Exploring the impacts of E-Mobility on the power grid

With the exponential growth of electrical vehicles in the near future, utilities need to be prepared to maintain reliability of the grid.
The growth of electric vehicles
How will it affect power systems?

The challenges of electric vehicle growth
The primary impacts on electrical systems are generation adequacy, generation flexibility, transmission grid capacity, and distribution grid capacity.

The main challenge of electrification of transportation expansion lies in the distribution networks and the overloading of network assets:
- Medium voltage substations may be needed (exceed feeder hosting capacity)
- Replacement of the head feeders and the distribution transformers
- Cable sections downstream may still lead to voltage limit violations
- Peak winter or summer demand, heating and cooling

Central challenges for Distribution System Operators consist of communicational and computational barriers, low visibility on distribution grid, optimal allocation of charging infrastructure, lack of regulation and market rules, and network codes devolvement.

New opportunities arise
Electrification of transportation provides utilities a way to solve the challenges of flat electricity demand, optimize decentralized systems, and improve customer engagement. Planning for E-Mobility can help mitigate utility pain points and provide new means of opportunity. Utilities are a critical partner for connecting vehicle charging stations to the grid and have the capabilities to own, operate, and support the charging infrastructure.

New opportunities for utilities:
- **Increase load demand**
- **New investments and business models**
- **Smart charging**
- **Ancillary services**

---

**9.4 million** EVs will hit the road globally by 2020
**74 million** EVs globally by 2030

**2.3 million** e-buses on the road globally by 2040
**80%** of global municipal bus fleet to be electric by 2040

**2.25 million** e-trucks globally in 2025
**15%** of global truck sales will be e-trucks by 2030

**7 million** residential charging points global by 2020
**30 million** residential charging points global by 2030

**1.1 million** public charging points global by 2020
**7.1 million** public charging points global by 2030

---

Sources: BNEF, GTM Research, McKinsey & Company
Utilities are a critical partner for connecting vehicle charging stations to the grid and have the capabilities to own, operate, and support the charging infrastructure.
ABB Power Consulting Solutions
How we can help you prepare

Where the electric vehicles are plugged in

Central generation

Distributed generation

End consumers

HV line

HV/MV

MV line

MV/LV

LV line

3-7 kW

10-20 kW

Isolated 3-350 kW

ABB Power Consulting Solutions
As a technology leader in e-mobility charging, power grid management, and planning, ABB wants to help utilities:

- Analyze regional scenarios with different e-mobility diffusion levels
- Illustrate potential challenges caused by the uncontrollable charging in different parts of power systems
- Demonstrate technical solutions which can mitigate potential grid issues

Electric Vehicle (EV) load demand pattern
Support in the conversion from the charging schedules to system electrical demand; analysis of optimal usage of the energy stored in the EV for Vehicle-to-Grid (V2G) application

Evaluation of distribution grid hosting capacity
Evaluation of grid current and future planning developments to determine grid capacity limits to ensure proper integration of EV

EV impact on distribution grids power quality
Voltage drops, harmonic, and resonance analysis

Analysis of alternative solutions to mitigate impact
Such as grid reinforcements, VAR solutions, and EV optimal location

Generation flexibility and response impact
Assessment of RES/conventional generation patterns to optimize generation dispatch philosophy to ensure availability of supply
ABB Power Consulting Solutions
How we can help you prepare

Smart charging/V2G
Operational strategy definition and impact to mitigate grid limitations

Cost-benefit analysis
Evaluation of advantages and disadvantages of EV solutions from a techno-economic and regulatory perspective including non-energy related cost assessment

Techno-economic analysis
Technology options reviews, capital and operational cost assessments and optimization studies, life time cost modelling, and levelized cost of energy estimation

Analysis of international regulatory frameworks
Regulatory international benchmarks, impact assessment of international regulation and trends, and development of regulatory proposals

E-mobility investment optimization
Definition of plausible and radical future scenarios and identification of the optimal investment in energy storage capacity, demand flexibility, and grid capacity expansion to allocate the different e-mobility scenarios

Energy market intelligence
Energy market intelligence and data analytics to support investment decisions; charging strategy definition, charging infrastructures management and operation

Market Modeling
Market simulation and transmission and distribution analysis, price forecasting, regulatory compliance and expert advisory, software and data for electric vehicle integration
Our unique approach
Optimizing the right solution for you

ABB Power Consulting’s unique approach allows grid planners to choose the right solutions that work best for them. Using our 5-TIP process, Five-step Technology-Investment Principle, we evaluate the different potential solutions based on the cost and benefits of each project. The strength of this method lies with the ability to assess a large portfolio of possible futures (thousands of variations) across the investment range of the project.

The graph to the right demonstrates the level of investment versus the percentage of time with grid violations. Our approach allows companies to choose the optimal solutions that best mitigates grid violations at the right investment price.
Contact Information
Sal Gill, P. Eng.
Manager, Global Business Development
Power Consulting
Office: +1 919 831 3185
Cell: +1 984 833 6402
Email: salman.gill@us.abb.com

ABB Inc.
901 Main Campus Drive
Raleigh, NC
USA

abb.com/powerconsulting