Sustainability & Profitability

How Digital Solutions Can Help Power Generators and
Oil & Gas Producers to Find Balance in the Energy Transition

Decarbonization Requires Balance

Tackling climate change doesn't mean choosing between the environment and the economy, legacy systems and emerging tech, the old way of doing things and new innovations. It's always a question of balance.

And, at the pace and scale required, this balanced energy transition is no simple matter. Success will take innovation, collaboration, and cooperation at an unprecedented level. It will require physical changes in how we generate, transport, and consume energy. It will call for capital and bold investments in nascent energy sources and assets. It will affect how we think about land use and the importance of energy density. It will change how companies and competitors work together to achieve progress.

And the energy transition is not just limited to power or oil & gas companies. Mining must consider its environmental footprint while extracting precious metals like lithium, essential to decarbonization technologies like battery storage. But as the world goes electric to speed up decarbonization, global demand for power will only grow. And net-zero targets aren't fixed. The gap to close continues to widen. While these physical changes will take decades, the need to embrace digital transformation is already here. Today, digital technologies play a vital role in improving the productivity and reliability of energy production. Tomorrow, they will tie disparate workflows and systems together to connect supply chains, assets, emissions, and operations - and fuel a successful energy transition.

GE Digital is helping customers to simplify and accelerate the journey. Digital innovation relies on a deep understanding of how physical assets are built, operate and potentially fail (e.g. physics-based knowledge). And any effort to digitalize the energy system must start there. As a 129-year-old technology company, no other organization in the world can match GE's understanding of complex energy technologies and how they operate in the real world. That physical world knowledge is the foundation on which GE Digital creates digital technologies that can help energy companies to:

- Unlock balanced energy and business models
- Better manage asset risks and carbon emissions
- Drive new levels of operational efficiency
- Generate significant new revenue streams

We have a proven track record in the energy sector and we're already helping some of the most forward-leaning customers on the planet make responsible and profitable energy transition a reality. But there's an enormous opportunity to do more for decarbonization efforts – and do it faster by enabling the seamless scaling of digital initiatives from single sites to whole enterprises. I'm hopeful for our future and hugely grateful that we get to play such an important part in building a better one.

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> *As a 129-year-old technology company, no other organization in the world can match GE's understanding of how to get the best from legacy energy technologies with emerging digital solutions.*
> **"**

Linda Rae General Manager,
Power Generation and Oil & Gas, GE Digital
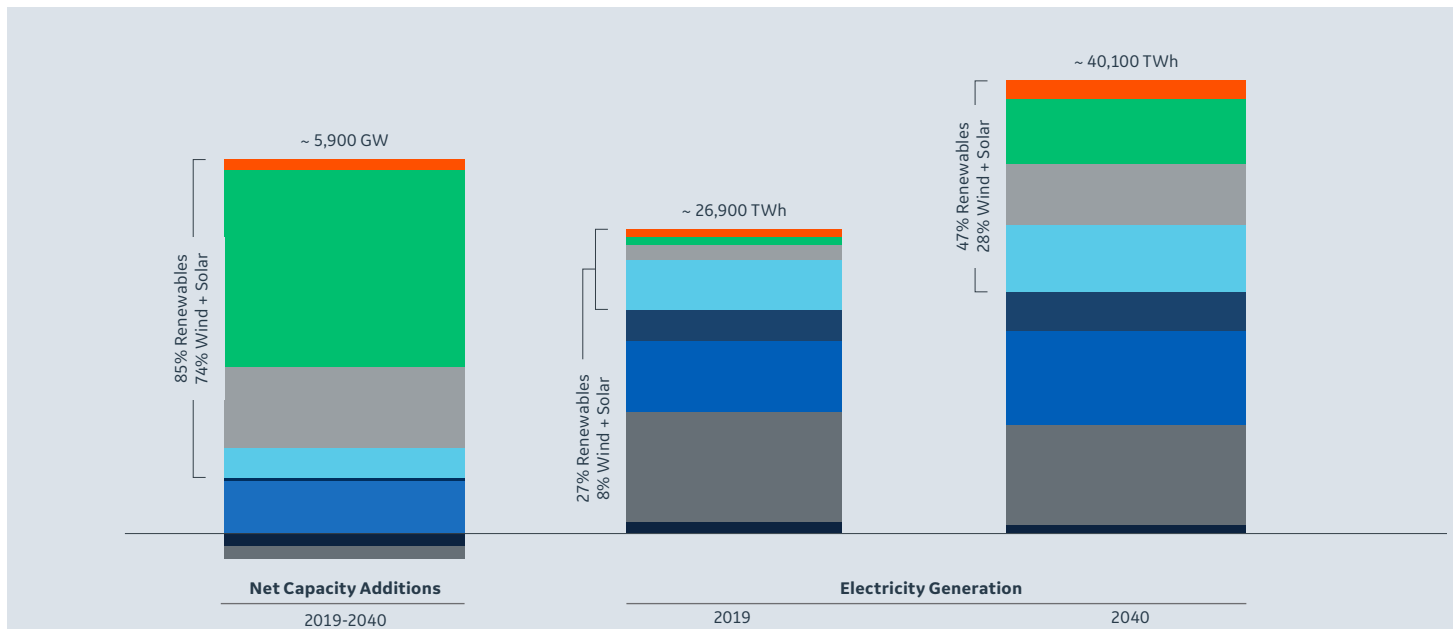
The Balance of Power

Investment in renewables like wind and solar will continue to grow exponentially over the next decade.

Given their status as more economical sources of power generation, wind and solar are expected to account for nearly 74% of global net capacity additions between now and 2040. Gas power will play a vital but changing role – providing flexible, dispatchable, affordable and reliable power with a lower carbon footprint than coal.

Nuclear will remain a key source of zero-carbon generation with small, modular reactors expected to reduce operating costs. And storage and hybrid solutions will emerge to enable baseload dispatchability of renewables. Decarbonization of the energy sector demands a holistic approach – one that takes the entire system into account. That includes the generating assets, the grid, and loads coming onto the grid, all efficiently integrated in order to optimize electricity generation and minimize carbon emissions. This is what makes the use of digital technologies so mission critical.

System operators will need to integrate and optimize dispatch of all assets (after factoring in wind and solar resources) in real time or even days ahead. And they'll need to do it while considering the actual cost of each generation source, including maintenance. It's a big ask. So how do power generation companies make it all happen? Digital software is ideally positioned to enable the transition to a system built on emerging, distributed, digitally enhanced and decarbonized technologies

~ 5,900 GW

85% Renewables
74% Wind + Solar

Net Capacity Additions

2019-2040

~ 26,900 TWh

27% Renewables
8% Wind + Solar

~ 40,100 TWh

47% Renewables
28% Wind + Solar

Electricity Generation

2019

2040

Oil · Coal · Gas · Nuclear · Hydro · Wind · Solar · Other

Capacity Additions Forecast and Resulting Generation Evolution

Net capacity additions and resulting change in electricity generation 2019 to 2040… despite aggressive renewables net additions, they are insufficient to result in a meaningful global coal generation by 2040.

Source: IEA World Energy Outlook 2020 Stated Policies Scenario

Agility & Optimization

Gone are the days when power generators could plan for predictable demand.

To stay competitive and profitable, today's power generators must have the agility to ramp up and down at short notice in order to meet ever-changing needs – while being just as ready to take advantage of low-carbon renewable sources when available. Generators must also be on constant lookout for ways to squeeze every ounce of optimization from their fleet.

With GE Digital's Operations Performance Management (OPM) software, Competitive Power Ventures (CPV) increased peak fire use by 10x – without impacting its maintenance interval. They've also improved the accuracy of day-ahead capacity predictions by 2%, replacing time-consuming, manual Excel processes and enabling CPV to compile comprehensive weather and plant status to predict output levels. This allows for increased accuracy while reducing the hours spent on manual calculations and the potential for errors.

How? OPM's use of Digital Twin technology is what gives teams the ability to predict day-ahead and intraday plant capacity, making the most profitable use of that capacity through commitment preparation, fuel nomination and dispatch planning.

Read the full story

Volatility & Risk

Simply put, greater variable demand means more volatility and more risk to generators.

Systems designed for a consistent baseload operation are now being asked to flex continually, putting added strain and wear on assets, and increasing the potential for unplanned downtime.

Supported by GE Digital's Asset Performance Management (APM) software, global power producer, Enel, has been using predictive analytics to address asset issues proactively to ensure safe and reliable fleet operations.

They recorded just 45 issues over the past 27 months, resulting in 750 GWh of avoided downtime and savings of $3.6M USD.

Read the full story

Beyond Power Generation

In 2019, coal and gas power generation accounted for 60% of total energy production.

That number is expected to fall to 43% by 2040, which would represent a significant reduction in the carbon emissions resulting from power generation directly. However, the impact will extend upstream to oil & gas and mining & metals supply chains – where the demand for natural resources needed to power vital assets will be similarly reduced.

Oil & Gas

Lower commodity prices and higher carbon prices are having a profound impact on oil & gas producers.

And while there are a range of multi-faceted strategies for producers to consider as they work to make their portfolios more resilient, a range of no-regret technologies are ready to help companies decarbonize their operations and supply chain right now.

Companies are already adopting digital solutions that can substantially cut fugitive emissions of CO_2 and methane (CH_4) – both powerful greenhouse gases. Use of APM software, for example, improves maintenance routines to reduce intermittent flaring and improve leak detection and repair (LDAR) to reduce methane leaks.

These changes alone have the potential to curb 62% of all emissions across upstream, midstream and downstream operations.*

Oil & gas giant Total hasn't recorded a single unanticipated failure of critical production assets since 2013, when they implemented GE Digital's predictive analytics technologies – with 30,000 sensors monitoring 260 shaft lines and 540 assets.

Read the full story

* Beck, C., Rashidbeigi, S., Roelofsen, O., Speelman, E. (2020) "The future is now: How oil and gas companies can decarbonize." McKinsey & Company.

Mining & Metals

The mining and metals industry will play a pivotal role in supplying key materials for decarbonization technologies.

This includes lithium, cobalt and nickel for battery storage and EV batteries. Likewise, nascent carbon capture and fuel cell technologies require platinum and other rare metals. Many large mining companies have already begun to rebalance their portfolios to capitalize on changing needs associated with the energy transition.

Like oil and gas, mining and metals is an asset-intensive industry.

And in an operational context, digital transformation has the potential to improve efficiency, cut cost per ton expenses and reduce emissions. GE Digital's APM software is used on more than two million assets for one major miner alone.
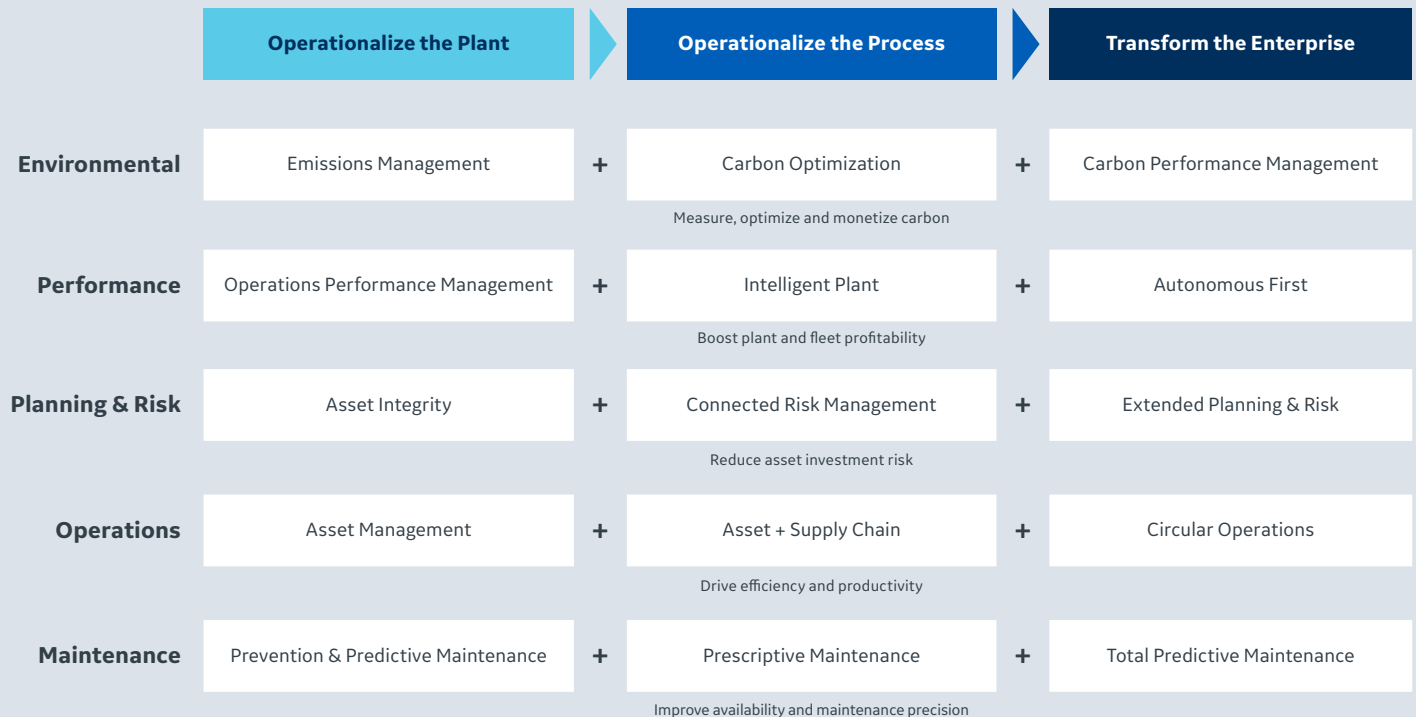
Finding the Harmony of Balance

Decarbonization is no small task. Those leading the transformation journey must be able to create (and demonstrate) clear and compelling enterprise value throughout.

To do that, leaders should look beyond single-point digital solutions to integrated workflows and systems that can unlock new operational value streams.

And as companies adopt these new energy technologies, they'll need to move from the disparate recording and management of emissions data to an approach that can be easily optimized and monetized.

That could mean anything from actively managing the dispatch of a singular asset and autonomously orchestrating a fleet of multi-generation assets to understanding asset risk and criticality and enabling circular operations. Simply put, enabling a successful energy transition will require a step change in the way that software, workflows and systems work together to manage increasing complexity and volatility.

Digital Maturity Model for the Energy Transition

	Operationalize the Plant		Operationalize the Process		Transform the Enterprise
Environmental	Emissions Management	+	Carbon Optimization	+	Carbon Performance Management
			Measure, optimize and monetize carbon		
Performance	Operations Performance Management	+	Intelligent Plant	+	Autonomous First
			Boost plant and fleet profitability		
Planning & Risk	Asset Integrity	+	Connected Risk Management	+	Extended Planning & Risk
			Reduce asset investment risk		
Operations	Asset Management	+	Asset + Supply Chain	+	Circular Operations
			Drive efficiency and productivity		
Maintenance	Prevention & Predictive Maintenance	+	Prescriptive Maintenance	+	Total Predictive Maintenance
			Improve availability and maintenance precision		

Digitalize to Decarbonize – A Maturity Model for the Energy Transition

GE Digital brings transparency to end-to-end operations – helping companies to optimize asset performance and improve process efficiency.

These individual transformations demand consistent data-led input from maintenance, operations, planning and risk, performance, and environmental arenas. This makes AI, data analytics and a wider digital transformation as important to building a sustainable future as the

deployment of wind and solar, nuclear power and lower-carbon natural gas turbines.

They can also be powerful tools for those exploring green hydrogen, carbon capture, use and sequestration (CCUS). And for hard-to-abate sectors like heavy industry, petrochemicals and manufacturing, AI and digitalization can help to increase efficiencies, reduce costs, lower emissions, manage volatility and other risks, and improve product quality.

Energy software accelerating the transition to a lower carbon future today	**Ensure availability** APM HEALTH & RELIABILITY *Day or night, whenever needed*	**Expand operating limits** OPM – PERFORMANCE OPTIMIZATION *To enhance dispatch position*
Reduce asset risk investment APM STRATEGY *For optimal use of capital*	**Maximise margins, manage risk** OPM – PRODUCTION PLANNING *With capacity predictions and decision support*	**Empower the workforce** OPERATOR ROUNDS *For team efficiency and improved asset reliability*
Enable the autonomous plant REMOTE OPERATIONS & COMMAND CENTER *For operational reliability*	**Achieve operating targets** OPM – PERFORMANCE INTELLIGENCE *With an integrated, single source of truth data*	**Energy transition is demanding agility from power generators – software will play a critical role**

Simplifying Complexity

The carbon market offers a great example of AI and digital's potential.

For industrial companies that need to measure, monitor and control their carbon emissions, digital solutions can be used to collect and analyze data at the level of the asset, plant or enterprise – giving visibility to Scope 1, Scope 2 and even Scope 3 emissions. The software can then recommend operating parameters to lower emissions and help meet targets – and further down the line, identify opportunities for further emission reductions.

As mentioned previously, AI and digital solutions can support performance improvements in complex emerging technologies like green hydrogen and CCUS, helping to lower emissions in energy-intensive sectors (e.g. aluminum smelting and steel manufacturing) and significantly reduce emissions altogether from gas-fired power plants.

At every step along the carbon capture infrastructure and value chain – processing, transportation and sequestration – digital transformation can optimize operations. The production of hydrogen is similarly complex, with an interconnected transportation, storage and distribution chain that stands to benefit greatly from digital solutions helping to streamline processes, unlock new efficiencies and reduce costs.

The electrical grid is set to become another major beneficiary of AI and digitalization. With the demand for variable renewable power and distributed energy generation growing steadily – alongside the increased electrification of transportation, manufacturing and other sectors – tomorrow's grid will need to be smart, agile and even more robust to ensure stability and security for the world's energy-dependent populations. Transmission and distribution teams that build greater control, awareness and insight capabilities into their networks will make it possible to achieve higher levels of reliability, availability and resilience. As a result, they'll enjoy an increased competitive advantage throughout the energy transition.

Breaking Down Siloes

Digital solutions are built to serve visibility.

Digital transformation also can drive operational improvements and efficiencies by eliminating the data, system and workflow siloes that hide an enterprise's untapped value. For example, inventory management and asset management are often viewed separately.

But when these systems are connected through a plant or enterprise platform, operators can see real-time asset health and maintenance requirements and make better decisions regarding inventory and reduce the operational risks that come with parts repair and replacement needing long lead times.

And when companies connect environmental, health and safety (EHS) workflows with emissions management and general operations, plant managers can use the data to reduce emissions or make other beneficial changes, in areas like design and engineering.

With AI, digitalization and data analytics technologies working toward the same goal, energy companies will be in a strong position to build their own greener, more sustainable future – while delivering broader economic benefits and setting an example for others looking to transform their own operations.

A Balanced Conclusion

Based on our long-held position as power industry leaders, GE believes early digital energy adoption needs to be encouraged as a decarbonization accelerator.

As with all technological innovation, many stakeholders initially resist adoption because of the perceived risks involved, up-front costs and uncertainty around positive outcomes.

Given the tremendous economic and environmental benefits of energy digitalization, industrial leaders should embrace digital at enterprise scale now to begin achieving no-regret wins in their journey through the energy transition.

GE Digital is proud to be the leader in this space.

Steve Deskevich
VP of Digital Product Management
Power Generation and Oil & Gas
GE Digital

Steve has over 37 years' experience in the industrial sector, including 28 years at a major utility in the US, several years as a software product management leader and five years within GE Digital. He has served in roles spanning reliability engineering, technology strategy development/execution and technology product management in asset, operations and reliability management.

Tracy Swartzendruber
VP of Marketing
Power Generation and Oil & Gas
GE Digital

Tracy has more than 20 years' experience bringing high-value products & services to market within a multitude of B2B verticals – using both traditional and digital marketing strategies. She's passionate about connecting industry with solutions that benefit the bottom line and support a healthier planet. She holds a journalism degree and MBA from Western Michigan University.

Scott Browne
VP of Strategy & Operations
Power Generation and Oil & Gas
GE Digital

Scott is responsible for GE Digital's strategic planning, alliances, business development and innovation – and currently leading the business's strategic and financial transformation. In his previous leadership roles for ENGIE and NRG Energy, Scott's focus has been on the development and launch of new energy solutions and platforms for driving growth. He is a graduate of Georgia Tech and Carnegie Mellon University.