SMART GRID
INNOVATION NETWORK

Smart Grid Innovation Network Canada

# Smart Energy Benchmarking

**October 2023**

dunsky Energy + Climate

UNB EST. 1785 UNIVERSITY OF NEW BRUNSWICK

SIEMENS

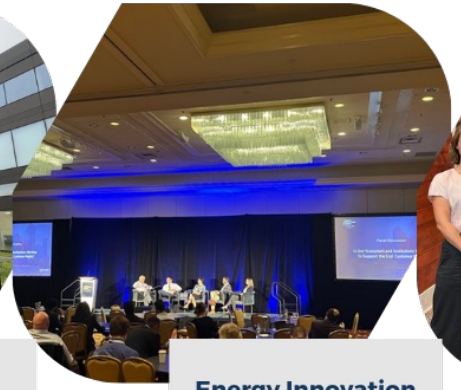
# SGIN Canada

**Vision:** A clean energy future for all Canadians.
**Mission:** We foster Canada's transition to a clean energy future.

SGIN Canada was founded to advocate for the many benefits of smart, clean energy in Canada. As a non-profit, member-driven organization, we enable the decarbonization and electrification of Canada's Grid by **supporting real implementation** and providing **centralized focus for knowledge**, **best practices** and **experiences** from our leading Smart Grid implementation communities.

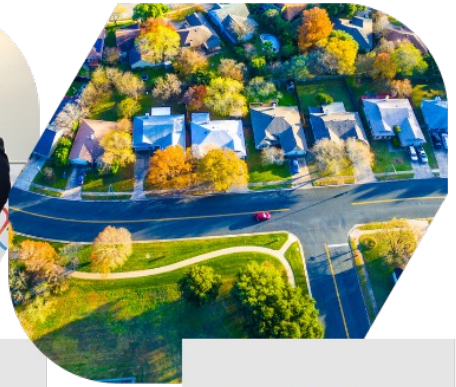

**Supply Chain Database**

**Energy Trade Missions**



**Energy Innovation Forum Canada**

**Smart Energy Benchmarking**



**Electrification 4.0**

SMART GRID
INNOVATION NETWORK

Smart Energy Benchmarking

# Utility Capability Assessment Results

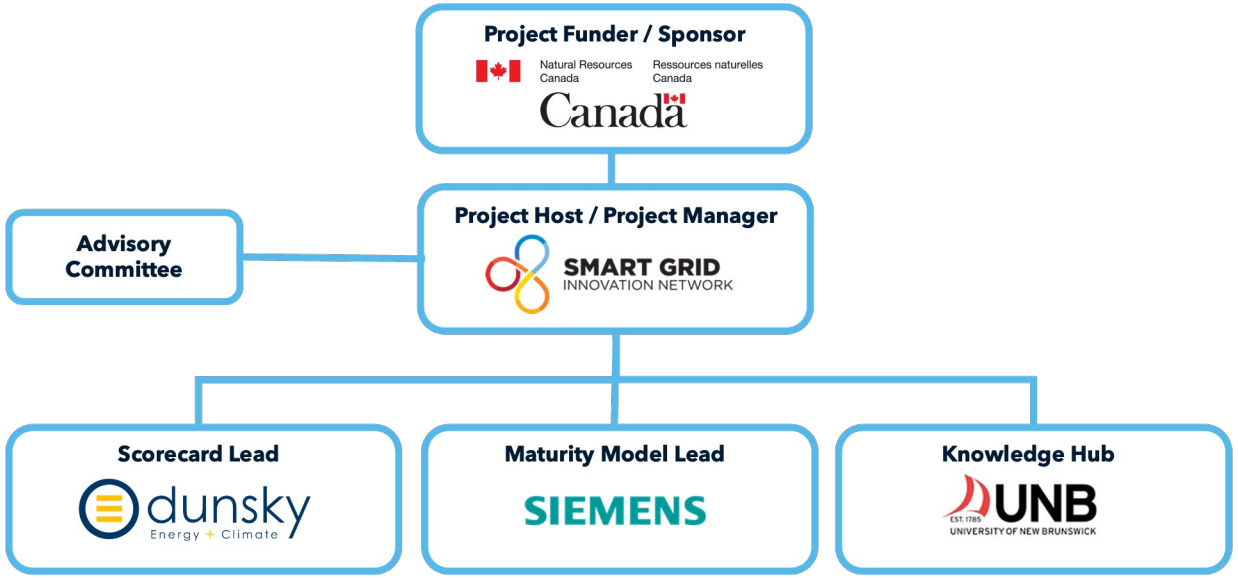
October 2023

SIEMENS

# About the Project Team

**The Smart Grid Innovation Network (SGIN)** supports Canada's clean energy transition by advocating for the smart energy sector. SGIN promotes, identifies, and helps drive smart energy solutions in Canada. Our mission is to foster Canada's transition to a clean energy future.

**The Smart Energy Benchmarking** initiative project team includes SGIN, Dunsky Energy + Climate Advisors, Siemens Canada Ltd, & University of New Brunswick (UNB). The project is guided by an Advisory Committee that includes representatives from government, utilities, academia and subject matter experts.




## About the Authors

SIEMENS

Siemens Canada Limited is a subsidiary of Siemens AG, one of the world's leading technology and engineering companies. Siemens Canada headquarters is based in the Greater Toronto Area, Oakville, Ontario and currently has approximately 2,900 employees based out of 25 locations coast to coast.

Siemens is known for its commitment to innovation, sustainability, and improving the quality of life through technology. Their diverse portfolio allows us to have a significant impact across multiple industries, addressing the complex challenges and opportunities of the modern world.

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# Introduction

For a comprehensive introduction of the context and project overview please see the report from Phase A.
This report summarizes results of Phase B: Maturity Model

| Phase A | Phase B | Phase C |
|---|---|---|
| **Scorecard** | **Maturity Model** | **Knowledge Hub** |
| Benchmark **12 electric utilities'** current smart energy development and identity performance relative to peers and best-in-class practices | Work with **a subset of utilities** to build on their strengths and develop their capabilities to improve preparedness and performance | Share findings, trends, and best practices to a **broader audience** to support industry capacity-building |
| June 2022 – April 2023 | **April 2023 – September 2023** | September 2023 – December 2023 |

# Overview and Key Insights

# Introduction

**The electric power industry in recent years has experienced a significant shift toward higher renewable energy targets and lower carbon emissions. Increasing intermittent supply, distributed generation, ambitious environmental targets, and new market entrants as well as the push from regulatory bodies and customers to level playing fields, and increase transparency, necessitates both the modernization of the grid and new capability development within utilities to realize goals and unlock value.**

The Utility Capability Assessment is the second phase in the SGIN's Smart Energy Benchmarking program with the objective of developing a framework that serves as a support tool for utilities in the planning of strategic programs that advance Smart Energy objectives.

**The project is divided into three phases:**

Smart Energy Scorecard

**Capability Model**

Knowledge Hub

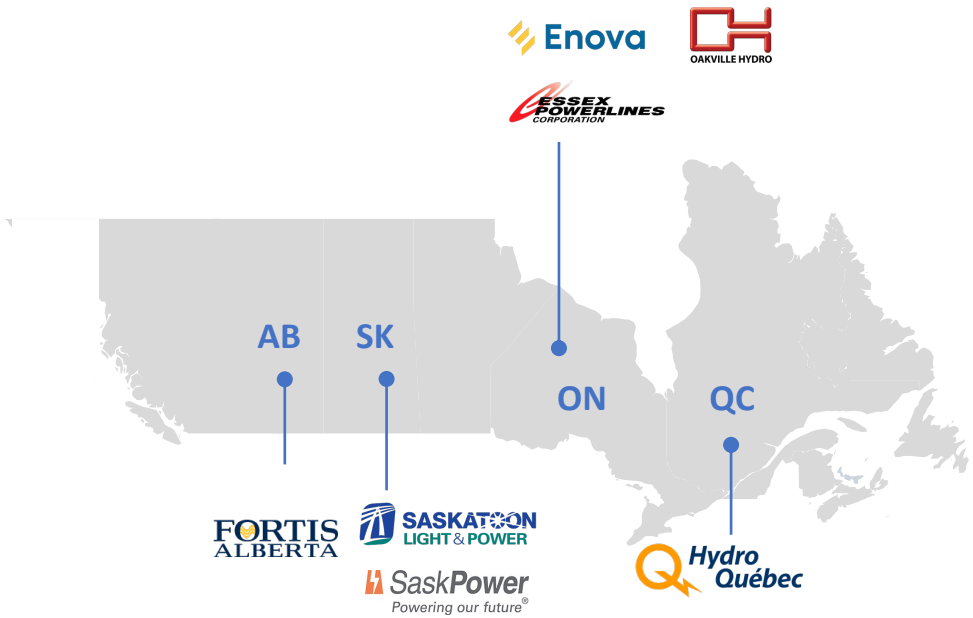
The Capability Model builds on the Smart Energy Scorecard and is intended to help utilities understand where they stand today and how they compare to others with their ability to realize objectives supporting the energy transition. This includes identifying key processes and use cases that have been implemented and comparing these to aspirational levels of capability and to those of other utilities. The results of this assessment are then used to inform recommendations on specific areas that can be matured by proposing initiatives that would drive the development of the changes in people, processes, and technology associated with the target level of capability.

The capabilities and resulting initiatives were developed to assess and advance utility readiness and ability to realize key objectives supporting the clean energy transition in three categories:

1. **Clean Energy Supply.** Reducing carbon emissions and increasing carbon-free energy supply by leveraging data, stakeholders, and integrated system planning, to align planning needs at all corporate levels, and embed climate goals in their core mandate and corporate culture.
2. **Modern Grid.** Modern and optimized grid operations leveraging data for operating and planning decisions to improve the management, maintenance, and integration of grid and DER assets while maintaining and improving service reliability.
3. **Customers and Society.** Fostering a customer-centric approach built on understanding the customer needs with a goal of supporting customer participation and engagement in the energy transition and equitable realization of benefits.

# Overview of participating utilities

## Six provinces




## Seven utilities serving close to 6 million customers (presented West to East)

| Utility | Type | Ownership | Nb. of customers | Provincial Electricity Market: Retail | Clean grid | ¢/kWh[1] |
|---|---|---|---|---|---|---|
| FortisAlberta | Distribution | Private | > 500k | Competitive | <50% clean | 19.9 |
| Sask. Light & P. | Distribution | Municipal | < 100k | Regulated retail | <50% clean | 16.5 |
| SaskPower | Generation, Transmission, Distribution | Crown corp. | > 500k | Regulated retail | <50% clean | 16.5 |
| Enova Power | Distribution | Municipal | ≥ 100K to ≤ 500k | Hybrid | >90% clean | 13.9 |
| Essex Powerl. | Distribution | Municipal | < 100k | Hybrid | >90% clean | 13.9 |
| Oakville Hydro | Distribution | Municipal, Private | < 100k | Hybrid | >90% clean | 13.9 |
| Hydro-Québec | Generation, Transmission, Distribution | Crown corp. | > 500k | Regulated retail | >90% clean | 7.6 |

This visual is reused from Phase A, and updated to reflect only the utilities participating in Phase B.

1 Source for pricing data: Hydro-Québec, Comparison of Electricity Prices in Major North American Cities 2022 (2021 data for average residential prices in Vancouver, Edmonton, Regina, Toronto, Montréal, Moncton). Data is indicative only and may not represent the actual prices charged by the benchmarked utilities to consumers in their specific service areas in 2021.

Generation · Transmission · Distribution · Crown corp. · Municipal · Private · Coop

>90% clean · >50% clean · <50% clean · < 100k · ≥ 100K to ≤ 500k · > 500k

# Maturity Model

The Capability Maturity Model for the SGIN Smart Energy Benchmarking initiative is tailored around the structure of the Scorecard in Phase A.

Specific business objectives and process capabilities are defined for the three categories: Clean Energy Supply, Modern Grid, and Customers & Society.

The capabilities describe the processes needed to attain the results expected with the business objectives. The description is at a high level, and generally describes "what" needs to be done, not "how". The implementation of such a business process impacts many aspects of people, processes and technology across the organization.

## Dimensions of the model

### Objectives – What am I trying to achieve?

Business objectives an organization wishes to achieve

### Business Capabilities – How can I do this?

Different ways an organization can execute a different activity depending on the extent of their smart grid implementation

### Applications – What do I need?

Solutions (Technologies, functions, tools and business activities) that support realization of business capabilities.

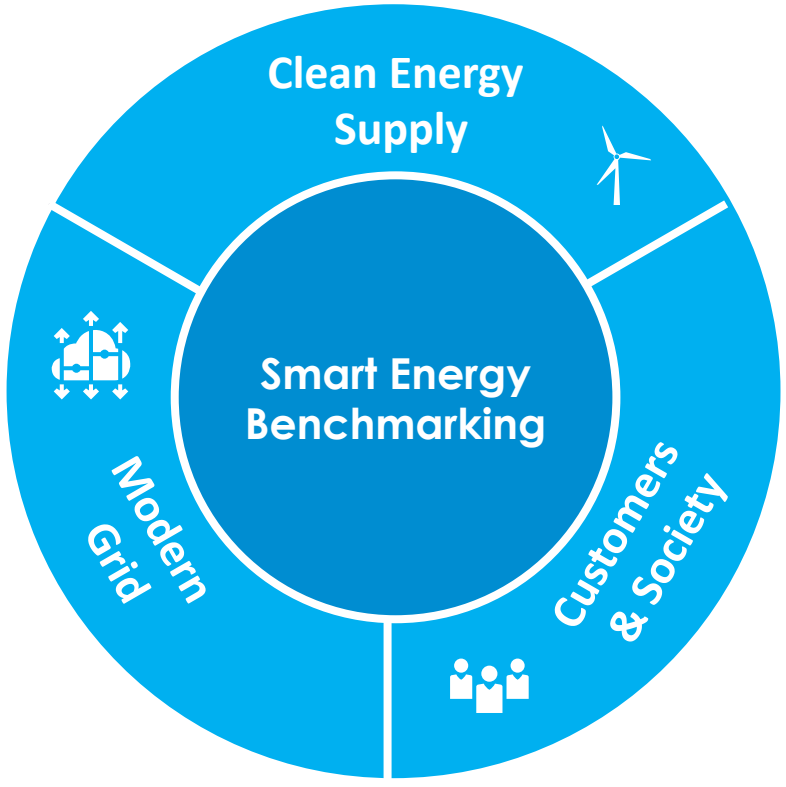
# Capability Model

The Capability Maturity Model for the SGIN Smart Energy Benchmarking initiative is tailored around the structure of the Scorecard in Phase A; however, the intent of the assessment was not to directly benchmark or compare utilities but rather to offer utilities a view towards their internal capabilities and progress towards realizing various smart energy objectives.

Specific business objectives and process capabilities are defined for the three categories: **Clean Energy Supply**, **Modern Grid**, **and Customers & Society.** The capabilities describe the processes needed to attain the results expected with the business objectives.

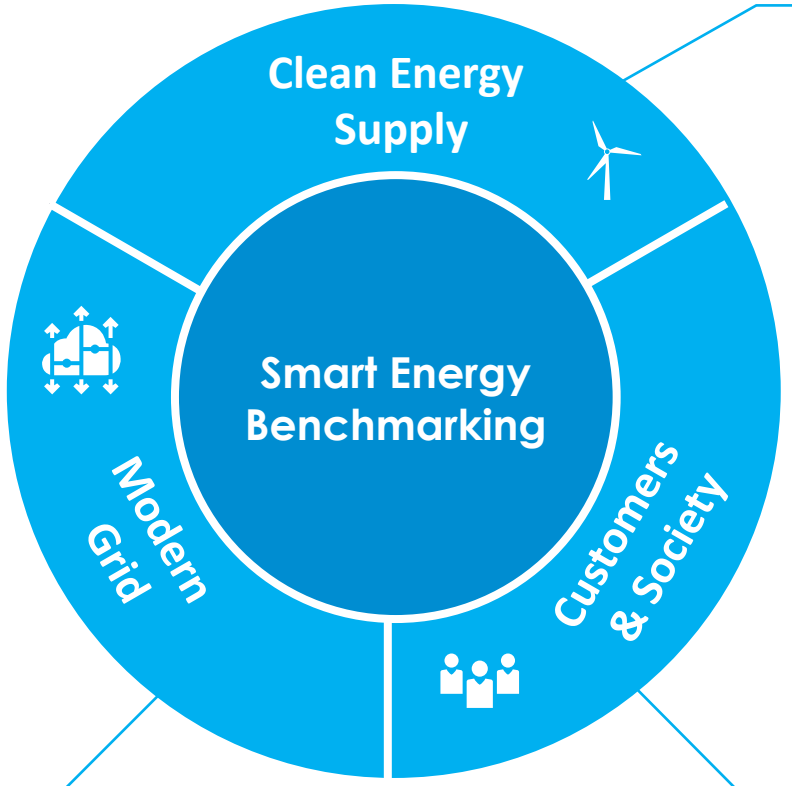
The scoring and recommendations for future initiatives are based on the self-assessment performed by the utilities. These assessments are subjective and interpretations of achievement of each level may vary in the utility responses; direct comparison with other utilities should be considered with this understanding in mind.

Maturity of 100% is obtained when Level 1,2,3 of a given capability are all fully achieved. While capabilities enable the achievement of objectives and improvement on metrics it is not a 1-1 direct relationship to outcomes. They are intended to be indicative of the organization's ability to realize or advance toward an objective.  While level 1 represents a base or expected level of maturity in a given capability, level 3  is intended to be far-reaching, and future-looking; it is expected that most utilities have not reached that level yet.



# Capability Model

## Capabilities Included for each category in the model




- Grid Information Management
- Grid Code Management
- Asset Management
- Grid Planning
- Operational Planning
- Grid Operations
- Power Quality Management
- DER Interconnection Process
- Manage DER Flexibility to Support the Grid

- Decarbonization Strategy Planning & Management
- Stakeholder Management
- Corporate Data Management
- Integrated System Planning
- Integration of Variable Energy Resources
- Clean Energy Contracting

- Customer Centric Operations
- Community Engagement
- Manage Educational Programs
- Provide Customer Solutions and Services
- Manage e-Mobility

# Overall Results

The overall scores illustrated here represent the % of the total score available across all Smart Energy categories. These results serve to illustrate that of the utilities assessed, the majority have made similar progress in developing Smart Energy capabilities in general.

While there were utilities that excelled in specific categories, no single utility was the top performer in more than one category. This is indicative of varying priorities driven by policy, regulatory, specific operating environment, and other unique constraints or opportunities present in a given jurisdiction.

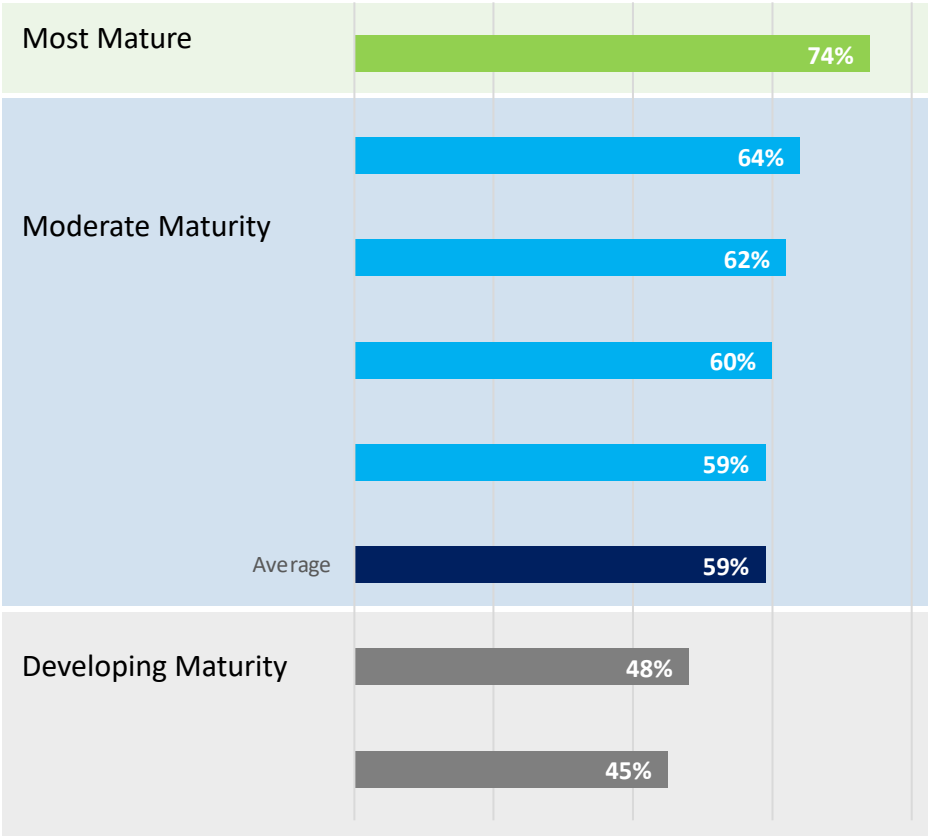
The average maturity would typically align with level 2 maturity which indicates a specific focus and ongoing effort to develop increased capability and improve performance against the objectives and reinforces that the energy transition is a significant driver of utility business transformation.

**Key Insights:**

1) **Size matters** – Large vertically integrated utilities typically have a greater scope of service as well as regulatory constraints which can mean larger hurdles to overall capability maturity. The dimensions and interdependencies between business groups within a larger organization can increase the effort and significantly challenge change management enablement.

2) **Policy direction is a significant driver** – Similar to the size of the utility, the influence of government and regulatory policy has a greater impact on the priorities and constraints of larger, vertically integrated utilities. This can have significant impacts on how the utility prioritizes grid modernization and business transformation activities

## Overall Capability Score (all categories)

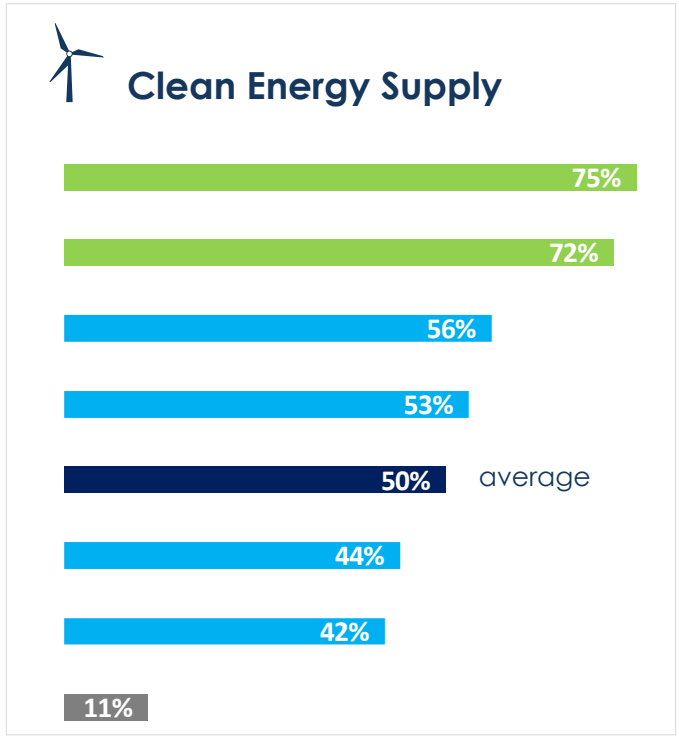


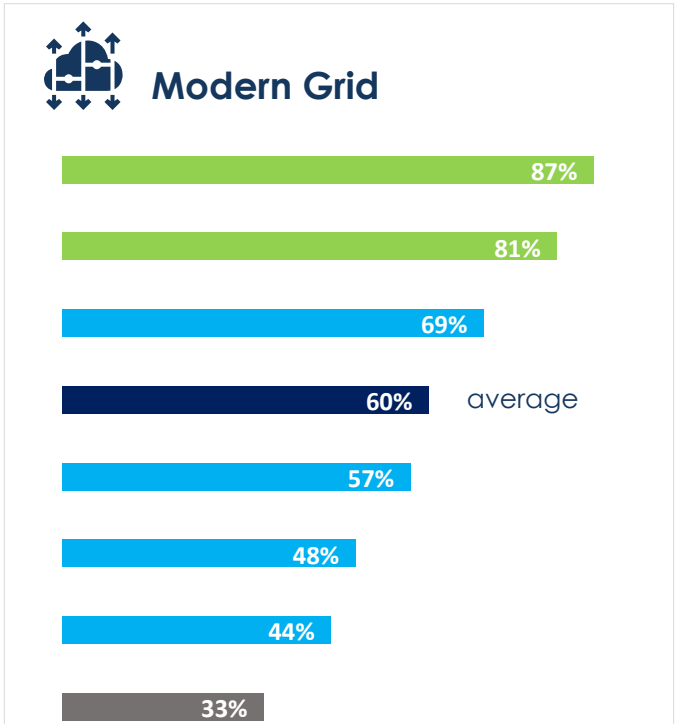
# Overall Results – By Category

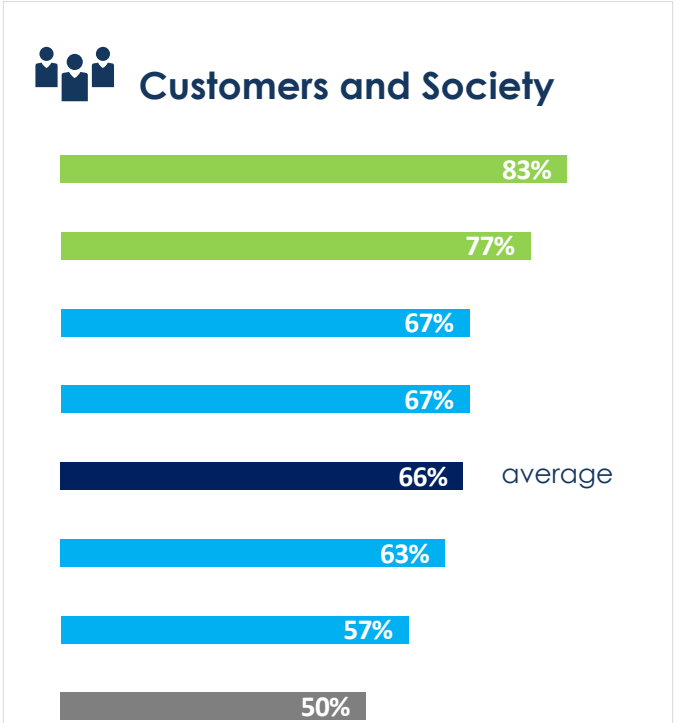
**Capability maturity varies across utilities, influenced by policy and regulatory environments, scope of service, and unique operating considerations.**

It is worth noting that although some utilities were consistently among the top performers, each category saw a different utility with the highest assessed maturity and the lowest. This indicates that each utility may prioritize the smart energy objectives differently and that the relative or perceived value of a capability will vary by utility.

**Overall, there is a clear focus and value placed on the customer, where the overall scores and average assessed maturity were the highest.**

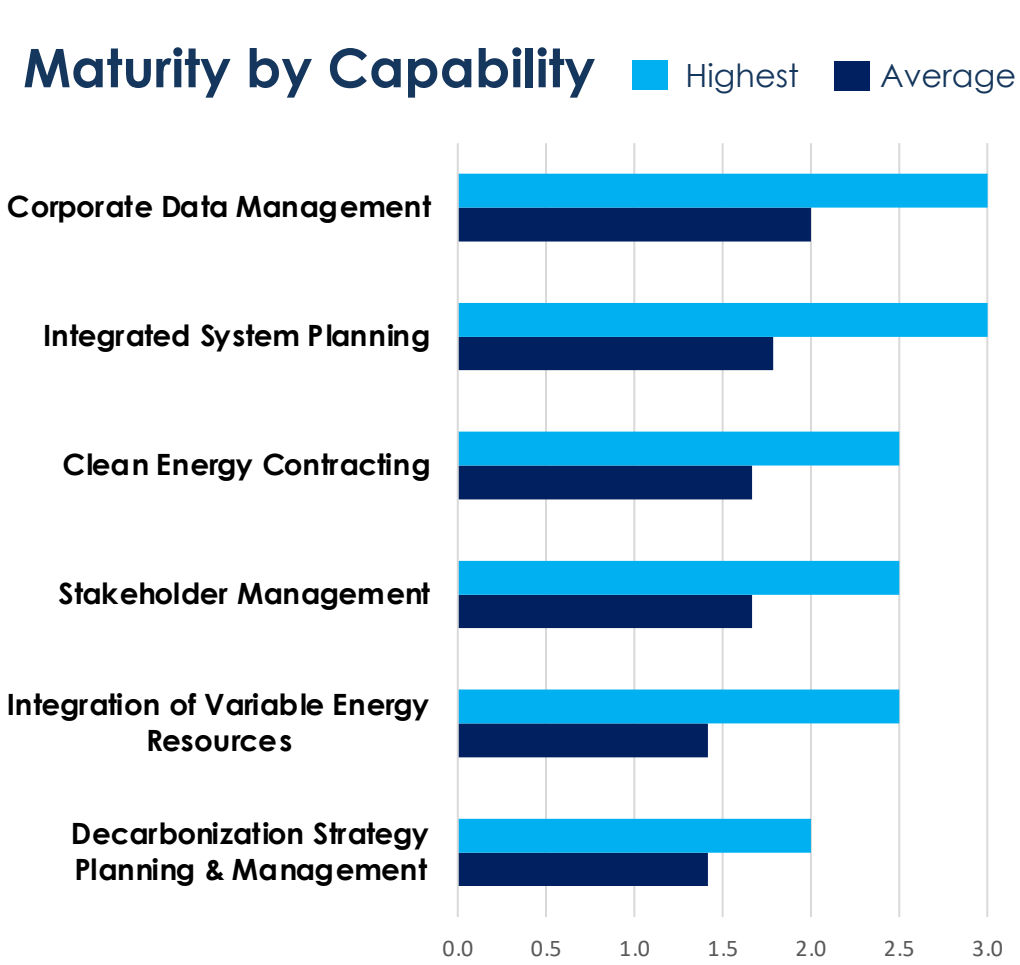


# Clean Energy Supply: Key Findings

## Maturity by Capability



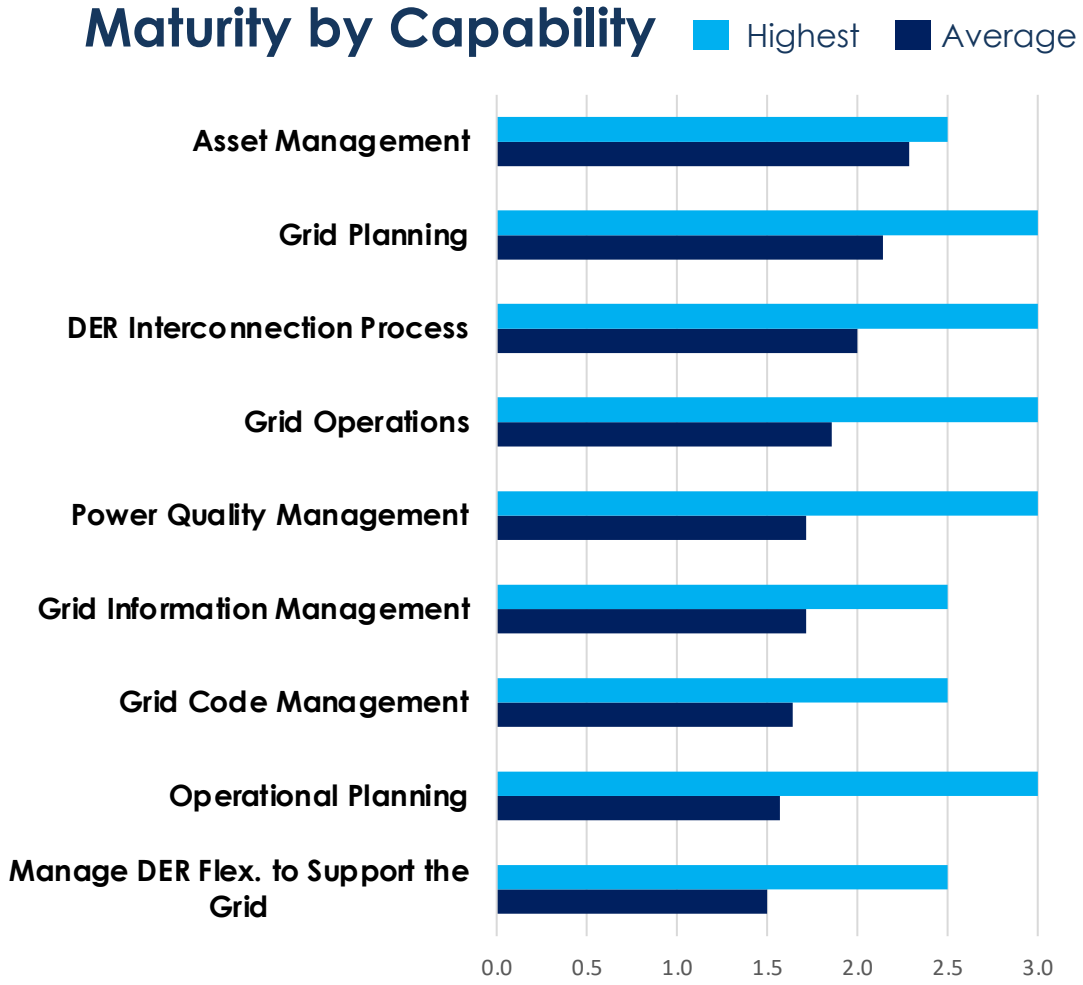

**The capabilities defined for this category are required to support utilities in the pursuit of corporate sustainability goals and the reduction of carbon emissions.**

This entails clear goals, alignment of planning needs across corporate levels, shared data and analytics connecting corporate strategic planning with operational planning, and the sourcing of energy supply both from self-owned facilities and external sources through contracting or partnership model.

- **Mandate drives necessity**. The average scores in this category trended lower than the other categories. This is due in part to how utilities perceived their mandate regarding generation sourcing and the interpretation of supply being the domain of System Operators only.
- **Data is foundational** The highest average maturity in Corporate Data management, signifies that managing rapidly increasing data sources for business advantage is a recognized area of opportunity.
- **Planning dimensions are changing**. The need for modernizing system planning processes and tools was also prevalent and would have dependencies on data management maturity. Increased frequency and dynamic assumptions is driving maturity.
- **Integration of generation on both supply and demand side**. Clean energy contracting and the integration of variable energy resources are somewhat co-dependent, and the assessments demonstrated one of the widest gaps in utility capabilities. 2 utilities reported maturity near the highest level in these capabilities while the rest assessed themselves near the lowest level. The highest scores include both a vertically integrated and a distribution utility which indicates that areas represent significant and unique challenges across the system

# Modern Grid: Key Findings

## Maturity by Capability



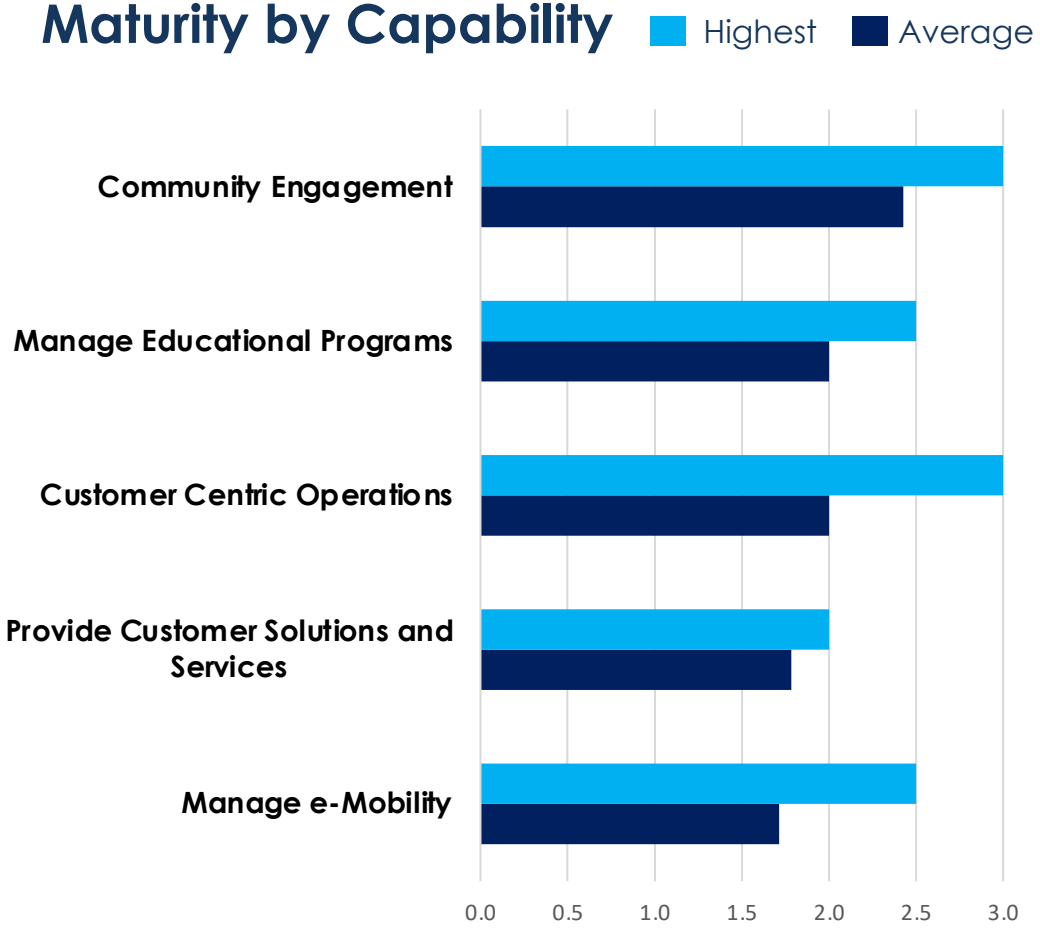

**Collectively, the capabilities supporting grid modernization enable the utility to create a more efficient, reliable, and valuable grid system while proactively managing and mitigating risks associated with the energy transition and capitalizing on opportunities presented by new technologies.**

The level of maturity in this category can be both a reflection of the utility's commitment to staying at the forefront of grid modernization, and the urgency associated with ensuring that it can adapt to emerging challenges and provide high-quality service to its customers.

- **Planning for electrification** The capabilities with the highest average maturity Asset Mgmt and Grid Planning, reflect current priorities for addressing the expected impacts of electrification on grid infrastructure, specifically on the distribution system as deferring investments in upgrades is a high-value business opportunity.
- **Data can preserve asset life** Asset management was the most consistently mature capability across all of the model categories with all utilities achieving at least level 2 but none reaching level 3. This is an area where advances in using data and analytics supporting the transition to proactive maintenance have a clear value proposition and priority for managing electrification.
- **DER connections increasing** While most utilities have a vision and plan for using DER flexibility to support the grid, streamlining the interconnection processes to support increasing customer requests and being able to build more visibility to DER has more immediate focus to most.
- **Focus on Gris Edge** Distribution utilities scored higher in maturity than vertically integrated utilities as the primary focus and benefits of grid modernization capabilities are at the "grid edge". Particularly in the area of using DER flexibility some distribution companies were near the top level of maturity including DSO.

# Customers & Society: Key Findings

## Maturity by Capability




**The capabilities in this category are designed to enhance the utility's ability to address the evolving needs of both customers and stakeholders across the energy ecosystem, while also promoting sustainability, affordability, and regulatory alignment.**

The highest collective level maturity of all the "smart energy" categories, demonstrates a commitment to customer satisfaction and ensuring the utility remains responsive to evolving market dynamics, customer preferences, regulatory changes, and a more equitable energy future.

- **Engagement is critical to success** It is vital for utilities to work collaboratively with regulatory authorities and local communities to address specific regional requirements and align on goals. The importance of this capability to utilities is evident with all utilities reporting advanced maturity and most at the upper end of the scale. The Ontario Energy Board (OEB) requires customer engagement in the development of distribution system plans.
- **Education creates understanding** Creating understanding and awareness of both the challenges and opportunities of the energy transition is key to building support and advocacy for measures required to ensure a sustainable grid. Most utilities provide education opportunities largely through online content and where smart meters are implemented, making personal energy data and recommendations available to customers.
- **EV focus varies –** While all utilities are pursuing EV initiatives, the level of maturity and priority varies significantly. Tracking EV growth and understanding potential grid impacts is a focus for all but actively promoting and developing solutions (rates, charging programs, etc.) indicative of the highest level of maturity was only reported by just over half. Generally, utilities were at either end of the maturity scale which is likely mostly a reflection of regional policy considerations.

# Maturity Model Objectives

# Objectives

## Clean Energy Supply

| Objectives | Description | Monitoring/ Measurement |
|---|---|---|
| **Reduce carbon emissions** | Corporate sustainability goals for clean energy drive the agenda of strategies and actions taken by utility leaders as they plan for a reduction of carbon emissions. Utility goals and plans should align with policy and regulatory targets, and possibly go beyond them when not aggressive enough to reach desired net zero goal. | • This objective is often measured at high level by GHG inventory (tonnes of carbon dioxide equivalent, tCO2e). |
| **Increase / Harness carbon-free energy supply** | This objectives aims at fostering an increase in carbon-free energy supply sources, both self-owned and externally-owned (through contracting / partnership models). | • This objective can be measured at high level by the ratio of non-emitting generation capacity (solar, wind, hydro, nuclear) to the total generation capacity. |
| **Convert energy supply sources / energy mix** | Similar to the previous objective, this objectives focuses on the shift from fossil-fuel-based generation assets to clean energy assets, primarily driven by the integrated resource planning process of utilities. | • This objective can be measured with the ratio of shifted generation to conventional generation. |
| **Improve corporate planning capabilities** | To ensure a sound and smooth transition to clean energy assets, utilities must define problems clearly and address them with integrated system planning, align planning needs at all corporate levels, and embed climate goals in their core mandate and corporate culture to drive decisions and actions. Strategies need to be aligned within the business at operational level, mandated, quantified and monitored. | • This objective can be monitored with proper business data analysis, linking corporate strategic planning with operational planning, and tracking actual target achievement. |

# Objectives

## Modern Grid

| Objectives | Description | Monitoring/ Measurement |
|---|---|---|
| **Optimize grid operations** | Efficiency of grid operations is an essential element of a modern grid. Modern and optimized grid operations leverage effective data analyses, to make informed-decisions and to precisely monitor and drive the grid operations. This will improve the management, maintenance, and integration of grid and DER assets. | • This objective can be monitored with a variety of KPIs, including OPEX / Energy Delivered, # of assets in register, etc. |
| **Increase service reliability** | Maintaining and improving service reliability is one of the core functions of utilities across the distribution and transmission system. Increasing challenges (climate resilience, variable renewables, customer demands) add further complexity to master this function often measured by clear metrics for system interruptions & durations. | • This objective can be monitored at high level by traditional KPIs like SAIDI, SAIFI, CAIDI. |
| **Increase grid value** | Certain grid infrastructure investments pay-off over the long-term perspective. This objective tries to reflect the current value of the grid infrastructure based on current and historic investments. | • This objective can be monitored at high level by metrics like the ratios between asset book values, capital, and operational expenditures. |
| **Hedge risks** | This advanced objective supports the identification and active management of risk distribution across the grid. Effective investments in grid infrastructure, software support, data analytics and risk procedures will lead to a more reliable, resilient and cost-efficient operation. | • This objective can be monitored at high level by critical risk indicators, such as anomalies of number of minutes a criteria is met. |

# Objectives

## Customers and Society

| Objectives | Description | Monitoring/ Measurement |
|---|---|---|
| **Increase customer satisfaction** | The evolving nature of the utility and its relationship with its customers and the market requires an accurate and timely understanding of the customer needs and the customer satisfaction with the utility's services and products. | • This objective can be monitored with multiple KPIs, like Customer Satisfaction Score (CSAT), Net Promoter Score (NPS) and other more specific ones. |
| **Increase enhanced services** | In an increasingly complex environment with changing customer demands, emerging technologies and value added services, utilities can strengthen their customer relationships by providing additional products and services. This contains recommendations for technology use, tariff changes or value added services based on historic consumption patterns or richer data analysis capabilities. | • This objective can be monitored with metrics measuring the number of new customer products & services and their success in the market. |
| **Provide affordable clean energy services** | Society and customers are shifting towards a more sustainable and environmentally friendly economy, where clean energy services are demanded. However, utilities are required to provide these clean services at an affordable cost. The adaption of clean electricity services and tariff rate options are few examples of this transformation. | • This objective can be monitored with metrics focused on customers with clean energy services, the affordability and the uptake of such services. |
| **Increase regulatory & community alignment** | Utilities are governed by legislation that aims to equitably decarbonize the electricity sector. Considering and aligning on legal and regulatory requirements, equity provisions and engaging the community are necessary to ensure the clean energy transition. While there are distinct challenges, burdens and specific requirements on local level, this creates an opportunity to enable participation, education, and efficient engagement between utilities, regulatory authorities and communities. | • This objective can be monitored with metrics and surveys focused on community satisfaction. |

# Capability Descriptions

# Business Capability

**A Business Capability** has a general description of the purpose and requirements for that business process and a more detailed description of **three levels of maturity**.
Utilities are assessed at what level of maturity they currently are. Additional comments provide insights into what is currently present within the utility.

| C2.9 - Manage DER Flexibility to Support the Grid | |
|---|---|
| **Description:** | Realizing the full potential for Distributed Energy Resources (DER) is dependent on a modernized grid and processes that enable the exchange of energy, information and value. Grid edge devices which offer energy flexibility, either through usage modification or storage, can provide both energy capacity and grid stabilization services targeted to both the locations and times of greatest need. Developing an organization's capability to use DER flexibility for grid services requires cross organization coordination and collaboration and a defined governance model. |

| Levels | Level description | |
|---|---|---|
| 3 | DER governance and operating model for key business functions supporting DER is in place. System integration ensures DER capacity and impacts on grid can be analyzed in context of the network model with any changes being synchronized across systems. DER data is available to system operations in real-time for individual or aggregated DER based on requirements of targeted grid services. DER respond in near- real time to digital signals from distribution management systems or autonomously based on sensing of prescribed grid conditions/ references. DER are included in distribution automation functions and can support power quality, reliability and improve resilience (reduce restoration times). | Not achieved |
| 2 | Formalized DER strategy defines organization objectives and key results/ targets, guiding business and project activities enabling use of DER to support the grid. Solutions exist to manage DER information individually and in aggregations. DER flexibility is a dispatchable resource, forecasted hourly, and integrated with day-ahead and hourly energy/dispatch processes. DER operations and performance information is available to system operations in near-real time (minimum hourly) with DER supporting market optimization/ energy arbitrage, grid constraint management and contingency reserve services. | Partially achieved |
| 1 | A visions and goals for using DER to support the grid exists. DER programs and technology are piloted to establish performance criteria and operational requirements. DER respond to static price signals (rates or incentives) scheduled up to a day ahead targeting peak reduction and resource adequacy services. System operations are informed of DER schedules and provided historic DER performance and settlement information, but do not actively manage or use DER flexibility. | Achieved |

**Comments:**
Please enter here any relevant comments in support of the assessment and answers.

# Capabilities Descriptions

## Clean Energy Supply

| Capability | Description |
|---|---|
| **Decarbonization Strategy Planning & Management** | Decarbonization Strategy Planning & Management helps the utility to define the direction in which the organization is achieving its established clean energy and decarbonization targets, through definition of realistic goals in line with the corporate objectives, a structured methodology and active tracking of actual results, and course corrections to reach the targets. |
| **Stakeholder Management** | Identifying, building and maintaining relationships with all individuals, groups, organizations, or communities who have a stake or interest in a specific project, program or activity related to the organization's clean energy initiatives (incl. underserved or vulnerable populations/communities). To engage them in the right way, understand potential impacts, their needs and actions, educate decision-making, foster trust, and produce outcomes that benefit all parties involved to ensure a just transition. An effective stakeholder management entails identifying and understanding the viewpoints, concerns, and requirements of stakeholders. Stakeholders may be actively involved in the planning, implementation, monitoring, and assessment of initiatives as well as in communication, consultation, and collaboration. |
| **Corporate Data Management** | The utility landscape is evolving towards a more complex and dynamic environment, due to more distributed and unpredictable energy sources, more grid connected devices, and greater need for customer information utilized throughout the organization.<br>These connection points will generate an increasing amount of data that require robust and sophisticated data management tools and methods.<br>Advanced data analytics capability is also required to leverage that data for operational, business and customer benefits and for internal and regulatory reporting. |

# Capabilities Descriptions

## Clean Energy Supply

| Capability | Description |
|---|---|
| **Integrated System Planning** | Government policy, strategic priorities and consumer sentiment are increasingly exerting influence on how utilities plan and source supply resources. Additionally, the electrification of demand and rapid rise of distributed resources create new challenges in forecasting load and matching supply with more variable load curves and unequal distribution. Integration of large-scale renewable energy into the transmission system involves more efficiently managing renewable variability, both within and outside utility geographical boundaries. This significantly impacts generation and transmission planning and requires new processes and tools which enable coordination across the energy system including generation, transmission, distribution, and consumers in order to ensure alignment of investments and realization of sustainability and reliability goals. |
| **Corporate Data Management** | The utility landscape is evolving towards a more complex and dynamic environment, due to more distributed and unpredictable energy sources, more grid connected devices, and greater need for customer information utilized throughout the organization.<br>These connection points will generate an increasing amount of data that require robust and sophisticated data management tools and methods.<br>Advanced data analytics capability is also required to leverage that data for operational, business and customer benefits and for internal and regulatory reporting. |

# Capabilities Descriptions

## Clean Energy Supply

| Capability | Description |
|---|---|
| **Integrated System Planning** | Government policy, strategic priorities and consumer sentiment are increasingly exerting influence on how utilities plan and source supply resources. Additionally, the electrification of demand and rapid rise of distributed resources create new challenges in forecasting load and matching supply with more variable load curves and unequal distribution. Integration of large-scale renewable energy into the transmission system involves more efficiently managing renewable variability, both within and outside utility geographical boundaries. This significantly impacts generation and transmission planning and requires new processes and tools which enable coordination across the energy system including generation, transmission, distribution, and consumers in order to ensure alignment of investments and realization of sustainability and reliability goals. |
| **Integration of Variable Energy Resources** | Electrification of energy uses, and reduction of fossil fuel generation driven by net-zero emissions goals, will require new sources of non-emitting supply. With low costs and proven technology, much of this new supply will come from variable energy resources (VER), such as wind and solar. This transition to system resources that are weather dependent, and variable, requires utilities to build more flexibility and responsive solutions to balance supply and demand in both transmission and distribution system operations. To ensure continued reliability of the grid, system planning and operational processes must be enhanced in order to support significantly higher penetration of variable energy resources. |
| **Clean Energy Contracting** | Decarbonizing the grid will require new ways of collaborating with customers and partners and integration of emerging business models to support diversity of supply (location and type of renewables) and increased flexibility to maintain reliability. Mechanisms exist to invite private capital into grid modernization efforts through both contracting of clean energy supply and providing access to markets and value for the flexibility required to scale clean energy sources on the grid. |

# Capabilities Descriptions

## Modern Grid

| Capability | Description |
|---|---|
| **Grid Information Management** | Grid data management focuses on classifying, archiving, and interpreting large amounts of data that distributed devices and systems in the field provide. Analyzing and interpreting the data to derive sustainable business value and informed decisions is key to manage increasing uncertainty within the grid. In order to manage data that is available when needed across many platforms and locations, advanced data governance and management functions are required. This will support gaining situational awareness in the field, utilization of resources, and optimizing grid techniques, tools and operations. |
| **Grid Code Management** | To realize decarbonization goals, grid codes, interconnection requirements and market mechanism will need to evolve in order to reliably integrate large amounts of solar and wind resources and realize benefits from new technologies. As the number of inverter based resources grows across the system, standards and requirements defining visibility, control, protection and performance criteria to provide grid stabilization services will mitigate the potential risks and impacts from these resources and create opportunities to unlock additional value they can provide to clean and reliable power delivery. |
| **Asset Management** | Asset management is the process of overseeing and improving the utility's property-owned assets. This can refer to a wide variety of possessions, including money investments, property, machinery, and intellectual property. Asset management seeks to gradually improve asset value while avoiding risk and optimizing profits in an environment with increasing uncertainty (e.g., increasing number of DERs). Setting investment strategies, choosing particular investments, evaluating performance, and making adjustments as needed are just a few of the different tasks involved in this. |

# Capabilities Descriptions

## Modern Grid

| Capability | Description |
|---|---|
| **Grid Planning** | Optimized grid planning to guarantee security and reliability of the power supply while using modern, controllable operating equipment under increasing uncertainty through increasing numbers of variable energy generation assets e.g., Distributed Energy Resources (DER) in the supply obligation. Utilities engage with stakeholders and other utilities in a variety of planning and operational processes, including: data generation, analysis, modeling to identify and resolve transmission, distribution and grid integration issues; design of financing and business models for new projects; and engineering, procurement, construction and operation of new grid infrastructure. |
| **Operational Planning** | Advanced operational planning helps maintain grid reliability (e.g., planned work & outages), resilience, and power quality. Operational planning, 1 day to 1 week ahead, analyzes data from system monitoring, weather forecasts, Distributed Energy Resources (DERs) flexibility, and Distribution Automation (DA) functions to develop optimized switching schedules. Planned outages are optimally arranged based on the latest prediction of the operating conditions. Changes for recloser settings and alarm thresholds are identified in plans for storm conditions. |
| **Grid Operations** | Grid operations, real time and emergency operations, are supported by advanced grid monitoring system, and by adding distributed energy resources flexibility and distribution automation functions to the operations, including overload elimination/reduction, load management and loss minimization in distribution and transmission. |

# Capabilities Descriptions

## Modern Grid

| Capability | Description |
|---|---|
| **Power Quality Management** | Power quality management analyzes Power Quality (PQ) events, trends, and profiles against planning limits and operation objectives, and identify causes of PQ problems and possible equipment problems that could be corrected. Improving power quality analysis capabilities which considers additional data sources and corrective actions will extend lifetime of equipment, reduce losses, and avoid interruption. |
| **DER Interconnection Process** | Policies designed to reduce the impacts of climate change, new technologies and evolving customer preferences are driving an increase in Distributed Energy Resources (DERs) connected both in front of and behind the meter. With the pace of adoption and variety of devices expected to increase, it is critical for utilities and grid operators to maintain situational awareness and develop capabilities to understand and forecast the impact of DER. Solutions are required that support scaling, reduce administration and ensure customer satisfaction while at the same time supporting the acquisition and analysis of key DER attributes required for cross organization planning and reliable system operations. |
| **Manage DER Flexibility to Support the Grid** | Realizing the full potential for Distributed Energy Resources (DER) is dependent on a modernized grid and processes that enable the exchange of energy, information and value. Grid edge devices which offer energy flexibility, either through usage modification or storage, can provide both energy capacity and grid stabilization services targeted to both the locations and times of greatest need. Developing an organization's capability to use DER flexibility for grid services requires cross organization coordination and collaboration and a defined governance model. |

# Capabilities Descriptions

## Customers & Society

| Capability | Description |
|---|---|
| **Customer Centric Operations** | Customer centricity defines the value chain in such a way that it begins with the customer: the customer's expectations, needs and wishes form the starting point for the corporate strategy of utilities. The utilities obligation to serve is expanded to consider customer control over their energy choices and motivations for engagement within the energy ecosystem. A customer-oriented approach accommodates the prosumer and create conditions for innovations in technical and market based offerings that expand customer choices. This capability leverages increasingly comprehensive methods and tools to conduct market research and understand customer needs. |
| **Community Engagement** | As providers of critical infrastructure, utilities are an integral part of the community. Because public expectations have changed, developing strong relationships, participation, and attractive programs for and within the community is key to ensure a collaborative partnership and mutual understanding. Infrastructure investments increasingly require the involvement, buy-in, and support of the local communities (e.g., not-in-my-backyard movements against wind power). In order to understand, inform, gather feedback, involve, and anticipate community thinking and reactions, it is important to successfully address their needs and interest at the right time (reactive, proactive, regularly) and manner (meaningful, interactive, open and inclusive) within planned activities, integrated strategies and programs (e.g., customers, local government representatives, environmental organizations, indigenous groups). |
| **Manage Educational Programs** | Targeted educational programs and marketing & communications inform customers, policy makers, partners and industry of key issues and considerations for energy transition and sustainability. As a result, stakeholders are better informed and motivated to take part in corrective actions individually, participate in programs and become advocates for measures needed to ensure a sustainable grid (economic, clean and reliable). |

# Capabilities Descriptions

## Customers & Society

| Capability | Description |
|---|---|
| **Provide Customer Solutions and Services** | With the cost of commercial solutions decreasing and utility rates expected to rise, the customer's value proposition for alternative energy solution will only improve. It is essential for continued business viability that utilities offer customer innovative solutions and services that support the realization of their energy goals while providing value to the economic and reliable operation of the grid. Only the utility is able to connect customer devices or behaviours to grid benefits, which requires new business models and operational capabilities to design and deliver. This capability is based on the utility's ability to create new successful business models that are different from their traditional business model, and uses comprehensive marketing methods and tools to understand and meet customer needs. |
| **Manage e-Mobility** | The electrification of transportation represents a significant source of new demand as well as new challenges to infrastructure and operations as demand will vary in time and location and large point loads will have acute impacts on the grid. This will also see marked change in customer expectation and requirements for service that will necessitate new policies, solutions and services to minimize negative impacts and ensure equitable access to all. |

# Capabilities

## Clean Energy Supply

Capabilities defined and how they support the business objectives and the benchmarking metrics



### Model Objectives

| | Capabilities | CLEAN ENERGY SUPPLY | | | | MODERN GRID | | | | CUSTOMERS & SOCIETY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reduce carbon emissions | Increase / Harness carbon-free energy supply | Convert energy supply sources / energy mix | Improve corporate planning capabilities | Optimize grid operations | Increase service reliability | Increase grid value | Hedge risks | Increase customer satisfaction | Increase enhanced services | Provide affordable clean energy services | Increase regulatory & community alignment |
| CLEAN ENERGY SUPPLY | Decarbonization Strategy Planning & Management | x | | | x | | | | | | | | |
| | Stakeholder Management | | | | x | | | x | | x | x | | x |
| | Corporate Data Management | | | | x | x | | | | x | x | | |
| | Integrated System Planning | | x | x | x | | x | x | x | | | x | x |
| | Integration of Variable Energy Resources | x | x | x | | x | | | x | | | x | |
| | Clean Energy Contracting | x | x | x | | x | x | x | | | | x | |

### Benchmarking Metrics

| | Capabilities | CLEAN ENERGY SUPPLY | | | | MODERN GRID | | | | | CUSTOMERS & SOCIETY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Planning and Designing to Decarbonize the Grid | Clean Energy Procurement & Deployment | Integration of Clean Energy Supply | Corporate Leadership | Enhance Grid Planning & Management | DER Enablement & Integration | Visibility & Control Capabilities | Innovation and Emerging Technologies | Climate Resiliency | Changing Customer Preferences | Enabling Transportation, Building, & Industrial Electrification | Diversity, Equity & Inclusion Goals & Actions | Aligned Actions and Engagement |
| CLEAN ENERGY SUPPLY | Decarbonization Strategy Planning & Management | x | | | x | x | | | | | | x | | x |
| | Stakeholder Management | x | | | x | | | | x | | x | | x | x |
| | Corporate Data Management | x | | | x | x | | x | x | x | x | | | |
| | Integrated System Planning | x | x | x | x | x | x | | | | | x | | x |
| | Integration of Variable Energy Resources | | x | x | | x | x | x | | | | | | |
| | Clean Energy Contracting | | x | x | | | x | | | | x | | x | |

# Capabilities

## Modern Grid

Capabilities defined and how they support the business objectives and the benchmarking metrics



| | | Model Objectives | | | | | | | | | | | Benchmarking Metrics | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLEAN ENERGY SUPPLY | | | | MODERN GRID | | | | CUSTOMERS & SOCIETY | | | | CLEAN ENERGY SUPPLY | | | | MODERN GRID | | | | | CUSTOMERS & SOCIETY | | | |
| | Capabilities | Reduce carbon emissions | Increase / Harness carbon-free energy supply | Convert energy supply sources / energy mix | Improve corporate planning capabilities | Optimize grid operations | Increase service reliability | Increase grid value | Hedge risks | Increase customer satisfaction | Increase enhanced services | Provide affordable clean energy services | Increase regulatory & community alignment | Planning and Designing to Decarbonize the Grid | Clean Energy Procurement & Deployment | Integration of Clean Energy Supply | Corporate Leadership | Enhance Grid Planning & Management | DER Enablement & Integration | Visibility & Control Capabilities | Innovation and Emerging Technologies | Climate Resiliency | Changing Customer Preferences | Enabling Transportation, Building, & Industrial Electrification | Diversity, Equity & Inclusion Goals & Actions | Aligned Actions and Engagement |
| Modern Grid | Grid Information Management | | | | x | x | x | | x | x | | | | | | x | | x | x | x | | | | x | | |
| | Grid Code Management | | x | x | | x | x | | | | x | | | x | x | x | | | x | x | x | | | | x | | |
| | Asset Management | | | | x | x | x | x | x | | | x | | | | x | | x | x | x | | x | | | | | |
| | Grid Planning | | x | x | x | x | | | x | | | x | | x | | x | | x | x | x | x | | | x | | |
| | Operational Planning | | x | | | x | x | x | x | | x | | | | | x | | x | x | | | x | | | x | | |
| | Grid Operations | | | | | x | x | x | x | x | | | | | | | | | x | x | | x | | | | | |
| | Power Quality Management | | | | | x | x | x | | x | | | | | | x | | x | x | | | | x | x | | | |
| | DER Interconnection Process | | x | | | x | x | x | | x | x | | | | x | x | | x | x | x | | | x | x | | | |
| | Manage DER Flexibility to Support the Grid | | x | x | | x | x | x | x | x | x | | | | x | x | | x | x | x | x | | x | x | | | |

# Capabilities

## Customers and Society

Capabilities defined and how they support the business objectives and the benchmarking metrics



### Model Objectives

| Capabilities | | CLEAN ENERGY SUPPLY | | | | MODERN GRID | | | | CUSTOMERS & SOCIETY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reduce carbon emissions | Increase / Harness carbon-free energy supply | Convert energy supply sources / energy mix | Improve corporate planning capabilities | Optimize grid operations | Increase service reliability | Increase grid value | Hedge risks | Increase customer satisfaction | Increase enhanced services | Provide affordable clean energy services | Increase regulatory & community alignment |
| Customers & Society | Customer Centric Operations | x | | | x | | | | | | | | |
| | Community Engagement | | | | x | | | x | | x | x | | x |
| | Manage Educational Programs | | | | x | x | | | | x | x | | |
| | Provide Customer Solutions and Services | | x | x | x | | x | x | x | | | x | x |
| | Manage e-Mobility | x | x | x | | x | | | x | | | x | |

### Benchmarking Metrics

| | CLEAN ENERGY SUPPLY | | | | MODERN GRID | | | | | CUSTOMERS & SOCIETY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Planning and Designing to Decarbonize the Grid | Clean Energy Procurement & Deployment | Integration of Clean Energy Supply | Corporate Leadership | Enhance Grid Planning & Management | DER Enablement & Integration | Visibility & Control Capabilities | Innovation and Emerging Technologies | Climate Resiliency | Changing Customer Preferences | Enabling Transportation, Building, & Industrial Electrification | Diversity, Equity & Inclusion Goals & Actions | Aligned Actions and Engagement |
| Customer Centric Operations | x | | | x | x | | | | | | x | | x |
| Community Engagement | x | | | x | | | | x | | x | | x | x |
| Manage Educational Programs | x | | | x | x | | x | x | x | x | | | |
| Provide Customer Solutions and Services | x | x | x | x | x | x | | | | | x | | x |
| Manage e-Mobility | | x | x | | x | x | x | | | | | | |

# Capability Assessment

## How to use the results to plan next steps

Utilities can use the results of the assessment, and the recommendations suggested in the utility report, to plan for **improvement actions**, using the following approach:

1. **As-is**: use the reports from Phase A (metrics results) and B (capability maturity) to take stock of the current status. More in depth analysis of the existing processes could be required to identify gaps in more detail
2. **Define to-be**: based on the as-is and the recommended measures, the utility's strategic objectives and its environment, decide the aspired level for every capability
    - The matrix to map metrics and objective to capabilities can be used to determine relevant capabilities to target given metrics and objectives
3. **Plan**: use the recommended measures in the utility report as guideline for the project to implement
4. **Implement**: execute the defined projects
5. **Assess**: monitor and measure the results from the projects and determine course correct actions is the results are not in line with the expectations.