White Paper

When it Comes to the Useful Life of Renewables, Can 40 Be the New 25?

By Heidi Larson, Todd Tolliver, Mark Reusser, and Chris Mertes, ICF

Executive Summary

Historically, the assumed useful life for solar and wind facilities have been 25 and 20 years, respectively. A baseline useful life for battery storage systems, a relatively new entrant to the wholesale power market, has not yet been established, but it is commonly assumed that lithium ion batteries have a life of 7-10 years before replacement or augmentation is required. However, in the ever-changing landscape of renewable asset development, financing, and tax reform, the determination of useful life plays an important role in assessing the overall value and long-term ownership.

Evaluation of a facility requires multifactor analysis, including the qualifications and experience of the contractors and suppliers; the design and construction of the facility and associated equipment; availability of replacement components; and proposed operations and maintenance plans

As technical advisors, we review the following areas to evaluate the potential useful life for a facility:

1. Site control and interconnection
2. Site meteorological and geotechnical conditions
3. Design specifications and criteria
4. Equipment selections
5. Experience and qualifications of the engineering, procurement and construction contractor(s)
6. Operations and maintenance plans and budget.

Check The Box

Do the following support the intended useful life?

- ☐ **Site Control/access**
- ☐ **Geotechnical findings and recommendations**
- ☐ **Interconnection agreement and access**
- ☐ **Engineering design basis and specifications**
- ☐ **Construction quality requirements, including quality monitoring and assurance**
- ☐ **Equipment selections and spare parts planning and procurement**
- ☐ **Technical pro forma assumptions**
  - O&M Budget
  - Major maintenance reserves planning
  - Availability assumption for initial, middle, and late years of project life
  - Degradation assumptions, especially in late years of project life (solar, storage)

Strategic consideration of these aspects during the project planning and development phase, as well as continued review during construction and operations, can help position assets for a longer useful life.

Site Factors

Site consideration primarily includes evaluation of the period during which an owner has site control, site access, and interconnection arrangements, as well as consideration of geotechnical characteristics for a project.

If the property on which a project is built is owned and associated access is controlled by the project company, these matters may become non-issues in assessing the long-term viability of a project. If property is leased and/or access or interconnection is dependent on easements, we look for those agreements commensurate with the anticipated useful life of the project. Typically, real estate matters are ancillary to the review of a technical advisor or independent engineer, though the review is more straightforward if site control and access are not limiting factors.

Additionally, interconnection agreements typically adhere to a stated term with automatic renewals. If this is not the case, however, stakeholders should consider and plan to provide for interconnection corresponding to the anticipated operation of the project.

In determining useful life, it is also important to understand geotechnical and hydrological site factors, such as geological, soil, or seismic conditions that may impact or limit design of the project. Similarly, for project sites prone to flooding or consisting of drainage ways, the aim should be to confirm (through review studies and conclusions) that the site civil grading and, ultimately, the overall project design aligns with the long-term operating goals for the project.

System Design, Equipment, and Construction

The methodology and quality of construction play a critical role in the longevity of a facility. As such, the evaluation of useful life must be informed by the design basis used for the overall project and its major components.

To help meet the intended useful life of a project, the design basis for the overall system or balance of a plant should reflect an appropriate design life in engineering and construction contracts. The quality of the engineering and construction team—specifically, their qualifications and experience designing and constructing high quality facilities—is another important factor. Understanding and establishing appropriate construction quality standards, including requirements for quality monitoring and assurance in the field, is also valuable.

Solar

For example, in solar facilities, proper module handling during delivery and installation can play a critical role in preventing micro-cracks—ones that may not otherwise be visible or manifest until several years into the life of a project

—within the cells. Similarly, the techniques and quality applied to back-fill and soil compaction, racking installation, wire and cable management/installation (above- and below-ground), and civil work (e.g. detention/retention system design) are other areas that can impact the expected lifetime of a solar facility and the expected maintenance costs of the system as it reaches the later years of operation.

Wind

Wind facilities should use foundation designs that account for both extreme loading and longer-term fatigue loads. The construction contract should specifically outline this in an appropriate foundation design life. During construction, a well-executed and documented QA and QC program will also support longer useful lives. Careful quality management of foundations, underground collection system installation, and even down-tower cable ties will not only reduce maintenance costs in the future but also streamline evaluation of useful life extensions.

Storage

As battery storage systems continue to gain attention, consideration of (a) the design architecture for the system and (b) the initial use application and flexibility to future use applications is advantageous. As an example, the battery life is generally the limiting factor, depending on the technology chosen and the applications the system serves. Capacity augmentation strategies — such as schedule, and plans for equipment addition or replacement to meet the long-term needs of the project—should be reviewed. Physical space for additional battery racks and method of integration to ensure new components retain their performance should be contemplated. To ensure adequate capability for the out years, cases of capacity overbuilding or actual degradation of battery efficiency and capacity due to potential calendar life degradation should be evaluated.

In general, regardless of technology, when selecting equipment for a project, it is helpful to consider a manufacturer's experience and the underlying technology and components of a product. For example, leading manufacturers of central inverters or converters typically report a 20-year design basis for their products. Working with manufacturers to understand recommended maintenance, including long-term unit refurbishment options, can inform operational plans and major maintenance budgets. It is often possible to work with manufacturers of key components to gather expected failure data (including potential types of failure), and understand the current and projected availability of replacement components/parts (including potential suppliers), to help develop the major maintenance reserves budget for outright component replacement.

Considerations and Assumptions for Long-Term Operation

Finally, O&M plans, operating budgets, and major maintenance reserve accounts are among the most significant factors useful life evaluations should incorporate. There must be adequate provisions to keep the project in top operating condition during the initial and middle years of operation. At a minimum, stakeholders should develop appropriate assumptions for (i) planned/preventative maintenance, (ii) unplanned/corrective maintenance, (iii) maintenance reserves, (iv) availability, and (v) degradation for solar and storage projects.

As a facility ages, it is expected that the rate of component failure may increase and that the availability of replacement components may become more limited. Retrofitting with new components may require design adjustments or added costs in order to maintain the desired performance. In the later years of operation for wind projects, economic decisions regarding maintenance likely need to be made. For example, if a blade fails in year 26, finding a replacement may prove difficult or cost-prohibitive, so decommissioning the turbine may be a better option. Considerations like this one should be reflected in project availability and thus energy production in the out years.

It may be appropriate to consider one or more of the following in the financial pro forma for the project intended to surpass historic norms: (i) increased O&M budget for corrective maintenance in the mid to late years of operation, (ii) reduced availability in late years of operation, (iii) increased degradation in late years of operation, specific to solar and storage, and (iv) specific to battery storage the augmentation strategy and budget to maintain the necessary capacity for the intended life of the project. Adhering to prudent industry practices, following manufacturer-recommended preventative maintenance guidelines, and responding diligently to unexpected issues are important for maximizing the useful life of the asset.

Diligent planning during the development for construction and long-term operation of renewable assets can support determination of useful life longer than the historic norms, adding to the overall value of a project.

About the Authors

Heidi Marie Larson is a licensed professional engineer experienced in technical and financial aspects of solar assets, and broader renewable generation. She has proven communication and project management skills that contribute to achieving objectives and creating value across organizationally diverse teams. She has supported more than 3.5 GW-AC of renewable generation assets through development, financing, construction/commissioning, and operation.

Todd Tolliver has over thirteen years of experience in the field of photovoltaics working in the research of and manufacture of photovoltaic materials, solar cells, and modules. He supports clients through technical due diligence and owner's advisory services and has leveraged his knowledge of solar materials, technology, and manufacturing to support 500 megawatts of solar photovoltaic projects.

Mark Reusser specializes in solar photovoltaics with over five years of experience in the field. He supports solar energy project owners and investors with due diligence and owners engineering services. He applies knowledge gained serving as an owner's engineering representative and independent engineering representative for over 2 Gigawatts of solar photovoltaic projects. Mark developed expertise in solar technology by supporting the independent engineering reviews of numerous utility scale and distributed PV projects.

Chris Mertes is a licensed professional engineer who specializes in wind energy development. Chris is experienced in project siting, wind resource assessment, conceptual design, permitting, turbine evaluation, turbine supply and EPC contract negotiation and project acquisition. He has also led owner's engineering engagements for projects ranging from a 100 kW single turbine installation to supporting a regulated utility's full wind program consisting of upwards of 1,500 MW.

For more information, contact:

Heidi Marie Larson, PE
heidi.larson@icf.com +1.970.372.3934

Todd Tolliver
todd.tolliver@icf.com +1.970.372.3931

Mark Reusser
mark.reusser@icf.com +1.970.372.3936

Chris Mertes, PE
chris.mertes@icf.com +1.970.372.3928

About ICF

ICF (NASDAQ:ICFI) is a global consulting services company with over 5,000 specialized experts, but we are not your typical consultants. At ICF, business analysts and policy specialists work together with digital strategists, data scientists and creatives. We combine unmatched industry expertise with cutting-edge engagement capabilities to help organizations solve their most complex challenges. Since 1969, public and private sector clients have worked with ICF to navigate change and shape the future. Learn more at **icf.com**.