Energy storage battery maintenance 90 kWh

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The 2021 ATB represents cost and performance for battery storage with two representative systems: a 3 kW / 6 kWh (2 hour) system and a 5 kW / 20 kWh (4 hour) system. It represents lithium-ion batteries only at this time. There are a variety of other commercial and emerging energy storage technologies; as costs are well characterized, they will be added to the ATB.

Current (2020) costs for residential BESS are based on NREL"s bottom-up BESS cost model using the data and methodology of(Feldman et al., 2021), who estimated costs for both AC- and DC-coupled systems for a less-resilient (3 kW/6 kWh) installation and a more-resilient (5 kW/20 kWh) installation. We use the same model and methodology but do not restrict the power or energy capacity of the BESS to two options. Key modeling assumptions and inputs are shown in Table 1. We assume 2020 battery pack costs of $248/kWhDC 2019 USD(Bloomberg New Energy Finance (BNEF), 2019).

As with utility-scale BESS, the cost of a residential BESS is a function of both the power capacity and the energy storage capacity of the system, and both must be considered when estimating system cost. Furthermore, the Distributed Generation Market Demand (dGen) model does not assume specific BESS system sizes and it needs an algorithm to estimate residential BESS system cost based on the attributes of the residences (agents) it generates.

Available cost data and projections are very limitedfor distributed battery storage. Therefore, the battery cost and performance projections in the 2021 ATB are based on the same literature review as for utility-scale and commercial battery cost projections. The projections are based on a literature review of 19 sources published in 2018 or 2019, as described by Cole and Frazier(Cole and Frazier, 2020). Three projections from 2019 to 2050 are developed for scenario modeling based on this literature.

NREL has not maintained future cost projections for residential BESS for the ATB as it has for utility-scale systems. In their absence, we base residential BESS cost projections on the NREL bottom-up cost model for residential systems combined with component cost projections from BNEF. BNEF has published cost projections for a 5-kW/14-kWh BESS system through 2030(Frith, 2020), with the projections being based on learning rates and future capacity projections.

Definition:The bottom-up cost model documented by(Feldman et al., 2021)contains detailed cost buckets for both solar only, battery only, and combined systems costs. Though the battery pack is a significant cost portion, it is a minority of the cost of the battery system. This cost breakdown is different if the battery is part of a hybrid system with solar PV or a stand-alone system. The total costs by component for residential-scale stand-alone battery are demonstrated in Table 2 for two different example systems.

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Within theATB Dataspreadsheet, costs are separated into energy and power cost estimates, which allows capital costs to be constructed for durations other than 4 hours according to the following equation:

Base Year: Cole and Frazier(Cole and Frazier, 2020).assume no variable O& M(VOM) cost. All operating costs are instead represented using fixed O& M (FOM) costs. They include augmentation costs needed to keep the battery system operating at rated capacity for its lifetime. In the 2020 ATB, FOM is defined as the value needed to compensate for degradation to enable the battery system to have a constant capacity throughout its life. According to theliterature review(Cole and Frazier, 2020),FOM costs are estimated at 2.5% of the capital costs in dollars per kilowatt.

The cost and performance of the battery systems are based on an assumption of approximately one cycle per day. Therefore, a 4-hour device has an expected capacity factor of 16.7% (4/24 = 0.167), and a 2-hour device has an expected capacity factor of 8.3% (2/24 = 0.083). Degradation is a function of this usage rate of the model and systems might need to be replaced at some point during the analysis period. We use the capacity factor for a 4-hour device as the default value for ATB.

Round-trip efficiency is the ratio of useful energy output to useful energy input.(Mongird et al., 2020)identified 86% as a representative round-trip efficiency, and the 2021 ATB adopts this value.

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Web: https://www.hollanddutchtours.nl/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346