DOCKETED	
Docket Number:	23-IEPR-05
Project Title:	Accelerating Distribution Grid Connection
TN #:	250044
Document Title:	Presentation - GRID INVESTMENTS TO SUPPORT CLEAN ENERGY POLICY GOALS
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Organization:	GRID Alternatives, Access Clean California
Submitter Role:	Public Agency
Submission Date:	5/8/2023 12:12:44 PM
Docketed Date:	5/8/2023

GRID INVESTMENTS TO SUPPORT CLEAN ENERGY POLICY GOALS

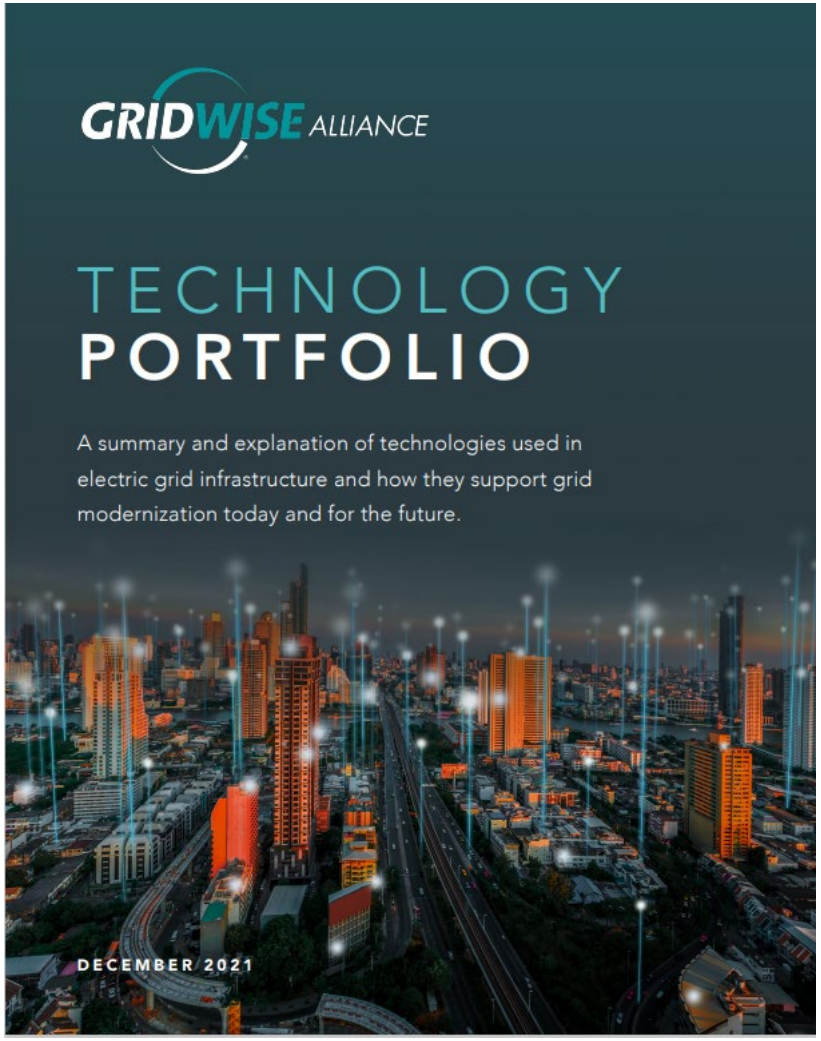
Karen G. Wayland, Ph.D.

Tuesday, May 9, 2023

IEPR Commissioner Workshop on Clean Energy Interconnection – Electric Distribution Grid Technologies, Processes, and Regulatory Strategies to Improve Distribution System Connections

www.gridwise.org

About the GridWise Alliance…



[GWA_GridWiseTechnologyPortfolio_Final.pdf]

DESIRED OUTCOMES

- DECARBONIZED POWER SUPPLY
- AFFORDABLE ENERGY
- BENEFICIAL ELECTRIFICATION
- RELIABLE DELIVERY
- RESILIENT SYSTEM
- CUSTOMER CHOICE

Functional Areas

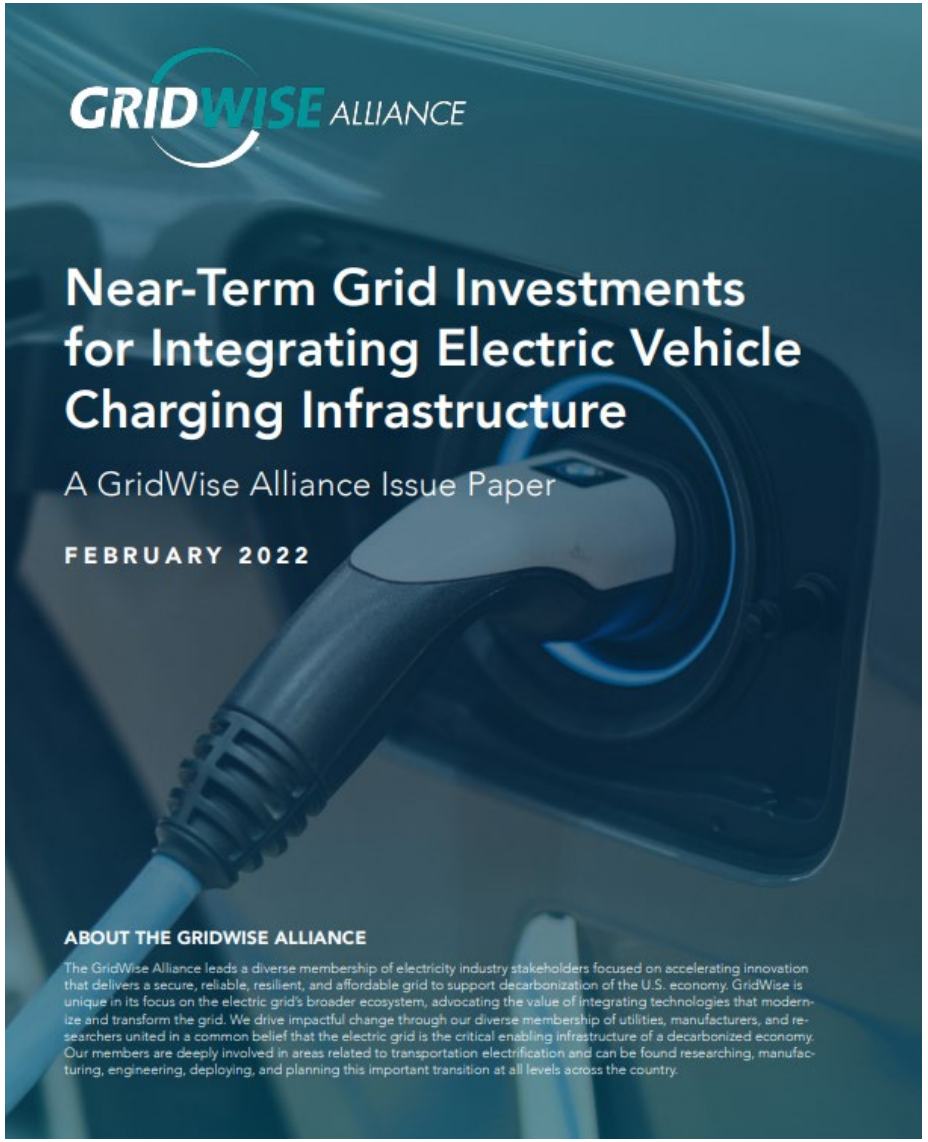
- Integrated Planning
- System Visibility
- Real-time Operation
- Consumer & Energy Services Engagement
- Emerging Grid Architecture

Technology Examples

- Automatic DER interconnections
- Interdependency coplanning
- Integrated distribution and transmission planning
- Synchrophasors
- Advanced distribution management systems
- Volt-Var optimization
- Home energy management
- Distributed energy resource management systems
- Networked microgrids
- Advanced metering infrastructure systems

Enabling Technologies

- Quantum computing
- Internet of Things
- Physical & cybersecurity protocols
- Open source and data standards
- Blockchain
- Data science
- Machine learning
- Cloud Services



Real-time Operation

BACKGROUND

At both the transmission and distribution level, the grid needs systems and technologies that can act automatically on system data and deliver the increased load associated with growing EV adoption. Electric vehicles will be a source of two-way power flow on the grid once vehicle-to-grid functionality is implemented and upgrades will need to occur at the substation level and throughout the system to prepare the grid for this reverse power flow. Several technologies available today can monitor and respond to grid conditions, especially important as EVs continually connect and disconnect from the grid, and are capable of immediately correcting operational problems related to voltage, current, frequency, and outages.

NEAR-TERM INVESTMENT NEED	REASONING
Voltage regulation technologies	Voltage regulation technologies offer greater visibility and control into real-time, localized usage of electric load. Electric load and quality fluctuate during EV charging or when vehicle-based stored energy is passed back to the grid. Proper siting of this technology allows the utility insights into the behaviors and patterns of an EV charging station while managing power quality. Smart inverters are one example of a voltage regulation technology, though they also provide other services including frequency regulation and DC-AC current conversion. Another type of voltage regulation technology is volt-VAR regulation, which regulates and optimizes power flow on the distribution system.
Energy storage systems	Energy storage, when co-located with EV charging infrastructure, could play a role in mitigating peak electricity demand of highway charging stations and ultimately lower the cost of charging for consumers. It may not be necessary to have storage at all charging sites however, so supporting early planning efforts around charging infrastructure and technology needs is important.
Distributed energy resource management systems (DERMS)	DERMS can both monitor and control DERs placed throughout the distribution system, such as EVs. At minimum, DERMS provide a way to make the load from EVs visible to the broader system. Fully implemented DERMS will be a key component to supporting advanced vehicle-to-grid functionality.

GWA_22_NearTermGridInvestmentsEVChargingInfra_Final.pdf (gridwise.org)

System Visibility

NEAR-TERM INVESTMENT NEED	REASONING
Broadband infrastructure	A communication network capable of rapid data sharing supports situational awareness of EVs on the grid.
Advanced metering infrastructure (AMI)	AMI is one way to facilitate EV adoption because it provides greater visibility into granular usage and power data by both the utility and the customer. This visibility and understanding of customer usage patterns can make it easier to incentivize optimal charging for both utilities and customers.
Dynamic line rating (DLR)	Installing DLR technologies along both transmission and distribution wires enables system operators to understand how much power is being sent across various parts of the system in real-time. This type of visibility into the system can help unlock additional capacity in the existing grid.

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Real-Time Operation

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Consumer & Energy Services Engagement

NEAR-TERM INVESTMENT NEED	REASONING
Communication and coordination with consumers, especially those requiring significant capacity upgrades	Electricity consumers, particularly those who have fleet electrification plans, and utilities should communicate and coordinate about their transportation electrification goals. In particular, fleet electrification of medium- and heavy-duty vehicles will increase electric demands and necessitate new grid infrastructure. Discussions with utilities will allow for system upgrades and other make-ready work (discussed below) to proceed further in advance and be coordinated among other nearby fleet operators.
Low-cost grid disconnects	To enable customers to island from the grid during outages and take advantage of a vehicle capable of providing power to a home.

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Integrated Planning

NEAR-TERM INVESTMENT NEED	REASONING
Early and frequent utility, state, and federal energy and transportation office coordination	Enable those with current knowledge of grid policy, planning, and operations to be leveraged to share information and shape the transition efficiently.
Hosting capacity studies from both the top-down and bottom-up	Evaluate existing hosting capacity of the grid along interregional highway routes, while also evaluating the ability of transmission and distribution lines to serve increased electricity demand from EVs.
Coordination of load forecasting assumptions and methodologies that are inclusive of anticipating consumer electricity demands	Planning EV infrastructure deployment is dependent upon consistent assumptions across multiple states, making the coordination of load forecasting methodologies and inputs important. Concurrently, anticipating consumer demands—in particular large new demands like those required for charging medium- and heavy-duty vehicle fleets—makes it important to plan grid upgrades for long-term electricity needs.

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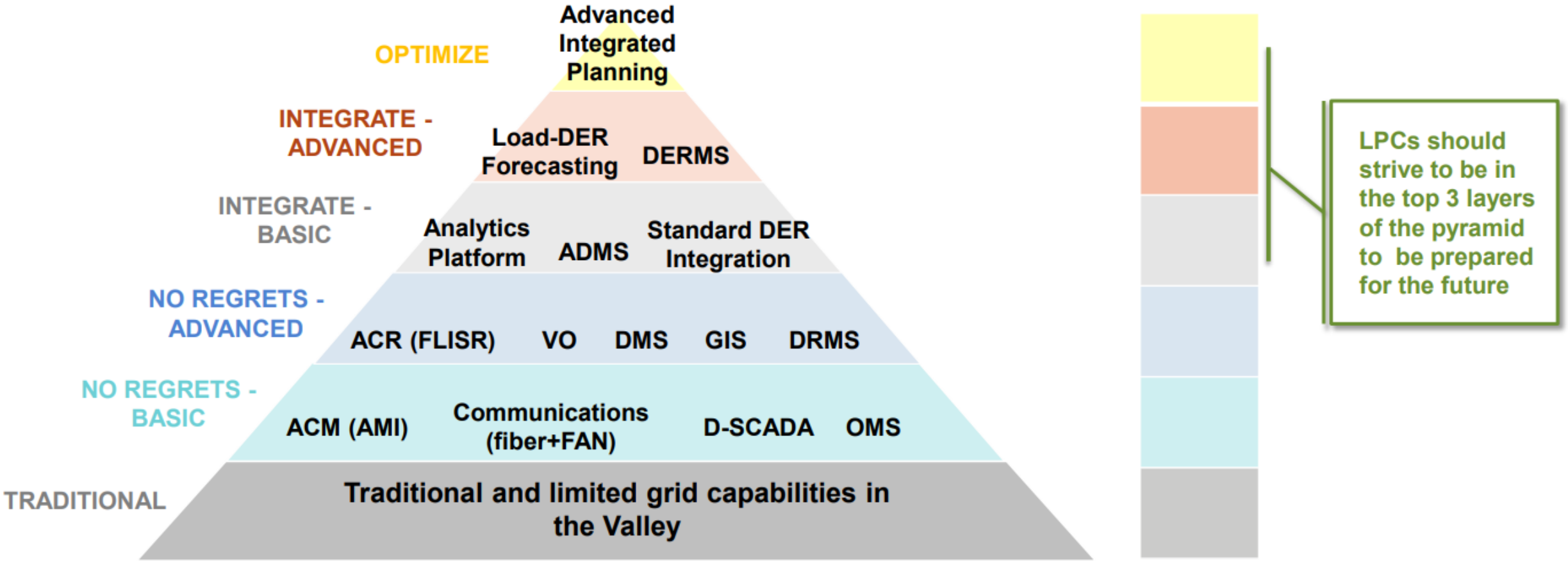
LPC Capabilities Pyramid: Where are We Now?

Each layer can build on the capabilities from the layer underneath: LPCs should move up over time.



Credit: Tennessee Valley Authority

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