

EXECUTIVE SUMMARY



Forecasting electricity usage is a foundational planning activity for utilities, underpinning billions of dollars in grid investments that ensure system reliability. Historically, forecasting relied on trends in economic and population growth; however, transportation electrification presents a new and complex planning challenge. Unlike conventional loads, electric vehicle (EV) charging has relatively limited usage history. In addition, charging is driven by complex human behaviors, is mobile, and at the same time can concentrate geographically in ways that, without proper planning, can quickly overwhelm local distribution systems.

As market share for new light-duty EVs grows—from 2% to more than 10% between 2020 and 2024—so does the need for new forecasting approaches. Load from a single EV can equal nearly half the annual electricity consumption of an average U.S. household, and this new demand can materialize faster and with less notice than traditional loads. Planners must anticipate not only *how much* power will be needed, but also *when* and *where*.

To adequately prepare for future EV adoption, utility planners, regulators, and stakeholders require robust, fit-for-purpose forecasts that can better support planning

See the full report—[EV Load Forecasting Guide](#)

for EV loads and help reduce the risk of service delays and inefficient grid investments. An EV load forecast is more than a prediction of future demand—it is a critical tool for evaluating potential solutions to meet load growth. As expanded upon throughout the report, scenario analysis is an increasingly important modeling technique that can help planners manage more effectively investment risks and design a more efficient, flexible grid.

The Energy Systems Integration Group (ESIG) developed this guide to articulate core principles for EV load forecasting, synthesize leading practices, and assist utilities, regulators, and stakeholders in adopting effective approaches.

Key Activities in EV Load Forecasting

This guide provides a practical framework for a diverse group of professionals involved in the three key forecasting activities, including:

- **Forecast scoping** (utility strategic planners, regulators, and stakeholders): Defining forecast objectives and scope, aligning the forecast with jurisdictional policies, and using outputs for high-level resource and infrastructure planning
- **Forecast implementation** (utility analysts and consultants): Executing the forecast, including data gathering, modeling, analysis, and documenting assumptions and results
- **Forecast review** (regulators and regulatory stakeholders): Evaluating submitted forecasts for methodological soundness, reasonableness of inputs and assumptions, compliance, and overall fitness for purpose

To better enable all stakeholders to develop, execute, and evaluate EV load forecasting models, the guide provides high-level summary information on the trade-offs and considerations for using different types of top-down and bottom-up data to develop robust EV load forecasts, as well as detailed examples of inputs, assumptions, methods, and outputs associated with each step in the modeling process.

The recommendations are informed by an industry advisory group, a regulatory advisory group, and interviews with subject matter experts. The resulting best practices are intended to improve forecast confidence, facilitate informed dialogue, and support the development of actionable strategies that keep pace with rapid changes in EV technologies and adoption.





The guide offers 20 best practices across the following core components of the EV load forecasting process:

- Scoping the forecast
- Implementing the forecast
- Reviewing the forecast
- Applying the forecast and advancing the practice

Each best practice includes explanations and examples. The following checklist summarizes all of these recommended practices. Given the resources required, small utilities in particular may benefit from using third-party or state forecasts and adapting them for their service area.

Best Practice Checklist for Performing EV Load Forecasting

Scoping the Forecast

Best Practice 1

Define the forecast's **core requirements collaboratively**, including the forecast area, time horizon, and required spatial granularity, to align with its intended purpose.

Best Practice 2

Specify the **mix of vehicle segments** to be forecast (e.g., light-duty, fleet, off-road) based on their potential grid impact and relevance to the forecast area.

Best Practice 3

Explore the use of **multiple scenarios** to investigate a range of plausible futures by varying assumptions about technologies, market conditions, consumer behaviors, and policies.

Best Practice 4

Engage **stakeholders early and consistently** to shape scenarios, define assumptions, and build trust in the forecast results.

Implementing the Forecast

EV Adoption Forecasting

Best Practice 5

Use **comprehensive and clearly documented inputs** for adoption forecasts—including baseline vehicle stock, ownership types, market factors, and relevant policies—for each adoption scenario included in the forecast, and identify how inputs apply to each vehicle duty (light-, medium-, and heavy-duty).

Best Practice 6

Model the adoption of both **personally owned and fleet-owned vehicles**, recognizing that fleets prioritize total cost of ownership and operational needs while consumers are influenced by a broader set of factors.

Best Practice 7

Select adoption forecasting models and approaches (e.g., consumer preference, propensity, diffusion) that are **fit-for-purpose** based on data availability and desired granularity.

Best Practice 8

Calibrate and **validate** adoption models against historical registration data, and **benchmark** results against reputable third-party forecasts to ensure credibility.

EV Charging Infrastructure Forecasting**Best Practice 9**

Base infrastructure forecasts on the outputs of the EV adoption forecast, including vehicle counts, characteristics, and spatial distribution.

Best Practice 10

Ground infrastructure assumptions in **empirical data** where possible, including real-world charging behavior, travel patterns, and observed charger utilization rates. (See Table 1 (p. 9) in the report.)

Best Practice 11

Select **infrastructure forecasting methods** (e.g., needs-based simulation, EV-to-charger ratios) that are appropriate for the required level of detail, from high-level estimates to specific siting analysis.

EV Charging Profile Forecasting**Best Practice 12**

Integrate vehicle, infrastructure, and grid data—including vehicle miles traveled, dwell times, charger power levels, and baseline grid conditions—to create **detailed load profiles**.

**Best Practice 13**

Model multiple charging scenarios to quantify a range of estimates for grid impacts of different behaviors, including unmanaged charging and various smart charging or demand response strategies.

Best Practice 14

Calibrate charging profiles by benchmarking against real-world metered data from sources like utility advanced metering infrastructure, charging network operators, or pilot programs.

Reviewing the Forecast**Best Practice 15**

Ensure forecast **transparency** through comprehensive and accessible documentation of all data sources, assumptions, methodologies, and calculations.

Best Practice 16

Evaluate the forecast for **reasonableness and analytical robustness** by benchmarking against other forecasts (such as past forecasts, state agency forecasts, or forecasts by other parties) and conducting sensitivity analyses on key variables (e.g., baseline EV stock, fuel price projections, technology cost curves).



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Best Practice 17

Confirm the forecast is fit-for-purpose by ensuring its outputs (e.g., granularity, time horizon) are relevant and clear for their intended use in planning or regulatory proceedings.

Applying the Forecast

Best Practice 18

Use the forecast as a tool to **inform actionable grid planning**, including identifying the need for targeted infrastructure upgrades and evaluating the potential of load management to mitigate costs.

Best Practice 19

Foster **coordination and data sharing** among all planning stakeholders—including utilities, regulators, other agencies, and other parties—to align assumptions and create more cohesive forecasts.

Best Practice 20

Incorporate **emerging technologies and modeling advances** into long-term scenarios to ensure forecasts remain forward-looking and account for potential market shifts like vehicle-to-grid (V2G) or ultra-fast charging.

The purpose of an EV load forecast is not to predict the future with perfect accuracy, but to provide a useful tool that enables robust, considered, and cost-effective electricity system planning. By adopting the fit-for-purpose, transparent, and collaborative principles outlined in this guide, the industry can develop forecasts that are useful, guiding the development of electricity grids that serve growing loads.

The *EV Load Forecasting Guide*, by the Energy Systems Integration Group's EV Load Forecasting Task Force, is available at <https://www.esig.energy/reports-briefs/ev-load-forecasting>.

To learn more about the topics discussed here, please send an email to info@esig.energy.

The Energy Systems Integration Group is a nonprofit organization that marshals the expertise of the electricity industry's technical community to support grid transformation and energy systems integration and operation. <https://www.esig.energy>.

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