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How Can Grid Modernization Facilitate Decarbonizing the Energy Sector?

Guidebook

The Power of Perspective

Executive Summary

How to gear our energy grids for the future — if you'll forgive the pun — is a burning question. Due to climate change, and aging power systems, the world's governments face extraordinary challenges in upgrading their energy sources. Reducing power outages has become a crippling issue. This guidebook examines in depth some of the problems the world's energy suppliers face and suggests some solutions. It concludes by showing how portfolio selection decisions can be based on data rather than intuition. After all, good project selection leads to more effective, profitable strategy realization — and can help to achieve carbon neutrality goals.

Introduction: Overhauling Our Power Systems

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Energy systems worldwide are currently undergoing transformational change, as the penetration of generation from renewable sources such as wind, sun and water is increased to decarbonize these systems and reduce dependence on carbon-intensive fossil fuels.

In the future, electricity will increasingly be used for transport, heating and other activities. As a result, overall capacity of transmission and distribution networks will also need to be increased. This requires network system operators to develop flexibility and resilience through increased interconnection, storage, new system services, the use of demand side response and the delivery of flexible and lower carbon systems which will support a high renewables system.

The UN Environment Program Finance Initiative ("UNEP FI") highlighted in its 2021 report, Decarbonization and Disruption, that: "A poorly planned disruptive transition would significantly destabilize global power resources if renewable and low-carbon power grids are not ready for widespread deployment."

They also added: "A hasty departure from fossil fuel power generation could mean the destabilization of power resources ... as a result of the massive short-term costs and technological challenges of modernizing the power grid."

Electrical power systems have always relied heavily on oil, coal and natural gas to generate electricity. For power system operators to achieve a net-zero power system, they must move to clean energy production technologies such as wind and solar-based generation.

This involves a fundamental overhaul of the power systems which will significantly change how they operate. There are a range of technical difficulties associated with operating an electrical grid from mostly renewable sources, largely due to the intermittent nature of power generation from those sources.

CHAPTER 1

System Security

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Reviews of the way that system security is delivered in the short- and medium-term are underway internationally. In general, these reviews are intended to ensure that system security is guaranteed, while supporting ever higher levels of intermittent renewable electricity. Grid modernization is needed to address climate-related resiliency risks, adapt to more distributed energy resources and help decarbonize the industry.

The number of power outages has been increasing year-on-year in North America over the past 20 years.

The United States has, for example, experienced a record-breaking year for power outages in 2020, according to the Energy Information Administration (EIA). The year 2021 has been just as bad. While many of these outages were due to weather events, the aging grid, much of which was built in the middle of the twentieth century, needs a serious overhaul.

It is estimated that decarbonizing and modernizing the US's existing electricity plant (whose average age is 35 years) alone could cost $7-8 trillion (EIA). The International Energy Agency in their report Net Zero by 2050 – A Roadmap for the Global Energy Sector estimated that global annual investment in transmission and distribution grids will expand from $260 billion today to $820 billion in 2030 to achieve global decarbonization by 2050.

Average duration of total annual electric power interruptions, United States (2013–2020)
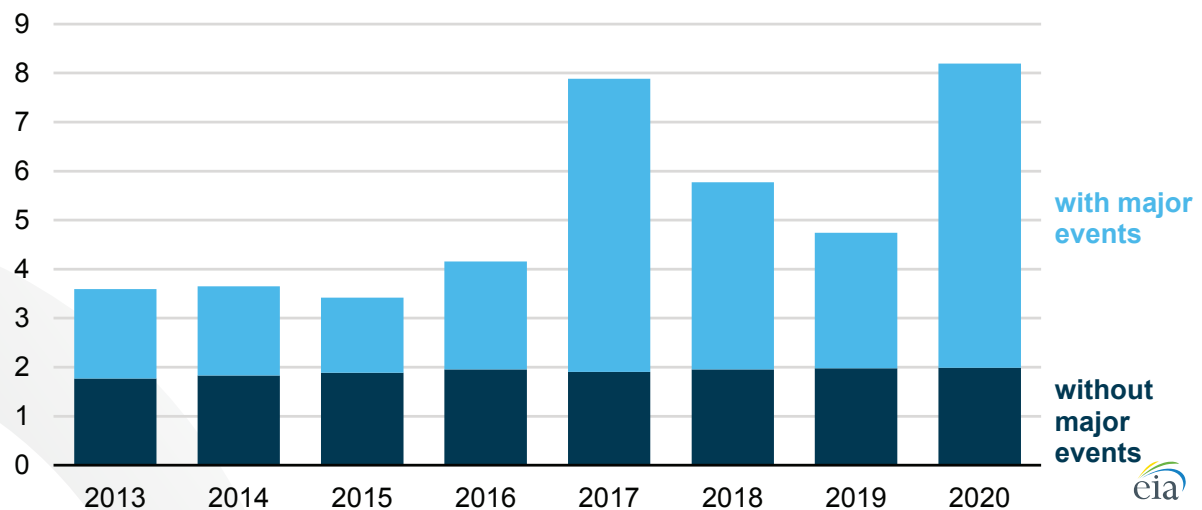hours per customer

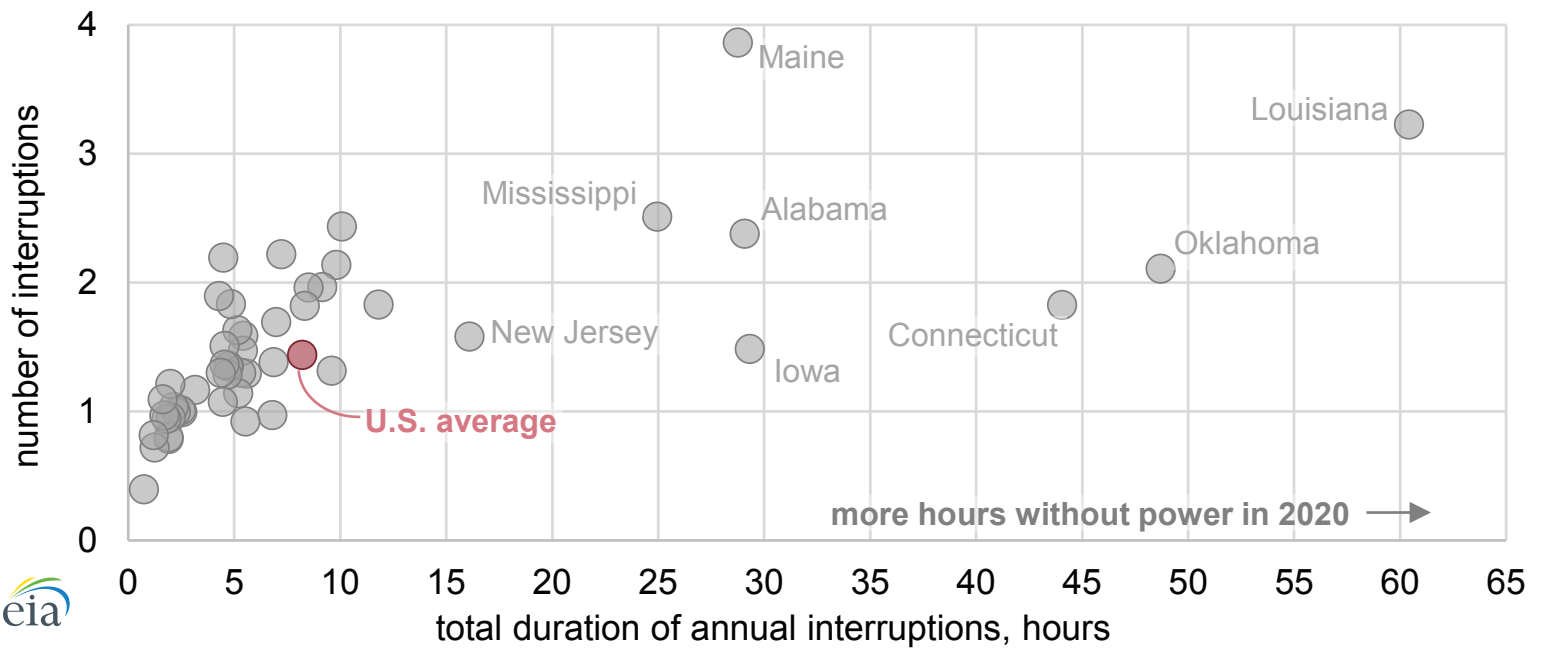**Figure 1:** © Power Outages, USA, 2001-2020. Energy Information Administration

Figure 2: © Average total annual electric power interruption duration and frequency per customer, by US state (2020).

Moving to a Low-Carbon System

At a European level, there are changes underway to harmonize a range of features of capacity markets amongst EU member states. This is to ensure that, as far as possible, these markets are designed to support the transition to a low-carbon system. The same sentiments exist across the Atlantic Ocean.

"In whatever ways the power system evolves in the future, the system must be simultaneously safe and secure, clean and sustainable, affordable and equitable, and reliable and resilient," concluded a 2021 report by The National Academies of Sciences, Engineering and Medicine, entitled [The Future of Electric Power in the United States](#).

Low wind conditions over the 2021 summer, for example, alongside high prices, have created a greater understanding across Europe of the scale of risk associated with the transition to a net-zero economy.

A net-zero emissions target means that any greenhouse gas emissions that a country produces would be removed by using new technologies to capture and store carbon. Planting more trees which absorb carbon is another example of carbon capture. Many countries have set out Climate Action Plans to achieve net-zero emissions by 2050, with interim targets set for 2030.

The development of microgeneration, the small-scale generation of heat and electric power by individuals and communities, continues. This will support communities and individuals to deliver small-scale renewable energy projects locally and export their excess domestic electricity to the grid.

In addition to the above, many countries are now examining short-term mitigation measures that can address some of the risks associated with this transition. However, given the scale of change needed, network system operators must also plan for a great deal of upgrading and provision of new grid infrastructure.

CHAPTER 3

Delivery of Grid Strengthening Challenges

It can be extraordinarily challenging to win internal and external approval for typically substantial and extensive plans, which can cost billions of dollars and stretch over multi-year time periods. Delivering on-time, on-budget completion of these upgrades, while meeting all stakeholder needs, can be even more challenging.

Among the issues and challenges facing the delivery of the grid strengthening programs of work are:

1. Compliance with statutory processes and procurement procedures

2. Alignment of expectations of customers, regulators and shareholders

3. Public expectations as regards system resilience and affordability

4. Gaining the support of landowners and wider communities for network upgrade projects

As we increase our ambitions towards renewables, we must continue to assess and mitigate the risks that come with these valuable and renewable natural resources. As the energy sector moves towards a sustainable, low-carbon future, there will be major changes in:

• how and where electricity is generated

• how and where electricity is connected to the grid

• how electricity is bought and sold

• how electricity is used; for example, for transport and heat

The electricity network will carry more power than ever before and most of that power will come from renewable sources such as wind and solar. Coal and fossil fuel-based generation will be phased out over the next decade, with natural gas helping to fill any gaps in the short term while we make the changes needed, and until biomethane and/or hydrogen replaces natural gas.

There is consensus about the way forward. For example, a recent white paper published by GD4S (Gas Distributors for Sustainability) sets out their commitment. Entitled [Gas Grids: A Key Enabler of Decarbonization](#), it explains details of a pathway forward to "support the EU in achieving a net-zero emissions continent by 2050. Gas grids can contribute towards and facilitate a successful, cost-efficient climate and energy transition in Europe."

At the same time, there will be significant changes on the demand-side as new technology allows electricity users to generate and store power and return any surplus power to the grid. These developments will require a significant transformation of the electricity system. More importantly, these changes will need to be managed in a coordinated way that delivers the best outcome for the public.

OFGEM, the UK Energy Regulator, states in its [Work Program 2021/2022](): "To facilitate the transition to a more flexible, data-enabled, net-zero energy system, we believe that there is a case for stronger strategic oversight and better whole systems coordination, which will likely require changes to existing governance procedures, codes, standards and licensing arrangements."

Clear and transparent communication to the key competent authorities, stakeholders and the public at large relating to the delivery of these programs over the coming years will be required if grid strengthening programs are to be delivered in a timely manner.

It is vitally important for network operators to stay agile as they execute and deliver their programs, and they can do so with the help of strategic portfolio management (SPM) capabilities supported by project and program management (PPM) tools that can help monitor hundreds of projects at once. These tools can help you quickly anticipate problems, keeping projects on time and on budget. In response to changing conditions, they can help you reprioritize or reallocate resources as required.

This provides an enduring focus on the management of benefits throughout a project or program's lifecycle, through to project outcomes and benefits' realization. This allows for the linking of benefits to projects, outcomes and strategies and ensures the projects and programs deliver on their objectives.

PwC's Six Principles for Grid Modernization Success

Grid modernization is moving forward, with programs securing approval, cost recovery mechanisms established, and putting shovels in the ground. Indeed, leading electric and gas utilities are achieving consensus around priorities, winning regulatory approval, and getting projects moving on within budget and schedule considerations. This success hinges on following six guiding principles, all fundamental to strategic capital program management.

1. Start with imperatives.

Grid modernization strategy begins with determining and clearly defining short and long term business imperatives. Seek input from top executives, community representatives, and those who design, construct, maintain, and operate the grid. A structured, transparent process will help drive early alignment on priorities.

2. Assess needs and capabilities.

Consider not only the utility's current state and ambitions, but also the day-to-day operations, issues and challenges that substations and feeders face. When performing feasibility studies, pay special attention to people capabilities: grid modernization requires skill sets both to oversee and deliver the program and to effectively apply new technologies and processes.

3. Set the scope.

As you develop a list of projects and perform a cost/benefit/risk analysis for each, consider technology tools that support portfolio optimization. Such tools can provide a dynamic view of the entire potential project list. You can then see how individual projects' costs, benefits and risks interact. During the scoping process, continue to communicate with key stakeholders to help maintain alignment on priorities.

PwC's <u>Grid Modernization for Electric Gas and Utilities: A Strategy for Success</u>

PwC's Six Principles for Grid Modernization Success

4. Be clear to win support.

To win internal alignment, community buy-in, and regulatory approval, clearly define the program and business case, including traceable metrics for expected outcomes, costs, benefits, and scope. Demonstrating proven project management capabilities will help convince stakeholders of the business case and the ability to deliver.

5. Create the map.

Develop a roadmap with an eye to both prioritized stakeholder ROI and "foundational" projects: ones that if completed early will support later projects. Consider a phased versus "big bang" approach, and choose the delivery model (predominantly insourced, predominantly outsourced, or hybrid) that matches your capabilities. Embed governance to control scope, cost, schedule and risk, and to track and report on benefit realization.

6. Stay agile as you execute — with the help of active portfolio-management.

Execute and deliver your program, with the help of portfolio management capabilities supported by technology tools that can help monitor hundreds or thousands of projects at once. These tools can help you quickly spot (or predict) problems, keeping projects on time and on budget. In response to changing conditions, they can help you reprioritize or reallocate resources as needed.

PwC's Grid Modernization for Electric Gas and Utilities: A Strategy for Success

Conclusion: Achieving Project Prioritization and Carbon Neutrality Goals

Network Utilities are investing while focusing on three key priorities:

1. Improve reliability and reduce costs by hardening distribution and transmission systems and deploying smart grids, distribution automation, and distributed energy resource (DER) optimization.

2. Provide customers with a more digital, transparent experience, providing detailed insights into consumption and service, as well as more control over usage.

3. Transform the organization to support a modernized, digital grid, by investing in digital upskilling as well as in new processes, technologies and structures to support organizational change management and long-term workforce planning.

In this way, where a project or program has the benefits it will deliver clearly defined upfront, the system operators, regulators and stakeholders can clearly see what enablers and actions need to happen to ensure those benefits are delivered by the project or program, should it go ahead.

Decisions made around portfolio selection are no longer educated guesswork: now they can be based on data rather than surmising the benefits that will be delivered, This results in project selection that will help network system operators realize their strategy. This, ultimately, can be good for the bottom line as well as helping to achieve carbon neutrality goals.

How Cora Systems Powers SPM

The Cora SPM platform – which is Gartner-approved – will provide you with the visibility for advanced portfolio management and decision-making. It will give you the confidence to select the right portfolio, and the digital know-how to execute them successfully, as well as ensuring the governance, monitoring and execution of your change initiatives.

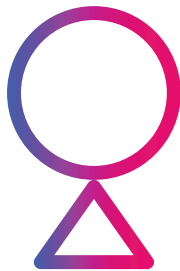The Cora SPM platform is built on four fundamental pillars:
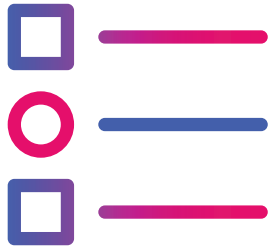
Inventory

Translate your business strategy into an actionable portfolio.

Analyze

Based on strategic criteria; analyze and select the best initiatives.

Balance

Implement the best aligned projects by allocating budget and resources that provide maximum business impact.

Execute

Manage approved projects to completion with full visibility over deliverables, timescales, scheduling and progress

Strategic functionality

The strategic functionality required to optimize capacity, prioritize and track the benefits of your business plan, inform all stakeholders and integrate across the business technologies to achieve maximum performance from your portfolios of work.

Portfolio Selection

Auto-select the preferred portfolio based on your criteria and compare alternatives, ensuring your portfolio delivers the maximum return.

Scenario Planning

Make Portfolio balancing easy, while ensuring strategic alignment, capacity planning and global efficiencies across the enterprise.

Top-Down Budgeting

Logically split budget across your portfolios. Easily track forecasting from execution against portfolio budgets to measure performance.

Prioritization

Using criteria, based on your requirements to score and weight projects, slice-and-dice data to come up with a repeatable, reliable and robust portfolio scoring mechanism.

Better Decision-Making

Increase return on investment, eliminate "CEO-specials" or "good-hunch" and enable decisions on the portfolio to be made with clarity and without guesswork.

Business Intelligence

Embedded "BI" provides powerful data and insights that enable fast, informed decisions accessible to everyone via shared dashboard and interactive reports.

Strategic Capacity Management

Easily understand requirements for the year ahead and maximize usage of global resource pools.

Benefits Realization

Plan and track benefit realization across the organization.

Execution functionality

The essential functionality required to automate your PMO, providing you with the ability to plan, prioritize, execute and evaluate your project portfolios

Engine

A full set of tools needed to create, plan and manage your entire portfolio of projects.

Finance

A full set of tools needed to create, plan and manage your entire portfolio of projects.

Document Management

Attach or link documents to projects, risks, tasks & registers. Annotate documents with mark tools directly within the application.

Forms

Turn free-format text into structured, reportable data.

Registers

Completely customizable logs for managing actions, lessons learned, decisions & more.

GIS Mapping

Plot projects on a map, visualizing activity location and identifying synergies.

Dashboards

Project and program level, visualizing the health of your portfolio; personal dashboards provide a digital "to-do" list.

Reporting

Suite of reports that are used by various roles to extract and publish information in just a few clicks.

Mobile

Mobile apps for Android and iOS. Access and update key project activity from anywhere.

Resources

Plan resource requirements for your project; track variation between planned and actual resources

Workflow

Design and manage the approval of data in Cora Forms and Cora Registers.

Portal

A flexible framework that provides access to data contained in Cora PPM to a wider audience.

API

Facilitates easy integration with any enterprise technology architecture, allowing for a central, enterprise PMO platform, providing one version of the truth.

Scheduling

Solid, sophisticated scheduling throughout project lifecycle, including inter-project and inter-program dependencies.

Progress Management

Ensures automatic digitization and tracking of corporate goals.

Satisfied Clients

"Cora PPM gives us a single version of the truth. We've got 50+ countries in which we work, with 12,000 people in our part. We have in the region of 40,000 live projects every day. Cora PPM provides us with insight into all of those projects."

Phil Howe

Project Management Excellence Lead,

Honeywell

"We have specific timelines, deliverables, stakeholder communications, risks and mitigations, all of these tasks need to be delivered and managed, Cora has helped us and supported us to be successful."

Alejandro Gutierrez

Senior Engineer,

Boston Scientific

"We save time and money and deliver quality information and Cora's solution enables us to do this."

Mark Cain

Program Manager,

NHS Digital

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"It works well at a low level for project planning, risk and issues, change logs, benefits tracking, weekly reports, etc. Then the PMO can roll up and summarize that low-level data into a full program/portfolio view."

Justin Leese

Program Director, Local Full Fibre Networks,

Department for Digital, Culture, Media & Sport

"It has an extremely customizable PPM solution, which is what we needed – a solution that would fit to the way our business processes operate."

Mark Ruettiger

North America Operations Manager,

Automated Logic

"With Cora, we're able to sit around the table at senior management level and understand where we are much better than previously."

Paul Moody

Director of Global Engineering,

Allergan

"Cora really allows us to drill down into information so we can give our senior management the key decision-making information to make informed decisions on all our schemes."

Ian Thrupp

Head of Planning and Project Controls,

WSP

"Cora gives us that single source of truth to what's going on in the organization and also gives us the ability to prioritize what's really important to us, allocate resources and funding for those projects to help move us into that strategic position is invaluable."

Sarah Malin

Head of Program Management,

CityFibre

The Value

Digitize your programs and lifecycles, gain greater insights, more informed decision-making, and streamline your governance and reporting.

Strategic Insights
Roll out failsafe, strategically-aligned projects that utilize resources and deliver maximum value.

See The Full Picture
Quickly view data dashboards that visualize the health of your portfolio and drill-down to focus in on any issues.

Support Governance
Ensure the right people have the right oversight with multi-level access protocols.

Easily Scale
Small to large, local to global, all in the cloud.

Complete Control
Manage scope, financials, progress and quality of project delivery in one centralized system.

Seamless Collaboration
No matter the team – internal or contractor, desk-based or mobile – integrations make workflows seamless.

$20 BILLION
Worth of projects managed on Cora PPM.

400,000+
Projects live on Cora at any one time.

50+
Countries where Cora is in use.

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Platform & version of the truth.

Author Bio

Gerry Galvin has worked in the water industry for over 40 years. He spent more than 20 years in Ireland's Department of Environment, Community & Local Government, responsible for technical oversight to support the development and implementation of policies, strategies and the investment program for the water sector in the country. In his last 10 years with the department, he served as Principal Engineering Adviser in its water division where he was responsible for capital project planning, implementation and expenditure reviews, including the application of project control systems.

Gerry joined Irish Water, the national water utility, on its establishment in 2013, in the role of Chief Technical Officer on the Management Team where he served for seven years. He was responsible in this role for enterprise risk management co-ordination, technical competency development and health & safety, as well as serving on investment and contract approval committees, providing governance on the utility's capital investment plan projects. He currently works as a Government and Utilities Industry Principal, Executive-in-Residence with Cora Systems.

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