id=881732&p_session_id=
[10] In its testimony, ENO presented its analysis for recommending the alternative peaker, which include 5 gas peaker technology options with a LCOE ranging from $75-89/MWh. See Table 1 on p 10 of Supplemental and Amending Testimony of Jonathan E. Long.
[11] https://www.greentechmedia.com/articles/read/sunrun-wins-new-england-capacity-auction-with-home-solar-and-batteries#gs.EnD76B0I

$803/kW to $1,045/kW.[12] Meanwhile, Strategen estimates that the cost to install a standalone battery storage facility designed to provide peaking power in the 2020 timeframe could be as low as $989/kW, which is well within the range of alternatives considered by Entergy (see Table 1).

On a levelized cost basis, including fuel and O&M costs, Strategen estimates that the range of storage resource costs is likely to be lower than those considered by ENO. Additionally, recent publicly available bid prices for standalone storage projects to be delivered by 2023 have demonstrated even more competitive pricing, with Xcel Energy (Colorado) reporting $136/kW-yr and NIPSCO (Indiana) reporting $135/kW-yr.[13] Notably, these represent actual bid prices by competitive suppliers, not hypothetical assumptions about future costs.

Table 1. Cost comparison for peaking resource options

Technology	Est. Delivery Year	Est. Initial Capital Cost $/kW	Est. Lifetime Levelized Costs $/kW-yr	Emissions, NOx & CO (ppm)	Groundwater Withdrawal
Proposed Gas Peaker (MHPSA)[14]	2019	$803	$304[15]	5/9	Very Low
Alternative Gas Peaker (Wartsila)[16]	2019	$942	$317[15]	5/15	Very Low
Other Gas Peaker (LM6000 PF)[17]	2019	$1,045	$313[15]	5/15	57
Storage – Low	2020	$989[18]	$175[19]	0	0
Storage – High	2020	$1,558[18]	$252[19]	0	0
Storage (Xcel bid price)	2023	--	$136	0	0
Storage (NIPSCO bid price)	2023	--	$135	0	0

Net Cost Comparison

Peaker plants, like the proposed NOPS project, are generally designed to operate infrequently, and often have capacity factors of less than 10%. Thus, while providing peak capacity during critical hours, these facilities provide little additional value in terms of energy or other grid services during most of the year. In contrast, an energy storage system, once installed, can efficiently provide value to the grid during many hours of the year, not simply during peak load hours. It is important to consider these additional values when evaluating a resource's cost-effectiveness. This can be done by

[12] See Table 1 on p 10 of Supplemental and Amending Testimony of Jonathan E. Long.
[13] https://www.ourenergypolicy.org/wp-content/uploads/2018/10/14618_economic_potential_for_storage_in_nevada_-_final.pdf
[14] Based on ENO's reported information for the M501F3 (MHPSA) unit, which is proposed by ENO.
[15] Includes capital cost, fuel (based upon 4000 hours per year dispatch and $3.50/MMBtu gas, consistent with Direct Testimony of Jonathan E. Long) escalated at 2%/yr, non-fuel O&M (based on Exhibits OT-1R & OT-2), and LTSA (based on Direct Testimony of Jonathan E. Long). Assumes a lifetime of 20 years and WACC of 8%.
[16] Based on ENO's reported information for the Wartsila Alternative Peaker unit.
[17] Based on ENO's reported information for the GE LM6000 PF Sprint 25 x3 units + evap cooler.
[18] Storage costs are based upon Lazard's Levelized Cost of Storage Analysis, Version 4.0 (2018): https://www.lazard.com/media/450774/lazards-levelized-cost-of-storage-version-40-vfinal.pdf.
The reported installed cost range reflects the Li-ion battery wholesale use case (100 MW, 400 MWh). 2018 initial capital costs – DC: $232-398/kWh, Initial Capital Cost – AC: $49-61/kW, and EPC Costs: $16 M. Assumes DC costs (i.e. battery packs) decline from 2018 levels to 2020 levels at the forecasted rate of -8% CAGR.
[19] Includes capital costs and charging costs. Assumes O&M and warranty annual cost equal to 3% of initial cost. Assumes daily cycling and average power purchase price of $23.50/MWh (based on 2017-18 MISO LA Hub price data). Assumes a lifetime of 20 years and WACC of 8%.

comparing the Net Cost, which includes the initial capital cost and O&M, net of energy value (i.e. from arbitrage) and ancillary services value (e.g. frequency regulation).

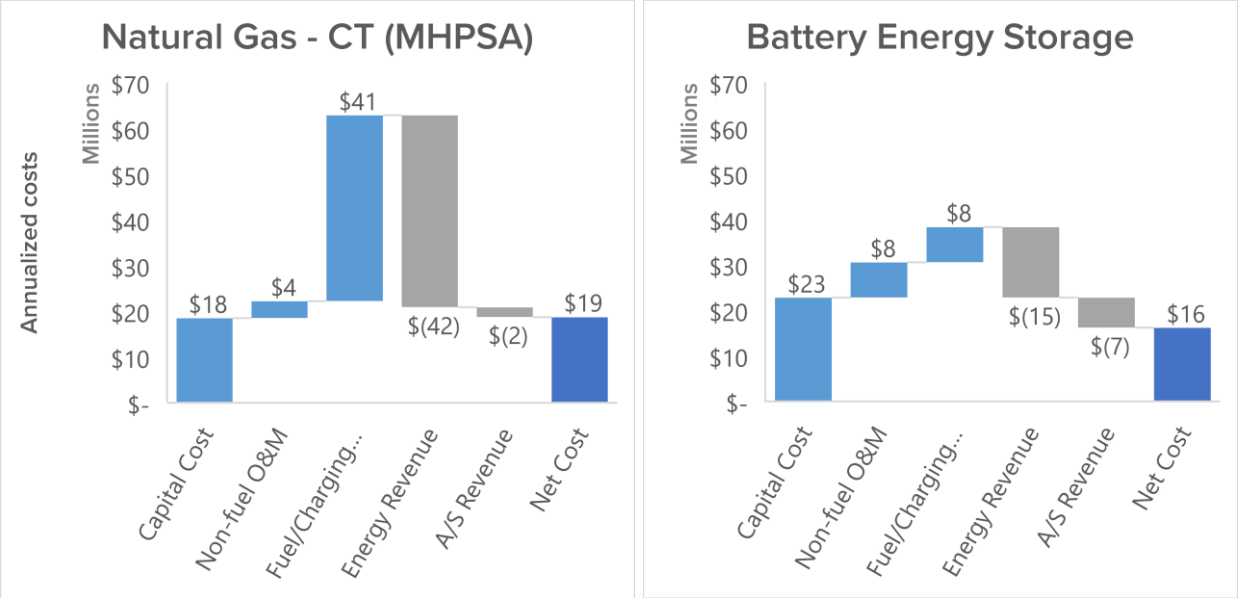

Figure 1. Illustrative net cost comparison of a 226 MW natural gas peaker (left) and 226 MW, 4-hour, battery energy storage (right). Peaker capital and fuel costs based on the ENO-Proposed Gas Peaker (MHPSA) and Battery capital costs (low case) shown in Table 1. Energy revenue and charging costs based on 2017-18 MISO Louisiana Hub price data. Assumes Ancillary Services revenue for battery from regulation at $5/MW-h and for peaker from supplemental reserves at $1/MW-h.

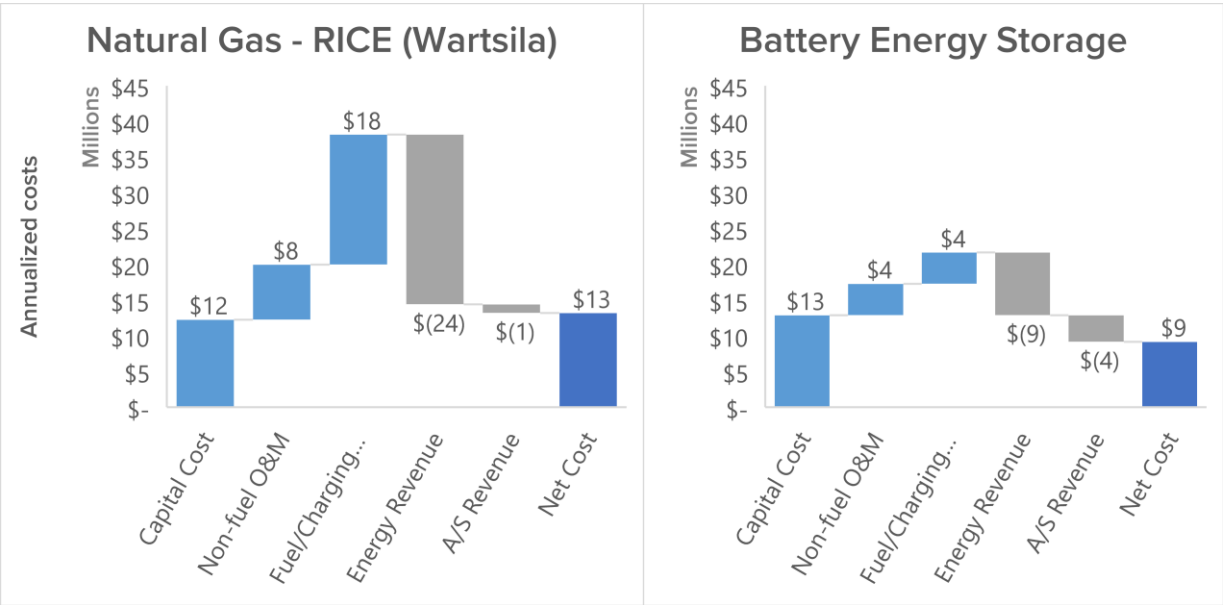

Figure 2. Illustrative net cost comparison of a 128 MW natural gas peaker (left) and 128 MW, 4-hour, battery energy storage (right). Peaker capital and fuel costs based on the ENO Alternative Peaker (Wartsila) and Battery capital costs (low case) shown in Table 1. Energy revenue and charging costs based on 2017-18 MISO Louisiana Hub price data. Assumes Ancillary Services revenue for battery from regulation at $5/MW-h and for peaker from spinning reserves at $2/MW-h.

Option Value

A major advantage of storage is its modular design meaning that incremental additions can be made as needed. Notably, there is always substantial uncertainty in future load growth as demonstrated by ENO's revised load forecast. For traditional power plants that are larger in size (e.g. greater than 200 MW), this presents a challenge since it often necessitates some amount of "overbuild" until load growth catches up to the installed capacity. In contrast storage can be added relatively quickly as needed or avoided altogether if load growth does not materialize. This reduces the risk of overbuilding thereby providing additional "option value" to ENO customers by avoiding costs of a large generator that could become "locked in" even when load growth is less than anticipated.

Subsidence Issues

A major consideration for new power projects sited in the New Orleans area is the effect of subsidence – including potential exacerbation of this issue through groundwater withdrawal.

ENO provided extensive testimony demonstrating that "groundwater withdrawal associated with the Alternative Peaker, like the CT, will not exacerbate subsidence or cause damage to infrastructure in New Orleans East."[20] It should be noted for comparison that a battery energy storage projects would require no groundwater withdrawal, thus would not pose any risk (even an insignificant one) of increased subsidence.

Additionally, even if a facility such as a CT is not a major contributor to subsidence, there is always a possibility it could become affected by subsidence in the future due to other circumstances. Energy storage projects provide an advantage in this regard since they can be relatively easily relocated. Recent examples of battery storage projects that have been relocated include the following:

- AES' 16 MW battery storage facility relocated to Ohio:
  - https://blog.fluenceenergy.com/aes-to-expand-energy-storage-presence-in-pjm-market-with-first-advanced-energy-storage-facility-in-ohio
- ConEd's 4 MWh mobile battery storage pilot program:
  - https://www.utilitydive.com/news/coned-nrg-partner-on-4-mwh-mobile-battery-storage-demo-for-rev-docket/437125/

Storm Resilience

A significant value that battery storage projects can provide is the ability to enhance resilience of the grid during catastrophic events like hurricanes. A real-world demonstration of this occurred during Hurricane Irma in the Dominican Republic. Two large battery storage projects installed on the island were able to help stabilize grid frequency, and alleviate fluctuations caused when 40% of the generation fleet had suffered an outage. Figure 3 (right) illustrates the relatively stable grid frequency during the storm despite significant fluctuations in power output.

[20] Supplemental and Amending Direct Testimony of Dr. George Losonsky at p 6.

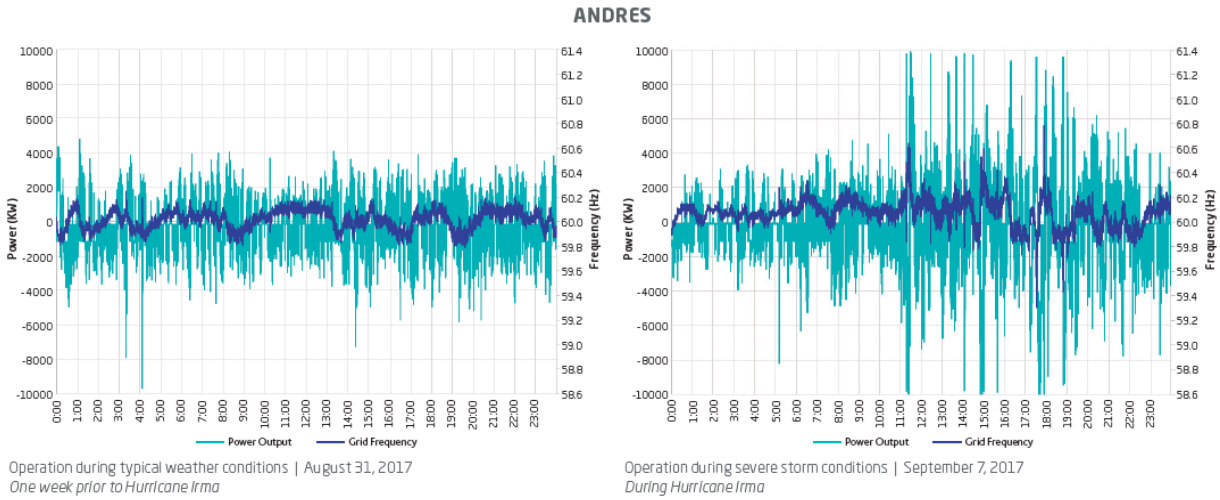

Figure 3. Demonstration of battery storage operation during Hurricane Irma.[21]

Recent studies have also shown that inverter-based resources (like batteries) can actually respond faster and more accurately than traditional generators in the face of a disturbance.[22] Additionally, some cities are currently seeking to deploy solar + storage at critical facilities (e.g. emergency shelters) to provide backup power during an emergency. Examples include the following:

- MA Community Clean Energy Resiliency Initiative[23] -
- San Francisco's Solar Resilient program.[24]
- Maryland Energy Administration Resiliency Hub program[25]

Reliability

Even though they are duration-limited, energy storage resources are able to meaningfully contribute to system reliability in the same manner as a traditional power plant. MISO recently reaffirmed this in its testimony to the Federal Energy Regulatory Commission (FERC) to comply with Order 841. As MISO stated, storage resources are able to qualify as capacity resources so long as they are able to operate for four consecutive hours:

"MISO's proposal modifies the definition of 1 Use Limited Resource and Section 69A.3.1.d of the Tariff to allow Electric Storage Resources to qualify as Use Limited Resources to the extent they are able to operate for a minimum of four consecutive operating Hours across the daily coincident peak for each day."[26]

This is consistent with other system operators which typically assign full or nearly full capacity credit to storage of at least four hours duration. As mentioned above, PG&E recently selected battery storage as a cost-effective option to address local reliability issues in place of an uneconomic gas plant.

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[21] *https://cdn2.hubspot.net/hubfs/2810531/Collateral/AES%20Collateral/Fluence%20Case%20Study%20-%20Storm%20Resilience.pdf*

[22] https://www.nrel.gov/docs/fy17osti/67799.pdf

[23] https://www.mass.gov/community-clean-energy-resiliency-initiative

[24] https://sfenvironment.org/solar-energy-storage-for-resiliency

[25] https://energy.maryland.gov/Pages/Resiliency-Hub.aspx

[26] https://elibrary-backup.ferc.gov/idmws/common/downloadOpen.asp?downloadfile=20181203%2D5244%2833269198%29%2Epdf&folder=7790360&fileid=15109008&trial=1

Recommendations:
Given the advancements in the state of battery storage leading up to and since ENO's application, it appears warranted to revisit the viability of this option in lieu of the proposed alternative. The Council should require Entergy to conduct an all-source RFP solicitation that clearly defines system needs and would be open to a variety of resources including (but not limited to), energy storage, solar + storage, and demand response. This would allow for broad market participation to determine the most cost-effective mix of resources able to fulfill Entergy's peak capacity and reliability needs.

Appendix: Overview of Strategen

Strategen Consulting is a strategic advisory firm that provides insight to global corporations, utilities, public sector leaders, research institutions, technology providers, project developers, and large energy users, helping them to develop impactful and sustainable clean energy strategies. Our clients come to us for our expertise in developing business models, commercial strategies, financing tools and regulatory support that empower them to create sustainable value and long-term solutions. Strategen's exclusive focus on clean energy and advanced grid technologies enables us to bring our clients a sophisticated understanding of industry trends, market drivers and regulatory policy.