In-Grid Analytics: A Path to Faster Electrical Utility Revenue Recovery

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Executive summary

Investments in smart meters alone are not sufficient for utilities to identify and eliminate efficiency losses. Analytics that integrate in-grid data and smart meter information, combined with robust performance management are critical for managing both technical and non-technical energy losses. This paper illustrates how grid-specific analytics help distribution network operators to better streamline operations and recoup smart metering technology investments.

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Introduction

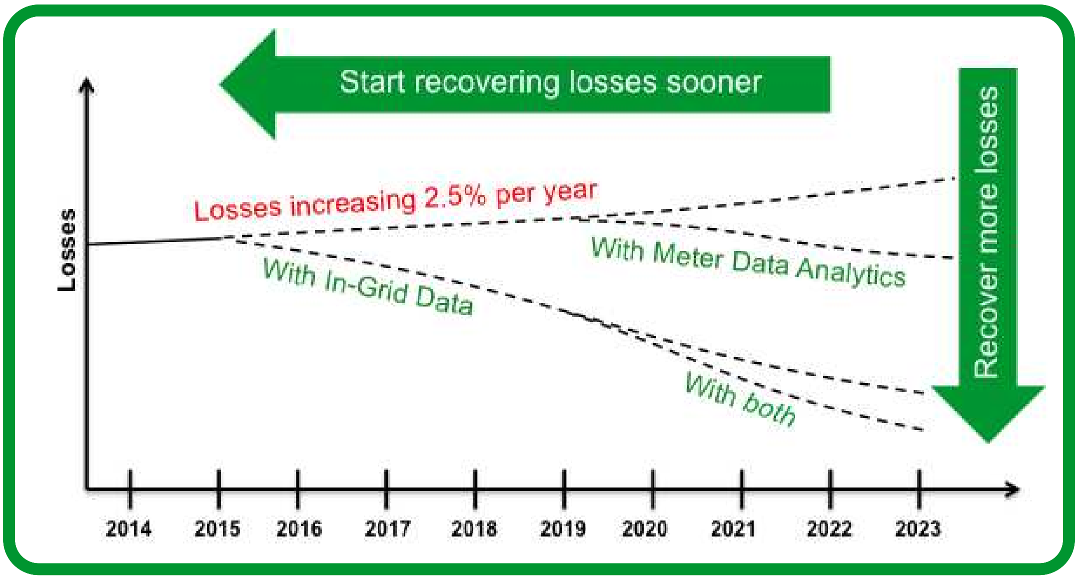
Utilities today absorbmore than $200 billion in annual theft aannd efficiencylosses, while up to 8% of generation capacity is wasted. In addition to wasting valuable resources, this inefficiency results in the unnecessary release of an estimated 1.2 trillion metric tons of CO_2. Control of such losses enables utilities to protect revenue, ensure worker safety, reduce operational costs, increase regulatory compliance and improve energy efficiency.

To begin to address this problem, many utilities have invested in smart metering, which is an important step for gathering the data from which to then improve operations. However, in many cases, the benefits of this smart infrastructure are not being sufficiently leveraged.

Metering data is out on the edge of the grid, but to obtain a complete view of their network, a utility also has to gather data from *within* their grid – from points between their customers and substations. Combining this "in-grid data" with information from a smart metering infrastructure provides a more precise, focused picture of real grid conditions.

The grid analytics correlate customer and consumption data from smart meters with grid operating conditions determined from in-grid data points so that this "big data" can generate notifications and identify trends. By incorporating billing, smart meter and in-grid data into an analytics platform, loss recovery, revenue increases, and risk reduction become possible. Utilities employing such a platform have seen losses reduced by 50% in less than 3 years. **Figure 1** illustrates the gains that are possible when smart metering and grid analytics are combined.

Figure 1
A grid analytics platform can generate savings even before a smart metering system is fully deployed.



New levels of intelligence

In-grid analytics also promote a more complete understanding of unique network characteristics, enabling smarter distribution engineering and operational reliability. For example, safety for line workers is improved through the identification of un-metered loads, and more accurate GIS topology is enabled through audit mechanisms. Rapid revenue recovery and exclusive issue identification capabilities are also enhanced.

In-grid data analytics solutions help identify key grid points that would benefit from equipment upgrades. The information gathered from in-grid data points and smart meters reflects the actual operating conditions of an electrical distribution network. This allows the grid to be divided into meaningful segments that can be prioritized by risk level, so that utilities can focus investigation and mitigation resources in a more efficient manner. Grid operators have access to more detailed operating conditions. This helps them to quickly identify energy theft, wiring errors, phase imbalances, overloaded transformers and other problems.

The strategic decision making of executives is enhanced because grid analytics systems reveal conditions that are actually occurring on a distribution grid (as opposed to speculation about what is happening). By integrating local knowledge and experience and tangible grid data, both technical losses (e.g., line losses, phase imbalances, and transformer core/copper losses) and non-technical losses are identified in the following ways:

- Alerts point out load and consumption anomalies and high risk grid service areas.
- Confirmation via GIS topology that energy balance comparisons are accurate and correct.
- Recognition of when theft is occurring on a grid.
- Automation of intelligent energy audits.
- Identification and prioritization of individual loads for further investigation.
- Identification of strategic placement locations for permanent sensors or smart meters.

A robust in-grid analytics platform can integrate data from multiple sources across an enterprise, such as substation and distribution automation systems, sensors, meters, automatic meter reading and meter data analytics systems, plus GIS/CIS and asset management systems. In-grid data analytics can be deployed in the cloud, so that IT costs can be minimized and so that the system can be deployed and maintained to support a wide user base.

Other advantages of in-grid analytics

Utilities are often challenged by energy balance discrepancies between their GIS topology and their actual LV networks By installing in-grid LV sensors on MV/LV substation feeders for a short (but statistically significant) period of time and comparing with smart meter data, an in-grid analytics platform can identify each individual smart meter on the feeder and phase. This provides much more precision when comparing energy balances.

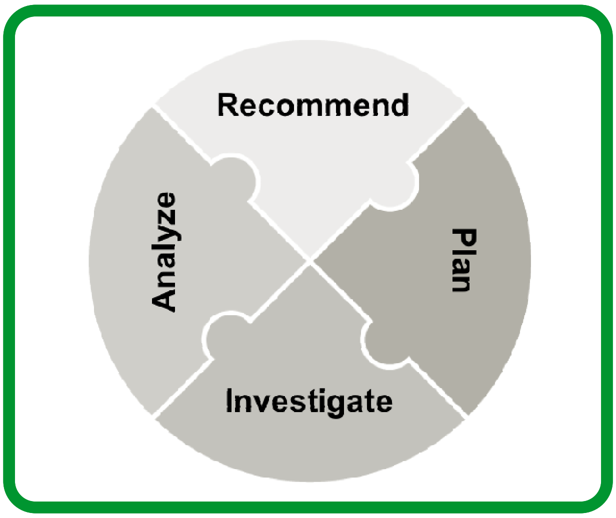


Figure 2

A systematic operations management cycle with manual or semi-automated rules-based triage helps identify the small percentage of alerts worth physical investigation.

Grid operators that employ a systematic risk analysis methodology, such as those proven effective by the insurance and finance industries, can more economically identify losses resulting from fraud, theft and errors. A four-step operations performance enhancement cycle (see **Figure 2**) can help to jumpstart continuous performance improvement initiatives in these areas:

1. **Plan** – During the planning phase, a grid analytics platform should be utilized to determine highest priority grid segments for further investigation based on risk metrics.
2. **Investigate** – Deploying sensors to collect load data from live distribution lines for study helps remove uncertainty from data sampling plans.
3. **Analyze** – Throughout the analysis phase, the in-grid analytics should be used to provide a chain of evidence and secure documentation for energy balance, phase balance, phase identification, transformer load studies, and reconciliation of GIS topology.
4. **Recommend** – The in-grid analytics platform should provide an advanced dashboard showing progress towards goals and the highest risk grid segment. It should also provide a litigation-ready audit trail of any completed investigation.

In addition to management-by-dashboard capabilities, grid analysis platforms can detect a wide range of less cost-intensive, non-technical losses such as wiring errors, and billing and metering errors. Even utilities which have yet to realize a fully deployed smart meter infrastructure can generate meaningful savings immediately, through the use of conventional billing data capabilities.

Conclusion

In-grid data analytics based on real operating data from within the grid, combined with a comprehensive operations management cycle can help utilities avoid technical and non-technical losses, recover lost revenue and operate more reliable and profitable distribution grids. Using a platform with risk-based analytics, and a systematic methodology to solve the problem of unidentified losses, can improve the impact on our environment and enhance economic performance.

About the authors

Jean-Yves Blanc is Vice President for Demand Management in Schneider Electric's Energy Business Unit, has spent many years focused on developing Medium Voltage switchgear, building automation and energy management solutions. His current areas of interest include Demand Response, energy efficiency, smart metering and analytics software. Mr. Blanc holds a degree in Electrical Engineering from Supelec (France) as well as an MBA from ICG (France). He is a senior member of SEE. He is also a board member of the Smart Energy Demand Coalition (SEDC).

Mischa Steiner-Jovic is CEO and founder of Awesense, Inc, a Canada-based provider of grid-related business intelligence software. Over this career, he has held various engineering positions in the areas of wireless, safety, generation, and alternative energy fuels. He has previously served as a voting and participating member in the Smart Grid Interoperability Panel (SGIP) led by NIST, and is an active member of the IEEE including IEEE Power Engineering Society (PES). Mischa's educational background is in Mathematics, Engineering, and Software. He holds degrees in Electrical Engineering from the University of Victoria and Wireless, Electronics, Engineering Technology diploma from the British Columbia Institute of Technology.