GE VERNOVA

CONSULTING SERVICES ASSESSMENTS AND STUDIES

Make complex energy decisions
while reducing potential risks.

Consulting Services holistic studies

With our inhouse experts, we can provide your team holistic studies that include:

- Power economics assessments and software tools that determine economic feasibility
- Grid stability and integration studies that evaluate the grid, transmission & distribution, and pathways to integrate conventional, renewable and emerging power sources
- Carbon management consulting that inform customers' strategies to lower their greenhouse gas and carbon footprint.

Power economics and software

Is a project worth building?

Grid stability and integration

Can a project safely interconnect and reliably operate?

Carbon management consulting

Can you operate sustainably in the future?

We have ~140 energy experts throughout 12 countries, and more than 100 patents.

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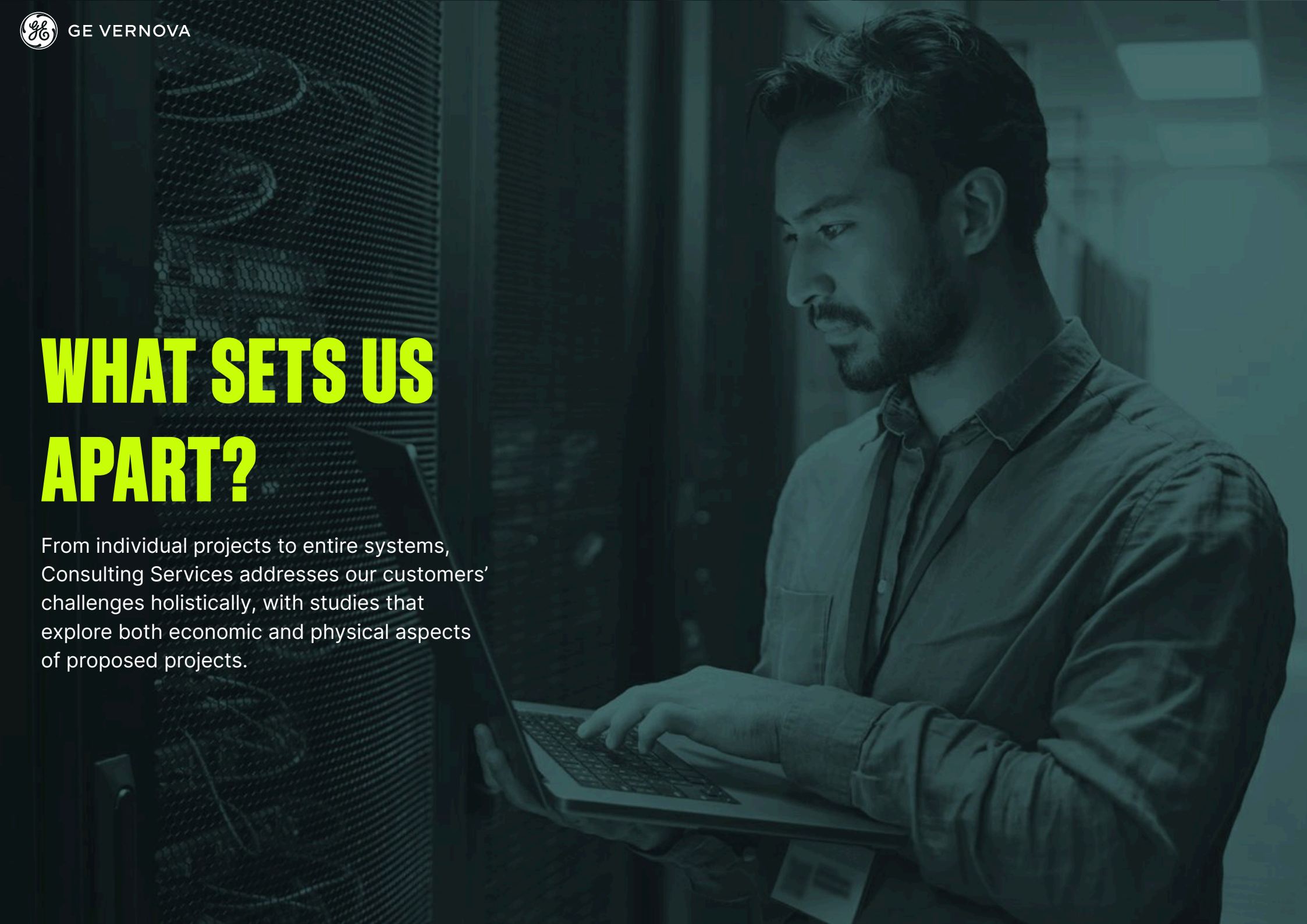
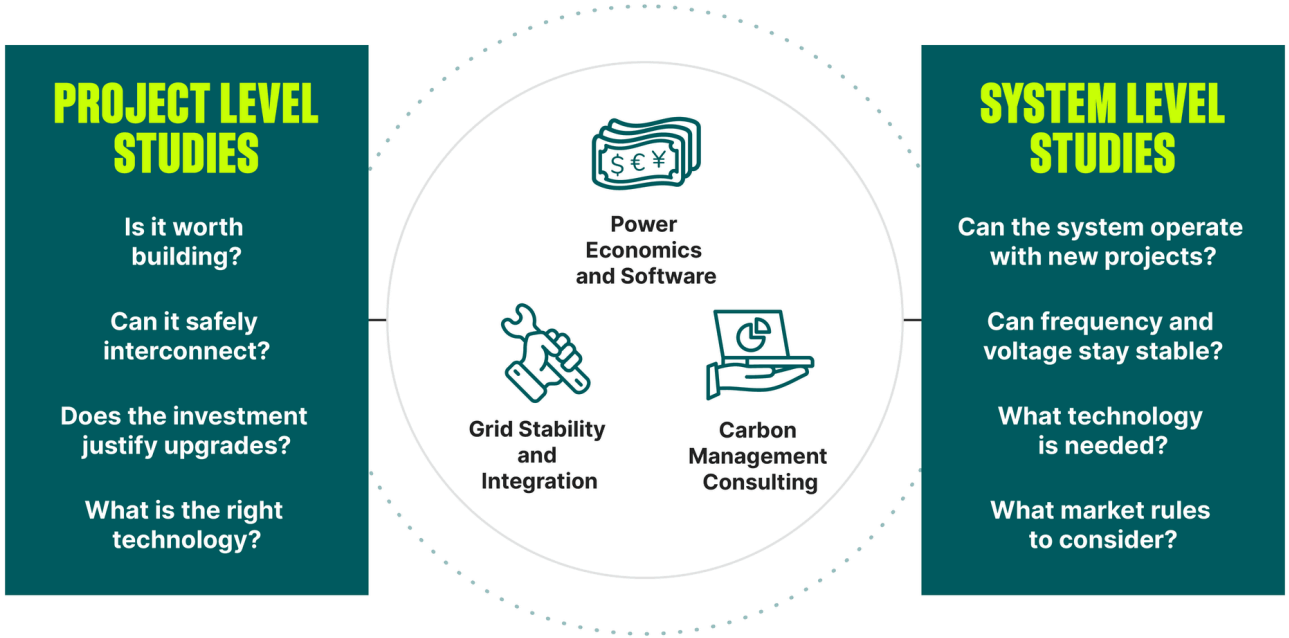
WHAT SETS US APART?

From individual projects to entire systems, Consulting Services addresses our customers' challenges holistically, with studies that explore both economic and physical aspects of proposed projects.



With Consulting Services studies, you will benefit from:

- Inhouse expertise and testing
- More than 50 investment-grade global models with regional and technology expertise
- A credible voice in the industry that provides fact-based analysis
- GE Vernova technologies and Grid Studies archive
- Global access to installed base and experts in all regions



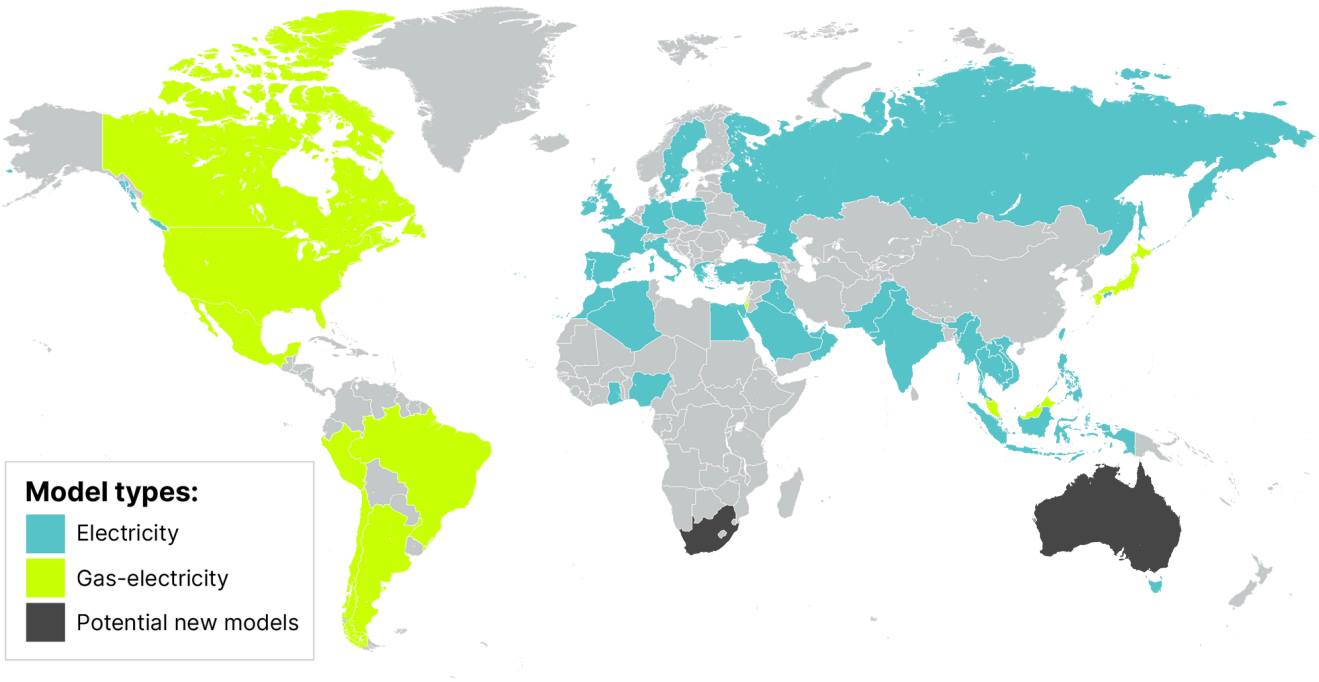
ENABLED BY OUR SUITE OF SOFTWARE TOOLS:

MARS *Capacity needs*

MAPS *Energy markets*

PSLF *Power flows*

Consulting Services models grids across the world



ECONOMICS + PHYSICS
Transmission constrained + least cost dispatch to serve load

ELECTRICITY + GAS
Global supply-demand balance informs natural gas price forecast

HIGH RESOLUTION
Every generator, every OEM, every hour, every year… nodal/zonal

FORWARD-LOOKING
20-year forecast… transmission, generation + historical validation

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EXPLORE OUR CONSULTING SERVICE AREAS

We provide policy, planning and investment decision expertise at both the project- and system-level to help make complex energy decisions while reducing potential risks.

Our consulting service areas:

Power economics and software

Grid stability and integration

Carbon management consulting

How to succeed in the energy transition

- Make decisions based on a range of economic, policy and regulatory drivers, not just technical considerations.
- Leverage Consulting Services' cross-functional teams.
- Weave stability and adequacy analysis into technical and economic recommendations and solutions.

We analyze:

- Electric power market conditions
- System dispatch and operations
- Energy policy implications

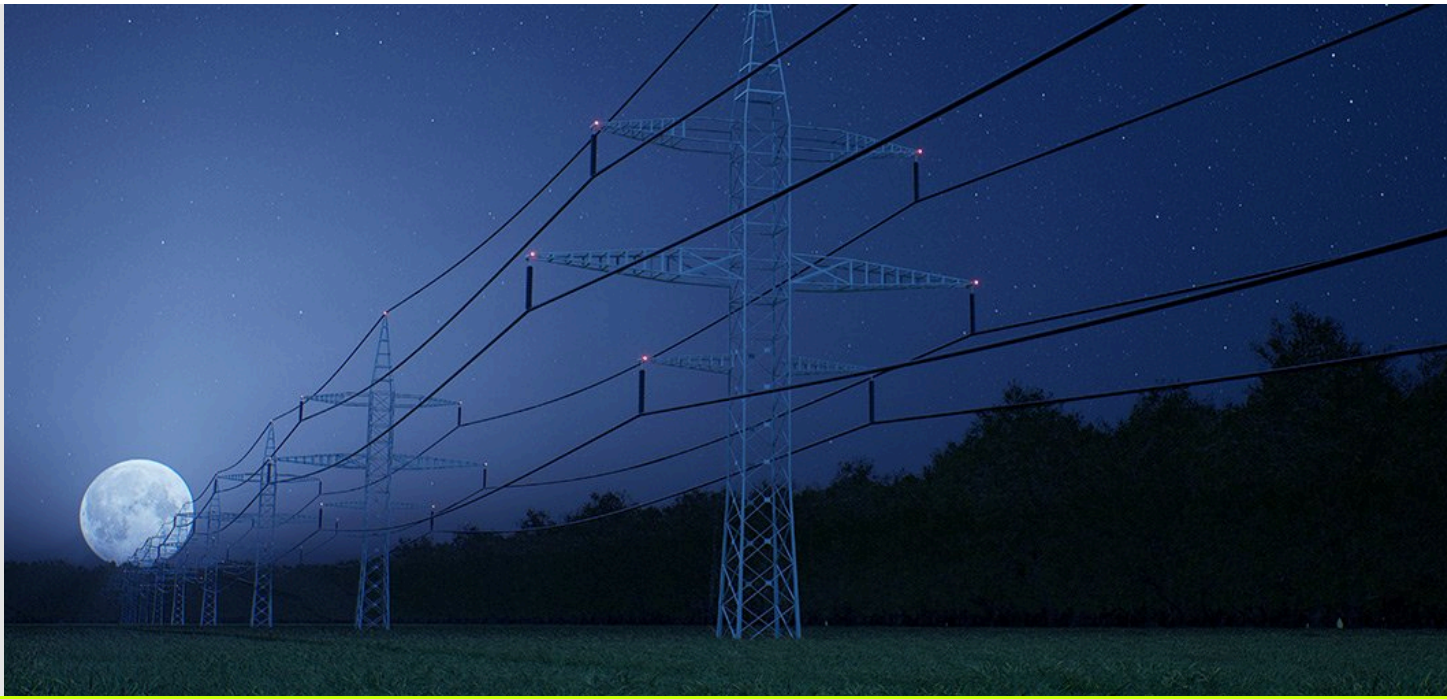
We can help you make strategic planning decisions in today's often uncertain world.

Interconnected power systems

The Consulting Services team has comprehensive, global experience in power system studies and in-depth experience analyzing all aspects of power plant and transmission system dynamic controls for successful grid integration of technology.

Focus areas include:

- Grid modernization
- Reactive power adequacy
- Distributed generation
- Distribution automation and smart grid analysis
- T&D long-range planning



We can help you plan, design, and operate interconnected power systems.

Meeting net-zero greenhouse gas emissions

Our assessments inform customer strategy and roadmaps to unlock opportunities to reduce and remove greenhouse gas (GHG) and CO_2 emissions, building the foundation for future energy systems.

With Consulting Services, you can:

- Assess your current GHG emissions through tailored analytics
- Track and understand your CO_2 impact
- Develop a strategic approach to meet net zero targets

We can provide your team with a better pathway toward net-zero emissions.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CUSTOMER
STORIES

New York's green hydrogen demonstration project

The New York Power Authority (NYPA), the Electric Power Research Institute (EPRI), and GE jointly conducted a hydrogen blending demonstration project at NYPA's Brentwood Power Station. The results? Decreased carbon emissions, continued thermal plant reliability, and perhaps a new key to unlock a cleaner energy future.

Learn more about this project

CO_2↓

14%

reduction in CO_2 emissions, using 35% (by volume) hydrogen cofiring at 47 MW

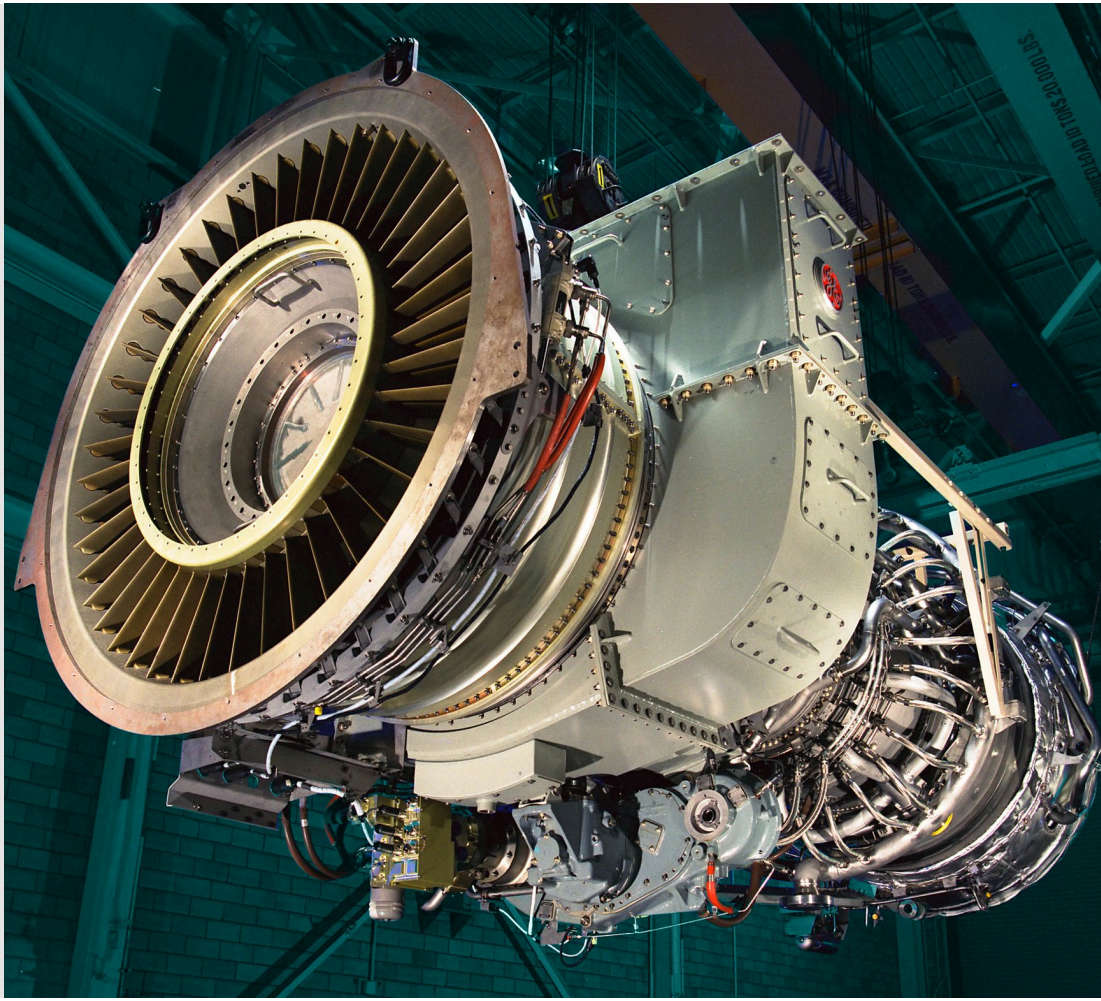
~88%

overall drop in CO_2 emissionsas the hydrogen fuel fraction increased during testing

Integrating hydrogen fuel blends with minimal alteration to plant systems

At 45 MW, the Brentwood plant consists of a GE Vernova LM6000 aeroderivative gas turbine, equipped with single annular combustion (SAC) technology which uses water injection and a SCR for NOx control. While NYPA and many power companies use hydrogen for cooling, firing blends of 5% – 44% (by volume) green hydrogen and natural gas helped identify and document the impacts on the LM6000's outlet emissions (specifically CO_2, NOx, CO). Ultimately, the demonstration saw that **carbon emissions decreased as the fraction of hydrogen in the fuel increased.**

But what do these results mean for the modern power industry? **With minor modification**, an LM6000 could operate on blends of H2 and natural gas for some **20% CO_2 emission reduction**. Hydrogen cofiring could allow turbines to operate across a wider load range with fewer CO oxidation catalysts—lowering CapEx, OpEx, and allowing cleaner energy to be produced at lower costs.



Planning the future of Bangladesh's electrical grid

To help avoid future blackouts and better prepare the Bangladesh grid for future growth, Consulting Services recommended code improvements and mitigation strategies to help avoid a future blackout, and worked with the country's grid to simulate, model and plan a more stable grid that can support the additional electricity needs of the future.

Learn more about this project

8%

annual power growth

10 GW

power needed in the country

Helping meet the power demands of a developing nation

Our consulting work included:

- Grid model development and validation
- Simulation and validation of future grid operation
- Stability study
- Islanding study
- Reviewing grid codes
- Reviewing generation and transmission planning

Bringing power to the people in rural Papua New Guinea

Papua New Guinea is aiming to increase access to electricity from 13% to 70% by 2030 through the government's Power to the People initiative. GE Vernova's Consulting Services business has been working with the government to design an electrification plan to bring power to people who need it most, especially in rural parts of the country.

Learn more about this project

13%

current access to electricity

70%

projected electricity access by 2030

Evaluating needs

We focused our work around a “hub and spoke” approach, which involves identifying a hub—such as a city, village or town—to serve as a focal point of electricity generation for spokes (schools, clinics and other community facilities) for the benefit of a larger rural area.

We researched and assessed:

- Amount of electricity needed

- Technologies that could meet the need
  - Solar PV
  - Micro Hydro
  - Gas Engine with integrated LNG infrastructure
  - Diesel Engine

- Microgrid solutions for village centers

Developing countrywide infrastructure in Myanmar

Consulting Services is providing a review of Myanmar's generation, transmission, and distribution planning that includes production simulation, load flow, short-circuit and contingency analysis.

Learn more about this project

$7 million

pledged to help the country through GE Vernova's corporate social responsibility program

The study highlights the need to focus on all fuel types being considered in planning, like gas combined cycle near load centers (Yangon) while reducing dependence on hydro power generation, especially during the dry season.

Sharing best practices in Myanmar

Consulting Services is training Myanmar's engineers how to conduct detailed generation, transmission and distribution planning and analysis. Our experts are working with the country's grid operator and other key stakeholders to model and plan the country's future grid, helping ensure more people can get access to more reliable, affordable and efficient energy.

We're sharing best practices for developing electric power markets as well as the regulations that could govern them with the country's key stakeholders based on our decades of experience consulting around the world.

Developing models for Cambodia's future grid

Cambodia's grid is interconnected with the grids in Vietnam and Laos. Interconnected grids provide support in the event something happens on a neighbor's system. GE Vernova's Consulting Services business was contracted by the grid operator in Cambodia to evaluate what would happen if Cambodia's grid were unexpectedly disconnected from Vietnam's.

Learn more about this project

1.4 GW

installed base of power generation

923 MW

power load in the country

Stabilizing the grid

In addition to developing and validating its grid models, Consulting Services deployed its expertise in Cambodia by training its grid operators on best practices for planning and grid operations, which was learned from working on power systems across the world.

The scope of our work included:

- Develop and validate Cambodia grid models
- Transmission analysis of Cambodian grid network
- Transmission planning software and training
- World-renowned Power Systems & Energy Courses (PSEC)

A new vision for electricity in Nigeria

Supporting an MOU GE signed with the Federal Government of Nigeria, Consulting Services is helping the country understand the risks and opportunities associated with achieving its goal of enhancing its electric power system.

Consulting Services performed a detailed analysis of the country's power supply and demand outlook, along with analyzing any constraints on gas supply that could inhibit the country's ability to meet its objectives.

10%

estimated population living without electricity supplies by 2030, down from 60% in 2015

1,400 MW

natural gas-powered electricity to be added

Learn more about this project

Conducting a full lifecycle risk assessment

Our role in the project:

- Power market analysis: Supply & Demand outlook through 2020
- Gas market: Analyze gas supply constraints
- Transmission analysis: Identify vulnerable points and transmission risks

Project outcomes:

- Nigeria Electric Regulatory Commission (NERC) amended the grid codes to allow unit sizes up to 275 MW.
- Independent Power Producers (IPPs) can consider generators with higher ratings that can offer lower cost per MW because of a smaller footprint.
- Fuel transportation and power transmission evacuation study developed for key plants.

Integrated wind, solar and storage project in India

Working with Shakti Foundation, CEA, POSOCO, and MNRE, Consulting Services developed an assessment to determine whether India's power grid could remain stable and meet load requirements while integrating additional renewable power sources. In their assessment process, Consulting Services developed a production simulation model in MAPS to examine the hourly and annual impact on system operations and economics, evaluated operational issues, and used MARS to assess the reliability of India's grid system and analyze additional generation capacity requirements to meet target LOLE levels.

24/7

affordable power for all residents

175 GW

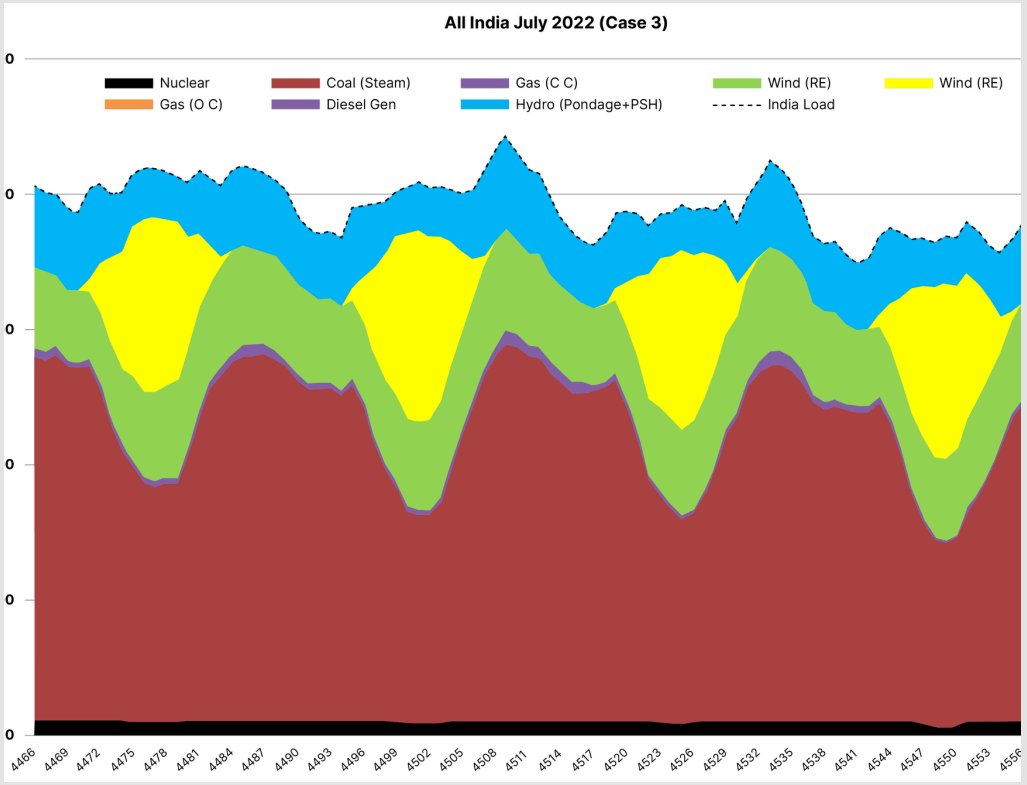
additional renewable power on the grid

Integrated wind, solar and energy storage project, India

Consulting Services explored the following questions:

- Given planned RE (175 GW) and non-RE capacity additions by 2022, will the system succeed in integrating new RE while meeting load (i.e. 24×7 affordable power for all)?
- What are the technical/infrastructure options (e.g. flexible generation, advanced grid operation protocols, expanded control areas, demand-side management, optimized transmission, etc.) for minimizing the cost of integrating RE while meeting load?

Read the full report
for the answers!



India’s blueprint for hybrid grid-scale renewable energy

With India’s ambitious renewable capacity goals, GE Vernova's Consulting Services team was called on to determine the technical and commercial feasibility of an integrated wind, solar and energy storage (IWSES) plant with combined generation capacity of more than 1,200 MW. The Consulting Services team provided a blueprint for developing the financial and technical elements of an IWSES plant that addressed challenges by connecting and siting wind, solar and battery storage in the same place, and laid out the business case to make it economically viable.

175 GW

renewable power goal

>1,200 MW

power generation

Renewables integration project in Canada

In collaboration with the Canadian Renewable Energy Association, Consulting Services developed a study to help Canadian policymakers and planners understand the impact of higher penetration of wind energy—from 5% today to 35% by 2025. Consulting Services needed to determine how to most effectively integrate large amounts of wind within the provinces, so they conducted the first-ever nationwide analysis of wind energy integration. Analysis shows Canada can get more than one-third of its electricity from wind without compromising grid reliability, while reducing greenhouse gas emissions and generating new export opportunities.

From

5% to ~35%

>1/3

of Canada's power can come from wind

Stability study and RTDS testing project in Saudi Arabia

Consulting Services set out to successfully demonstrate PMS functionalities in RTDS to the customer. After developing a network island and stability study for different contingencies and fault scenarios, Consulting Services worked with a local testing lab to test PMS on RTDS, which involved model development/validation, demonstration of PMS performance, and technical support. In the end, Consulting Services developed control philosophy for islanded operation, and developed models, RTDS test cases and acceptance criteria. And a reduced number of test cases (from 150+ to 26) shortened the test schedule and avoiding commercial implications.

675 MW

installed capacity

245 MW

total plant load

Helping balance battery energy storage on the Texas grid for ERCOT

With battery energy storage systems becoming a larger portion of the energy grid, the Electric Reliability Council of Texas (ERCOT) came to GE Vernova's Consulting Services team to help understand how to leverage battery storage without compromising the grid.

GE Vernova's Consulting Services team conducted a study that provided ERCOT with recommendations for future resource qualification, procurement structure, and operational practices.

37 GW

wind energy managed by ERCOT

125 GW

batteries that need interconnection to the grid

Global cooperation to grow renewables in Asia

Based on the findings of Consulting Services ASEAN Interconnection Masterplan Study, ASEAN countries will be able to set out the transmission infrastructure needed and required investment to support multilateral power trade in ASEAN and renewable energy integration into the ASEAN Power Grid throughout Southeast Asia region.

38%

renewable energy in the region in 2021

44%

goal for hydro, solar, wind and other renewables by 2025

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Thank you for reading

CONSULTING SERVICES ASSESSMENTS