Portfolio Screening and Prioritization for Onsite Energy

Background

Many corporate sustainability managers are evaluating opportunities at dozens or hundreds of sites in different locations across the country and need a way to prioritize investments.This collection of sites if often referred to as a portfolio. This primer provides organizations with guidance to screen and prioritize a portfolio based on favorable project development criteria. The overview of screening approaches outlined include:

- **Qualitative screening**, which focuses on assessing project development criteria related to regional geographic, state and utility, facility-organization, and site-specific factors for favorable project outcomes.
- **Data modeling**, which focuses on using techno-economic analysis tools that can evaluate many facilities with limited input data and the results can help prioritize specific sites for further evaluation based on economic, renewable energy, or emissions reduction metrics.
- **Favorable screening outcomes by technology**, which focuses on screening project development criteria that are associated with positive feasibility outcomes by specific onsite technologies.

The outcomes from the application of these portfolio-screening principles intend to support improvements in identifying projects in early stages for targeted feasibility analysis and commissioning projects which are favorably positioned for successful financial performance.

Qualitative Screening

An effective approach to qualitatively evaluating and prioritizing potential onsite clean energy projects across an organization's portfolio is founded on identifying factors that lead to more promising business case outcomes for projects. These factors can be categorized from regional to site-specific and are shown in Table 1 and discussed in greater detail below.

Table 1. Overview of Favorable Onsite Clean Energy Project Development Factors

Regional Geographic Factors	State and Utility Factors	Facility-Organization Factors	Site-Specific Factors
Are there sufficient solar or wind resources?	Is there a renewable portfolio standard in effect?	Is the facility owned or leased?	Is the roof/space acceptable for solar photovoltaics? Are there parking spaces for carport or canopy photovoltaics?
Are multiple facilities in proximity to one another?	Are there favorable utility and/or state incentives?	Is the facility important to key stakeholders?	Is there available land on which to install solar photovoltaics or wind turbines?
Are electricity energy and demand charges high relative to the rest of the portfolio?	Are there favorable utility tariffs and programs?	Is there a positive long-term outlook for the facility?	Is there a suitable location for batteries, fuel cells, or combined heat and power infrastructure?
Are natural gas prices high relative to the rest of the portfolio?	Does utility interconnection support dispatchable generation?	Are greenhouse gas emissions calculation factors higher relative to the rest of the portfolio.	Are there large fossil-fuel heating loads and do they coincide with electric loads? Are low-carbon or renewable fuels available to replace existing fossil-fuel consumption?
Are third-party ownership options legal?	Is net metering available?	Is the facility located near a disadvantaged community (DAC)?	

Regional Geographic Factors

- **Renewable Energy Resources**
  The costs of developing, designing, permitting, constructing, commissioning, and operating onsite renewable energy continue to decrease. The intensity of the solar and/or wind resource at a facility can often result in higher performance per capital dollar spent, thereby improving the business case for deployment.

- **Proximity**
  Having multiple potentially favorable sites in proximity to each other can support feasibility, design, construction, and commissioning economies of scale.

- **Higher Energy and Demand Charges**
  Generally, higher than average electricity energy and/or demand charges, and natural gas prices equate to a better payback for onsite clean energy. Deploying a battery-based energy storage system in tandem with solar power technologies can often better manage electrical demand charges while solar intermittently produces less energy on cloudy days or when more grid power is required due to load spikes.

- **Legality of Third-Party Project Ownership**
  Third-party ownership models (such as a lease or power purchase agreement) allow for the generation of renewable energy and monetization of federal tax credits for renewable energy by a third party that is not the local utility. The legality of these models is clear in some states, while in other states, they are viewed as conflicting with statutes that govern electricity service monopoly. Further, in other states, the legality of whether a third party other than the vertically regulated utility can own and supply power to a customer remains unclear.

State and Utility Factors

- **State Renewable Portfolio Standards**
  Compliance with state renewable portfolio standards (RPS) is usually tracked by the generation, sale, transfer, and retirement of

  RPS compliance renewable energy certificates (RECs). A REC is a legal instrument that represents the environmental attributes of 1 megawatt-hour (MWh) of renewable energy generated.

  Depending on the robustness of the policy, RPS compliance RECs often add significant financial value to the project developer via sales to the local utility. Although these compliance sales accentuate the business case for the project, if a customer sells the RECs, they forfeit the right to claim the renewable attributes of the energy. In such a case, the customer would have to replace the compliance RECs by purchasing unbundled voluntary RECs in order to claim a greenhouse gas (GHG) benefit and/or renewable energy accounting benefit.

- **Utility or State Incentives**
  State and utility-based incentives for onsite energy technologies are often critical to developing a positive business case for a project. These incentives are developed to support RPS or other clean energy policies and typically require rulemaking and implementation by state agencies and local utilities.

- **Favorable Utility Tariffs**
  In addition to general higher electricity rates, there are other utility tariffs factors in vertically regulated retail utility markets that either undermine or benefit the value of onsite clean energy projects. Examples that are less favorable include high or unreasonable standby demand charges required to support delivery of grid electricity should the onsite generation system fail or overlapping tariff rates the utility can switch the customer to that differ from the tariff scenario they initially considered.

On the other hand, time-of-use tariff rates and demand-response programs often have criteria that can pair favorably with facility load profiles. While a project development team may not be able to confirm the value until a full feasibility study is undertaken, favorable time-of-use and demand-response rate terms are positive screening criteria.

- **Favorable Utility Interconnection**
  Some facility feeders may not have access to three-phase power, which can hinder the facility's ability to connect and operate dispatchable generation (e.g., battery storage, combined heat and power (CHP), fuel cells) in parallel with the utility's distribution system. Conversely, an industrial facility that intends to interconnect to the utility's system at transmission voltage can also present the local utility with atypical challenges to allow the grid's system to operate in parallel with customer load.

  In addition to these technical factors, utility interconnection program and system upgrade requirements are often unclear, which can add time and uncertainty to project development efforts. Engaging your local utility up front on the requirements of their interconnection program and leveraging NREL's interconnection guidance can help identify projects with anticipated favorable outcomes.

- **Net Metering Availability**
  Screening for the applicability of net metering early on should always be considered. In some cases, electricity use at industrial sites can exceed the threshold for state net metering programs and limit their eligibility. For some sites, examining the utility's tariff for the export of electricity from onsite generation under their Federal Energy Regulatory Commission-mandated cogeneration-small power producer tariff may offer an opportunity to improve a project business case for electricity exports.

Facility-Organization Factors

- **Ownership**
  It may be more favorable to prioritize owned sites than to navigate the implications of engaging a landlord on leased properties. Further, for leased sites, an organization should consider engaging the property owner on workarounds upfront if the remaining duration of a lease does not align with to the life span of the onsite energy project.

- **Visibility/Importance**
  Many organizations view onsite energy deployment at high profile sites, such as headquarters or key manufacturing locations, to add intangible stakeholder value.

  Engaging critical internal (current and potential employees) and external stakeholders (customers, suppliers, community members) in support of sustainability goals can help an organization obtain support for projects that may transcend traditional bottom-line cost savings.

- **Long-Term Facility Outlook**
  When internally screening a portfolio of potential sites, it is important to gauge the likelihood that the facility will be maintained during long-term operations to avoid the potential sale or consolidation of a facility, which could complicate the onsite energy project value.

- **Emissions Benefits**
  Organizations should also consider the impact of onsite generation technologies on CO2 emissions. There are regional variations in the carbon emissions associated with each MWh of electricity produced by a competitive supplier or local utility grid. Therefore, organizations should factor in where onsite clean energy projects will result in the displacement of electricity with the highest CO2 emissions to support greenhouse gas emissions commitments.

- **Opportunity to Benefit Community**
  Sites near designated disadvantaged communities (DAC), according to Justice40 Initiative criteria, provide a unique opportunity to engage with the community and identify onsite energy project options that would result in favorable outcomes for both the organization and the community. Many DACs have been historically overburdened by energy system externalities, underinvestment in critical infrastructure, and lack of representation in decision-making processes. Establishing mechanisms for community engagement and participation in onsite energy planning can encourage informed decision-making, leading to project outcomes that better align with community needs and bolster public acceptance. Community benefits related to clean onsite energy deployments include, but are not limited to, improved environmental and health outcomes due to reduced dependence on pollution-heavy generation sources, greater grid resilience (e.g., fewer, shorter power outages), stabilized utility costs due to deferred distribution and transmission system upgrades, and local economic revitalization through job creation, workforce training, and property tax revenue. Proactive community engagement can also foster workforce development opportunities, providing local jobs to support onsite energy deployment and project maintenance. Community benefits plans are key components of the technical merit review process used to determine eligibility of onsite energy deployment projects for Bipartisan Infrastructure Law grants or Inflation Reduction Act bonus tax credits.

Site-Specific Factors

Screening for the basic physical and operational logistics may determine whether onsite energy technology deployment is feasible. It is important to do this at the outset of the process to avoid stranded project development efforts. The following factors support positive project outcomes.mortgage lender consent to be valid.

- **Acceptable Roof Condition and Space for Roof-Mounted Solar Photovoltaics**
  One initial favorable screening factor for rooftop solar photovoltaics (PV) include sufficient rooftop space to place a system large enough to have impact on energy use and costs. The available space should be as free from vents and other rooftop penetrations as possible to optimize design and installation efficiency.

  Further, the roof age should coincide with the anticipated duration of a solar PV project (often 25 years or more), and the structural capacity of the roof must be adequate to support the panels and racking systems. Unless a roof is new, projects may require a roof condition assessment as part of advanced feasibility work.

- **Available Land for Onsite Renewable Energy Generation**
  Ground-mount solar projects typically have the lowest equipment and installation costs per kilowatt-hour (kWh) generated followed by rooftop PV. Carport solar PV projects typically have the highest equipment and installation costs per kWh generated. The availability of suitable land to install onsite wind turbines and solar PV and/or parking lot space for carport-supported solar PV can broaden project deployment outcomes.

- **Suitable Space for Batteries, Fuel Cells, and Combined Heat and Power**
  Battery energy storage systems, fuel cells, and CHP systems do not require the same amount of available land as onsite wind and solar power infrastructure. However, the location of suitable space to safely operate these technologies is critical to the feasibility, design, construction, and operation of onsite technology projects. Many local authorities having jurisdiction on permitting approval are new to technologies and need to be engaged proactively.

- **Large Fossil-Fuel-Based Heating Loads**
  Fossil-fuel-based thermal loads can widen the types of onsite generation solutions that may be feasible. One example includes CHP systems that efficiently produce power and thermal energy (steam/hot water) onsite for facilities where consistent and coincident heating and electrical loads optimize the value of waste heat recovery from power generation. Another example could be heating loads currently served by natural gas boilers and furnaces that could be electrified.

Data Modeling

- **Using Distributed Energy Resource Screening Tools to Evaluate a Portfolio**
  Publicly available techno-economic analysis tools can provide a quantitative method to evaluate the potential for onsite energy technologies across an organization's portfolio of sites. This allows prioritization based on metrics such as cost-savings and emissions reduction potential, and a down-selected list of sites with favorable projected outcomes can then be chosen as candidates for more in-depth analysis. This allows organizations to allocate their limited resources to evaluate the individual sites more thoroughly with the highest potential for onsite energy deployment.

- **Modeling Methodology**
  One such tool is the National Renewable Energy Laboratory's Renewable Energy Optimization (REopt®) tool, which includes a publicly accessible programming interface API). The methodology this document presents to perform quantitative portfolio screening analysis has REopt-specific references, which may differ across similar tools. The process for a REopt screening analysis is illustrated in Figure 1; the main difference between a detailed site-level analysis and a portfolio-level analysis is the amount and reliability of known site attributes.

  A portfolio analysis may involve 10 or more sites. The site data collected should be detailed enough to capture site-specific attributes that will inform the value of different onsite energy technologies while timeline expectation of the analysis.

  Tools such as REopt can consider hourly load profiles and detailed electric rate structures but gathering those may not be practical for many sites. Similarly, the time-varying profile of natural gas consumption in facilities is often not understood at the portfolio level because the size and operational details of boilers or furnaces is not known at this level of data gathering.

- **Candidate Technologies**
  The technologies to consider in a portfolio analysis may determine the amount and reliability of the site data required for the analysis, or vice versa, where the amount of data which can be gathered for each site may limit the ability of the analysis to properly evaluate certain technologies. For example, if the hourly variation of the electric load is unknown and therefore modeled as constant and the electric tariff is unknown so blended average annual electricity charges are assumed, then it is not worth evaluating battery storage because the tool would find no economic value.

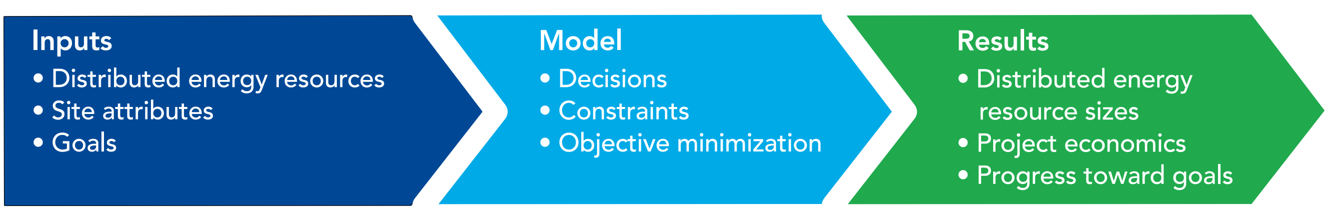

Figure 1. REopt screening analysis inputs, model considerations, and result

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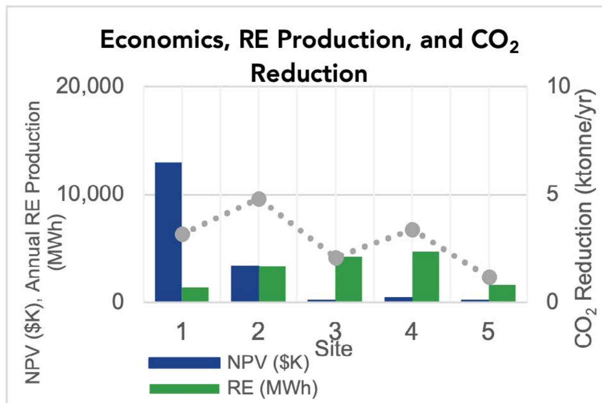
Minimum required:
Annual electric consumption (kWh)
Average-blended electricity price ($/kWh)
Annual natural gas consumption (million British thermal units [MMBtu])
Natural gas price ($/MMBtu)
Estimate of usable land (acres)
Estimate of usable roof area (square feet)
Optional (to strengthen the analysis):
Operating hours/schedule (e.g. two 8-hour shifts per day seven days a week)
Building type(s) and size(s) (e.g., a large office = 50,000 SF)
State and local incentives ($ or $/kW)

- **Site Data Needs for Portfolio Analysis**
  The following is a list of site data that is important for evaluating onsite energy technologies and assumed to be obtainable across a large set of facilities while balancing the trade-off between accuracy and level of effort to collect. If more detailed data is known for every site, that could be used in the analysis. However, the level of data used for each site should be consistent for a fair comparison and prioritization.

- **Example Data Modeling for Portfolio Screening and Prioritization**
  Figure 2 shows the results for an onsite energy screening of five hypothetical sites considered in a portfolio to prioritize and choose one or two sites for more detailed analysis. A positive net present value (NPV) indicates that the onsite energy solution recommended by the tool exceeds the organization's threshold internal rate of return, but a larger NPV is indicative of a larger volume of investment, which exceeds that internal rate of return.

PV and CHP systems are cost-effective at Site 1, which has the highest NPV and the second highest CO2 reduction potential (nearly tied with Site 4). Site 2 has a lower NPV but the highest emissions reduction potential with a similarly sized CHP system but a larger PV system. Site 3 has the second largest renewable energy production, but it only achieves the second lowest CO2 reduction. Both Site 1 and Site 2 are good potential options for a more detailed analysis.

However, if the organization prioritizes Site 3 or Site 4, due to facility-organization factors, or if it favors renewable energy production, then these two sites could be candidates for further investigation.



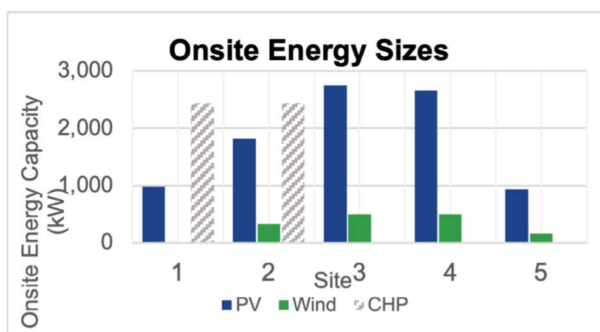


Figure 2. Example sites with onsite energy options including PV, wind turbines, CHP showing NPV, annual renewable energy (RE) production, CO2 reduction, and the onsite energy capacity in kW of each technology.

Table 2. Overview of Favorable Onsite Clean Energy Development Factors by Technology

A green up-arrow indicates a favorable criterion, a blue N indicates a neutral criterion, and a black down-arrow indicates a negative criterion

	Solar Photovoltaics	Distributed Wind Turbines	Battery Energy Storage Systems	Combined Heat and Power Systems	Heat Pumps
High $/kWh Electricity Rate	↑	↑	N	↑	↓
High $/kW Demand Charge Rate	N	N	↑	↑	↓
High Nat. Gas Prices	N	N	N	↓	↑
Available Roof Space	↑	N	N	N	N
Available Land Space	↑	↑	N	N	N
High Heating Loads	N	N	N	↑	↑
24/7 Electricity and Heating Loads	↓	↑	↓	↑	N

Favorable Screening Outcomes by Technology

The confluence of several positive screening outcomes contributes to a screening result that helps effectively identify target projects for detailed feasibility assessments to confirm project viability. The following table summarizes and ranks favorable screening outcomes by specific onsite energy technologies. Note, the magnitude of each site attribute, the combination of two or more site attributes, and the combination technologies may have different outcomes than what is qualitatively characterized in this table as favorable, neutral, and negative criteria.

- **Solar Photovoltaics**
  For solar PV systems, key factors that merit a favorable screening determination include high electricity energy rates, the presence of a state RPS, the availability of third-party ownership options, and available land or roof space. Demand charges cannot always be reliably reduced with PV due to solar intermittency and load spikes.

- **Distributed Wind**
  For distributed wind turbine systems, key factors that merit a favorable screening determination include high electricity energy rates and consistent 24/7 electrical load. Demand charges cannot be reliably reduced with wind due to intermittency of generation.

- **Battery Energy Storage**
  For battery energy storage, which can be paired with intermittent renewable technologies, key factors that merit a favorable screening determination include (a) time-of-use electric energy rates with large off-peak and on-peak differentials and high demand charges where the cost to store and use renewable electricity onsite is favorable; and (b) a load profile coupled with time-of-use rates where the renewable energy technologies and battery energy storage can effectively and predictably reduce demand charges.

- **Combined Heat and Power**
  For CHP, assumed to be fueled by natural gas, key factors that merit a favorable screening determination include high electricity energy and demand charges, low to medium natural gas prices, consistent steam or hot water thermal loads that coincide with electrical loads, and extended operating hours (>4,500 hours/ year) to optimize the value of waste heat recovery.

  Natural gas fueled CHP systems generally increase a facility's Scope 1 GHG emissions and reduce Scope 2 GHG emissions; overall CHP typically reduces the site's net emissions.

- **Heat Pumps**

  Heat pumps in this context are used to electrify heating loads currently served by natural gas boilers and furnaces. Heating, ventilation, and air conditioning (HVAC) systems' heating loads, like space heating and domestic hot water systems, can be served by air- or ground-source heat exchange systems. Industrial heat pumps can leverage a waste heat source to supply a process heating load.

  In each case, heat pumps reduce natural gas consumption and increase electricity consumption, so lower electricity prices and higher natural gas prices improve the cost savings of heat pump use. Larger heating loads improve the economy of scale of installing any type of heat pump, and the presence of a higher-temperature waste heat stream improves the cost savings and emissions reduction potential for industrial heat pumps.

Conclusions

Portfolio screening and prioritization is an important first step in identifying favorable sites for onsite clean energy deployment opportunities that include financial benefits and emissions reduction impacts. By down-selecting to a smaller, targeted number of sites, organizational resources can be efficiently used to perform more detailed feasibility studies. The process may consider qualitative factors based on regional, state and utility, facility-organization, and physical site-specific considerations, leveraging tools for data modeling to achieve quantitative metrics for each site or use a combination of the two.

ABOUT THIS SERIES

Over the course of eight months, the Onsite Renewable Energy and Storage Working Group convened over 20 partners to identify and highlight ongoing issues and opportunities when planning and deploying onsite renewable energy systems and energy storage systems. This fact sheet is part of a series to provide technical recommendations resulting from the discussion among Better Climate Challenge partners, allies, and DOE experts.