

Supporting Data-Driven Grid Planning and Investments

The Problem

The transportation sector is in the fast lane to electrification. However, the need for expanded grid infrastructure to support electric vehicle (EV) charging is quickly becoming a bottleneck and presents an emergent challenge for utilities managing the grid.

Given market expectations for rapid EV adoption, today's largely reactive utility planning model — responsible for long timelines and procedural delays — needs significant rethinking. The last time demand for electricity grew this quickly in the United States was when air conditioning was introduced in the mid-20th century. In response to the historic scale of load growth associated with electrification — including but not limited to electric vehicles — there is an increased responsibility for prescient decision-making from utilities, who need to make careful proactive investments in the grid today to support EVs tomorrow.

[\(Learn more about proactive planning.\)](#)

About GridUp

Data-driven insights, based on real-world vehicle operations: The GridUp tool forecasts when and where energy and power demands will materialize from vehicle electrification. GridUp is uniquely detailed and flexible, allowing users to gain greater insight into the behaviors of drivers and how driving behavior will create and shape charging demand.

Enabling proactive planning: Equipped with GridUp, decision makers will be able to identify areas for proactive investments in the grid where the future growth of EV charging demand is clearly established, enabling rapid EV adoption and supporting cost-effective buildout of needed infrastructure.

GridUp's Value Proposition

GridUp is designed to answer key questions for different stakeholders, including:

Distribution Grid Planners:

- Provides data-driven insight that promotes confidence in necessary grid infrastructure investments based on real-world driving patterns.
- Offers improved forecasting and localized load growth visualization to ensure right-sizing of grid investments. If utilities overlay this tool on their network maps, planners can identify local constraints and propose targeted infrastructure upgrades to serve future load growth.

Grid Customers (Fleet Operators and EV Charging Providers):

- Supports fleet operators' electrification plans by helping integrate commercial charging needs with utility planning processes.
- Helps EV charging service providers understand how to prioritize charger installations in specific locations based on localized demand forecasts.

Regulators and Policymakers:

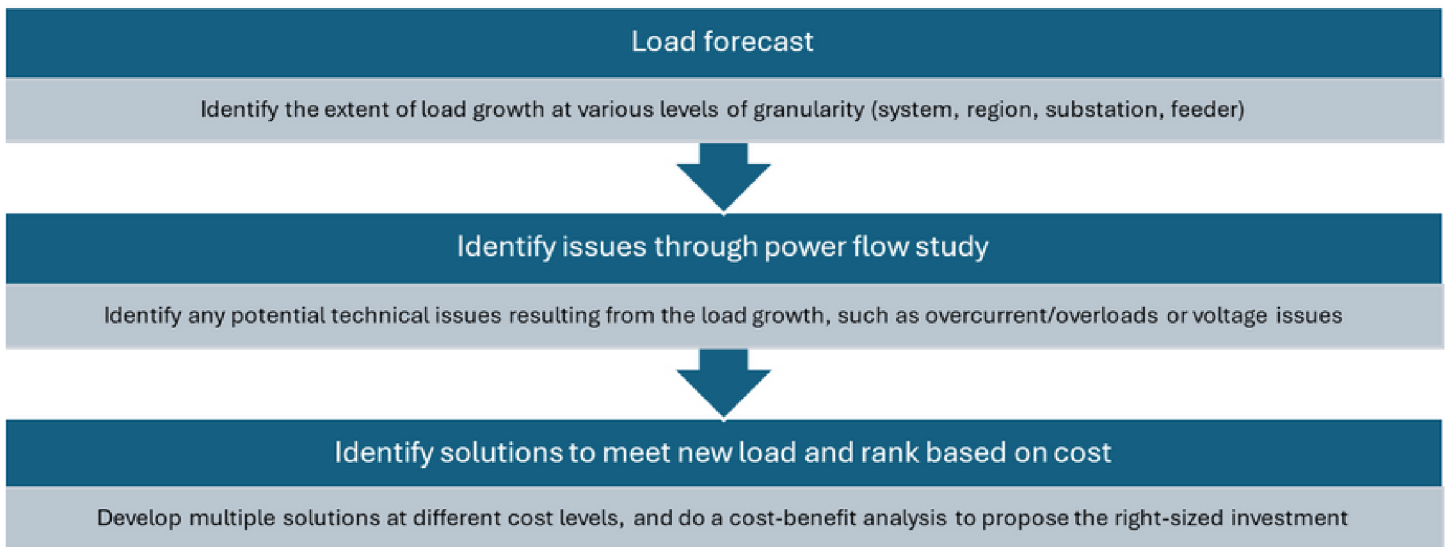
- Helps regulators and policymakers understand when and where EV load growth is anticipated, positioning them to work with utilities to ensure these needs are met cost-effectively and on-time. Can be used to test utilities' proposed grid investment decisions, facilitating an open conversation on grid needs across all stakeholder groups using the same publicly available tool.

To help non-utility stakeholders better understand how GridUp can inform strategic planning and investment decisions, it is useful to walk through a quick overview of how utilities plan their distribution systems.

Distribution System Planning: A Primer

A distribution planner's main role is to ensure the utility distribution infrastructure has sufficient capacity to serve the peak power demand of its customers. This section provides an overview of a planner's thought process, how new loads connect to the grid, what questions need to be answered to assess the impact of load growth on the distribution system, and the portfolio of solutions that planners employ to address any anticipated grid issues that arise from such load growth.

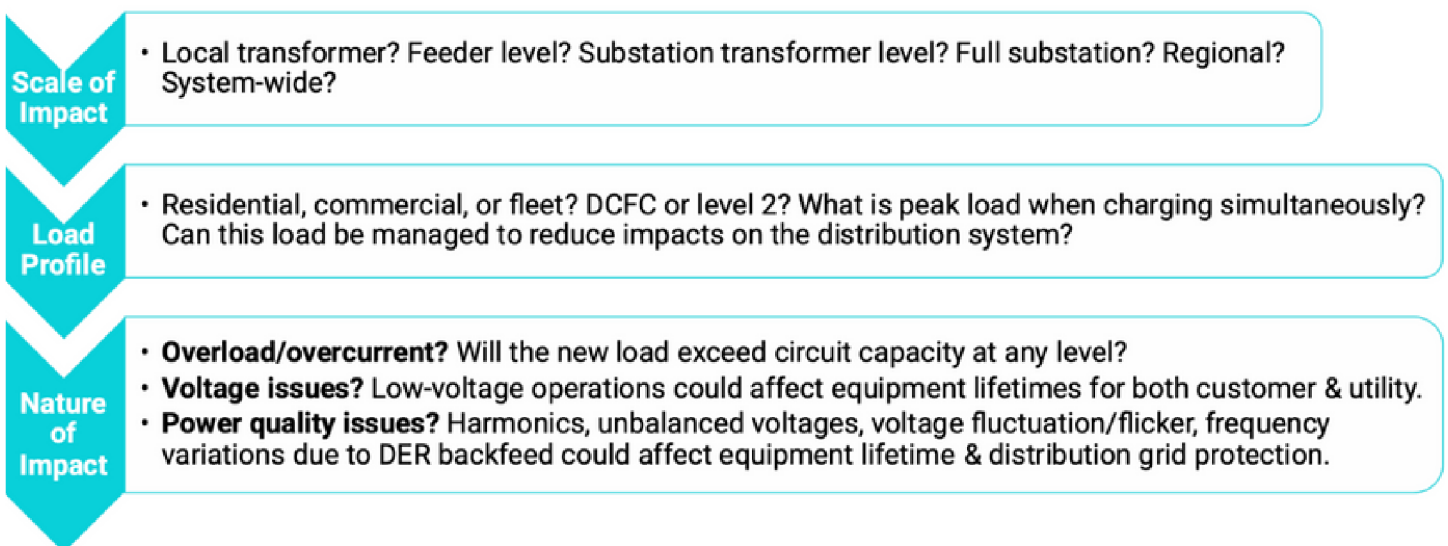
Distribution Planner Workflow



New Customer Loads Connecting to the Utility Grid

New customers — or those expanding their electricity needs — apply to connect to the grid through a “Load Letter” and utility connection request forms. At the utility, there is typically a dedicated department that is responsible for collecting this information and working with the new customers, while also communicating internally with the distribution grid planners to figure out how best to connect these loads. Grid planners perform an engineering study to assess what it would take (actions and cost) to connect the new load onto the grid, and provide a cost estimate for any infrastructure investment or system upgrades that need to be made to accommodate the customer load.

Assessing the Impact of Load Growth on the System – Key Questions a Planner Asks



Infrastructure Investment Actions and Costs

When a distribution planner proposes infrastructure investment decisions, they must navigate the delicate

balance between identifying the best engineering solution to a grid issue and achieving it at the least cost possible, to ensure minimal ratepayer burden and a smooth regulatory approval process. Further, there typically is a limited budget for infrastructure investment, which is a common pool to address grid needs across the utility’s service territory. Therefore, unless the grid planner’s area is in dire need of upgrades, the “perfect engineering solution” is unlikely to be approved even at the utility’s internal review processes for capacity planning investments.

Solutions and Costs (in ascending order of price and complexity)

Action	Load level	Cost (order of magnitude)
Local distribution transformer upgrades	< 150 kW	~ \$5000–\$20,000
Phase switching/rebalancing at feeder level	< 500 kW	Nominal; cost of labor
Load switching to a different feeder or substation	Up to a few MW. Depends on available tie feeder/substation capacity	Nominal; cost of labor
Feeder line extension	Up to a few MW. Expensive option.	~ \$500k to \$1M per mile
New feeder	< 12 MW	> \$4M
Substation transformer upgrade	20–40 MW	~ \$1–\$2M
Substation expansion	40–80 MW	\$1–\$2M for transformer + \$4M for each feeder
New substation	80–120 MW	\$15M

Non-wires solutions (NWSs) are another class of solution options designed to address grid constraints and accommodate additional load growth without adding physical grid infrastructure like transformers or wires. The objective of NWSs is to defer or avoid investing in new infrastructure and extract the maximum value out of existing grid infrastructure (given that it has already been paid for). This can be achieved through a combination of incorporating operational flexibility, designing customer programs, distributed energy resources (DERs) like solar and batteries, and communications technology to enable orchestration of these discrete components. A few examples NWSs are listed below:

- Managed charging for EVs
- Demand response
- DERs/virtual power plant programs
- DER management systems
- Battery energy storage programs

Considerations for Various Locational Grid Infrastructure Constraints

Considerations	Urban	Suburban	Rural
Substation capacity and costs	Capacity constraints are likely, so grid connection might be tough or prohibitively expensive for larger fleets.	Variable. Most suburban substations have sufficient available capacity but some are already heavily loaded.	Distance to substation, many single-phase networks — potential line extensions needed, which will increase costs significantly.
Fleet Operations	Best suited for local fleets with slower charging speed or managed charging throughout the day because of capacity constraints.	If capacity is available, DC fast charging can be deployed.	After upgrades, feeder may have hosting capacity for faster charging speeds.
Miscellaneous (land cost/availability, managed charging)	Likely premium real estate, and low supply. Managed charging is a must due to capacity constraints.	Land costs are variable, highly dependent on location. Managed charging might be required if the location is near a constrained substation.	Land might be cheaper and abundant.

How Proactive Planning Can Help

Utility infrastructure upgrades typically range from several months to multiple years. Yet customers are adopting EVs rapidly, and the lack of grid capacity is becoming a bottleneck in some areas — especially for medium- and heavy-duty vehicle fleets that often require large amounts of power and therefore require larger grid upgrades by the utility. If targeted investments were approved proactively and infrastructure buildout commenced more quickly based on our knowledge of forecasted load growth, the timelines for grid connection of new customers would be much shorter. This would significantly help to mitigate the risk of insufficient grid infrastructure being a bottleneck, allowing utilities to fulfill their core obligation to provide electric service, facilitating increased customer choice, and saving all utility customers money by efficiently and strategically planning for long-term grid needs to avoid duplicate work.

By providing detailed estimates of when, where, and at what magnitude EV loads are likely to materialize on a utility's distribution system — and at a hyper-local level — GridUp can help both utilities and other stakeholders such as city planners and local or state policymakers better and more strategically prepare for the electrification of our transportation system.

Learn more about GridUp and use the tool at gridup.rmi.org.