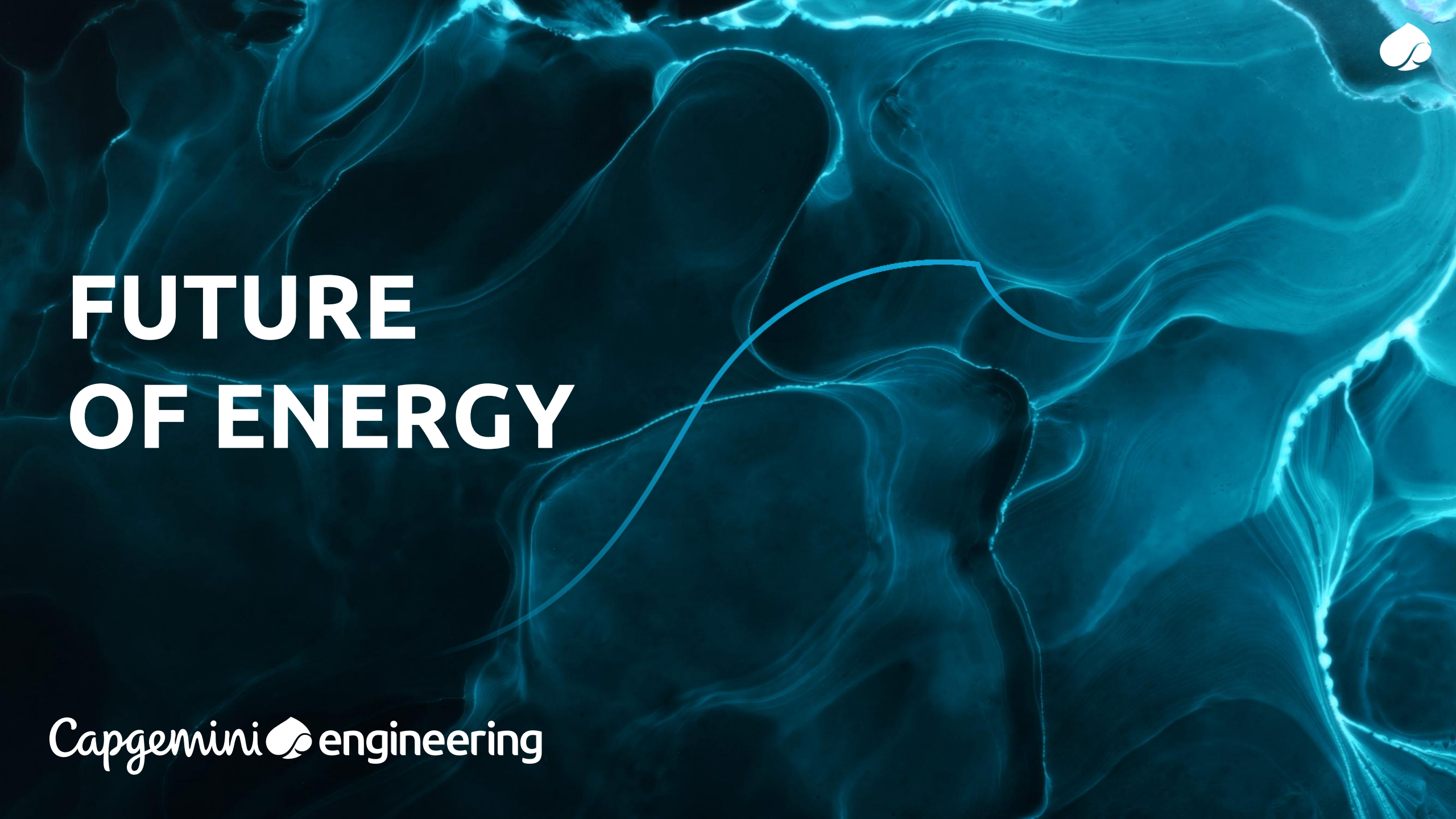

FUTURE
OF ENERGY
Capgemini engineering

Why the Future of Energy Matters?

Current growth of sustainable electricity is far below what's needed	The share of renewables in the global energy supply should increase from 12% in 2023 to 33% by 2050. Electricity is becoming the strategic energy source for domestic applications, mobility and for data centers, whereby consumptions doubles every 4 years.
Energy sovereignty has become an objective	The current geopolitical context has led countries to implement energy sovereignty measures. Nuclear revival (22 countries want to triple their nuclear production by2050), SMR and AMR markets are gaining prominence.
Storage serves as a key tool for renewable integration and grid stability	Scaling storage capacities in the new power ecosystem is essential for managing the intermittent nature of renewable energy sources like solar and wind. It ensures that excess energy can be stored and used when production is low, stabilizing the power supply and reducing reliance on fossil fuels. Additionally, scalable storage supports the integration of distributed energy resources, enhancing grid resilience and facilitating a sustainable energy transition.
Grid needs modernization to cope with new demand & supply	Modernizing the electric grid is crucial to handle the increasing demand and decentralized generation, such as renewable energy. A more flexible and resilient grid can better integrate intermittent power supplies, manage peak loads from electric vehicles and smart appliances, and quickly recover from outages. Additionally, it can help mitigate negative prices, which occur when supply exceeds demand, by balancing and distributing energy resources more effectively.

Challenges faced by the Energy sector

Accessible Infrastructure not agile enough to face fluctuating markets ity

It has to become reactive, with stationary storage, and proactive, with intelligent exploitation of large amounts of data - smart grid is key.

Otherwise, the electricity market will remain “spot oriented” to respond real time on network balance and limited to “peak shaving” and “dispatching” measures to prevent grid congestion.

Digital revolution not fast enough

Digital technologies impact every step of the electricity value chain.

As prediction and risk assessment tools, they enable scalability and affordability. OT/ IT support and increase control, monitoring and KPIs.

But data center and artificial intelligence are sources of demand growth and cyber attack becomes high risk

Nuclear to become undoubtly sustainable

All equipment in the electricity value chain must be sustainable, whilst its LCOE must decrease.

As part of this sustainable nuclear is possible, but 4th generation technology needs to innovate in three domains:

- Alternate fuels (Thorium, …)
- Cooling (liquid metals, …)
- Size (SMRs)

Clean hydrogen still not available and affordable

Emergence of clean hydrogen economy is happening, slower than planned, due to TCO issues for customers and challenges for investors considering the size of investments and market remaining uncertain.

Clean hydrogen has to be prioritized for “hard to abate “ sectors (steel, chemistry, .. and long-range mobility).

“White” hydrogen is trendy (Jeff Bezos, Bill Gates, ..).

Our statement: “Researching with Clients and Partners innovative and disruptive solutions to the energy transition journey, ensuring the highest standards of safety, affordability and sustainability by applying our engineering capabilities and know-how. ”

Our Convictions

Softwarization of energy to support insight driven operations for utilities

Using data and AI to predict demand and manage assets in a fast-changing world: intelligent energy distribution management, asset and infrastructure management require facing specific data challenges (techno, regulation, cultural…). Decentralized software platforms to manage future distributed energy grids: increasing number and type of assets, enabling new type of services (e.g., mobility) and increasing number of stakeholders in addition to regulators, operators and sometimes asset owners.

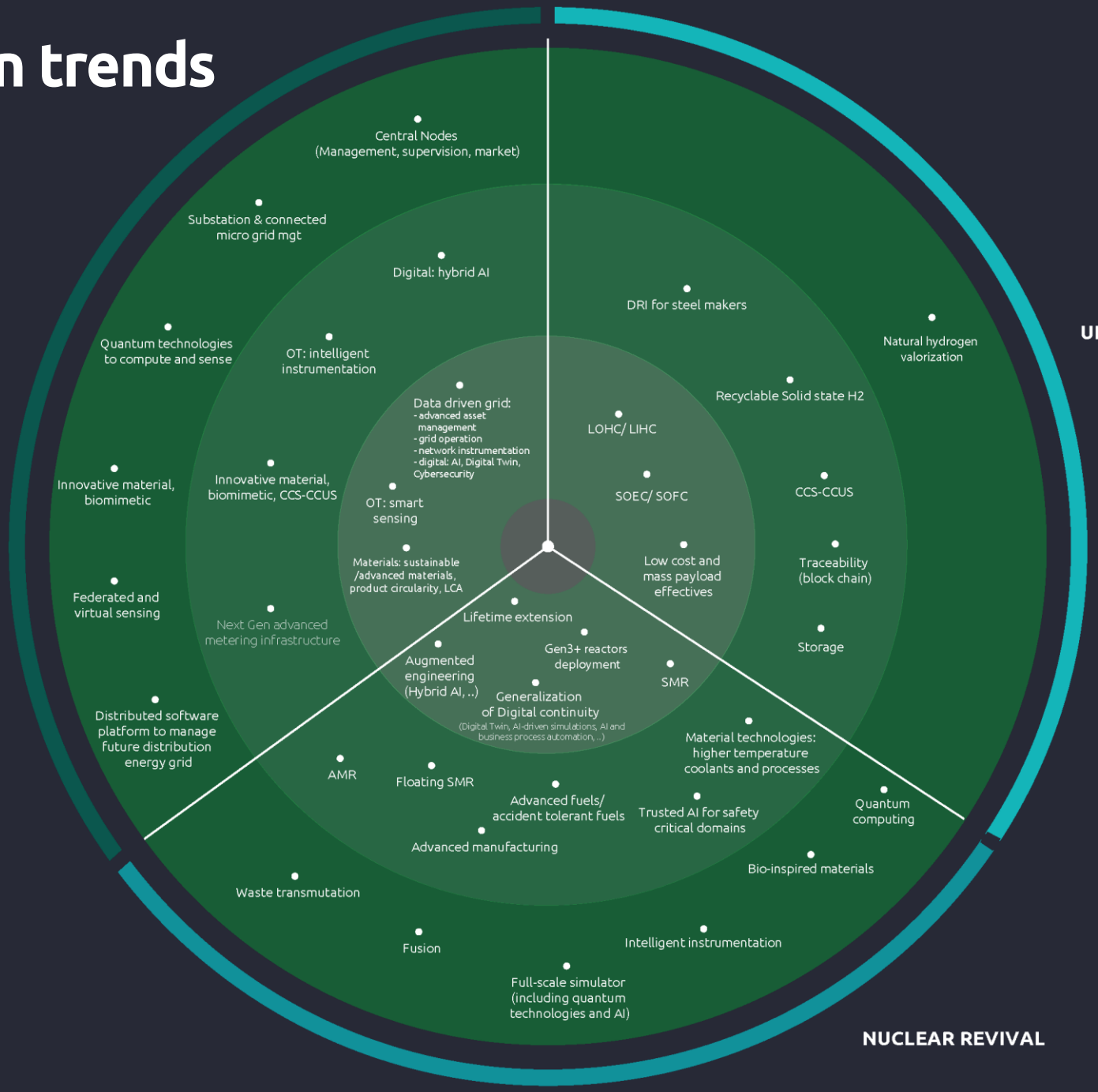
Unlocking the hydrogen age

To tackle engineering challenges in the hydrogen value chain, and assess, maintain, and maximize efficiency, clean green hydrogen will need significant infrastructure investment, including Intelligent Industry-friendly digital infrastructure and advanced digital engineering.

Nuclear revival

The vanguard of new nuclear power transformation will be new Small Modular Reactors (SMRs). Based on proven reactor designs, their small scale, modular construction, and high-power density makes them ideal for broad scale deployment for a variety of use cases, applications, and industries.

Summary of main trends



H1 Scaling

H2 Innovation

H3 Research

R&I projects

Softwarization

TREE

How to design and optimize a complex multi-scale energy system?

FLEX4FACT

Cluster flexibility platform for sustainable factories to reduce Co^2 emissions and enable energy transition

- Optimization of capital projects of new transmission lines of the grid
- AI Energy Chrono (AI-EC)

Admirable

Artificial intelligence supported digital twins for ageing modeling to optimize operational management

TOpWind

Active flow control for an optimized wind harvest on wind turbines

Hydrogen

EEE

Integration of hydrogen technologies and eco-design tools to reach a zero-pollution industry

Sister

How to design, more reliable, safer and cheaper solutions for hydrogen storage, whatever the production mode and the field of application?

H2 NNOVATION HSU I ALTRAN

PEM fuel cell optimization, market, technologies and LCA assessment

HZwo- DigiTwin

Scalable digital twin for flexible H2 operational management

HyReflexS

Sector coupling: emergency energy supply LCA assessment

Nuclear

Newclear

How to propose innovative solutions for the nuclear industry?

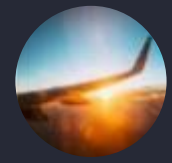
Plant

How can we predict the shutdowns of nuclear power plants due to climate change?

NextMat

How can innovative & sustainable materials replace current materials and overcome various key industrial challenges?

Specific challenges



Cruise

Can we harvest multi-source energies to meet the aeronautical challenges of tomorrow?

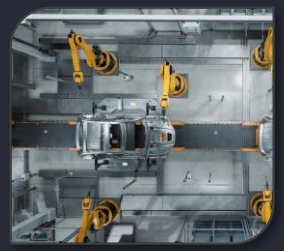
Seanergies

How to design low-carbon energy marine demonstrators at sea?

Our key offers

Software Development and Support	Engineering ADM for Energy & Utilities
AI in Energy	Insight driven operations, digital rejuvenation
Digital Continuity PLM	PLM in Energy, ADM for Digital EPC continuity, Federated data hubs with Open Cascade
Smart Infrastructure	Next gen AMI
Sustainable Energies	Renewables (wind and solar), decarbonized hydrogen well-to-tank, Gigafactories
Optimized Engineering	Nuclear capex excellence, EPC 4.0 , Engineering core context disruption
Intelligent Operations	Smart nuclear factory decommissioning and waste management

The power of partnerships to drive innovation



Industrial partners

- Nuclear Fusion
- Integration of renewable sources into industrial energy systems
- Development of Sustainable and efficient energy systems

Academic partners

- Solid State Hydrogen for Mobility
- Sustainable future of energy supplies in electromobility
- Green Energy Storage solutions

Consortia

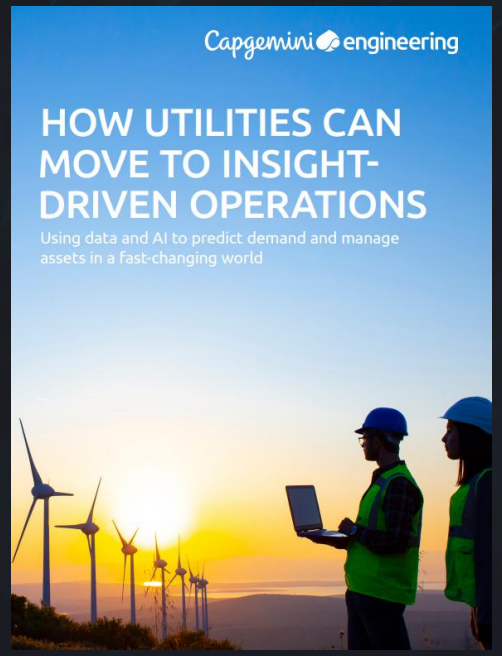
- Developing green energy with an important societal dimension
- Applied research to develop a green hydrogen eco-system

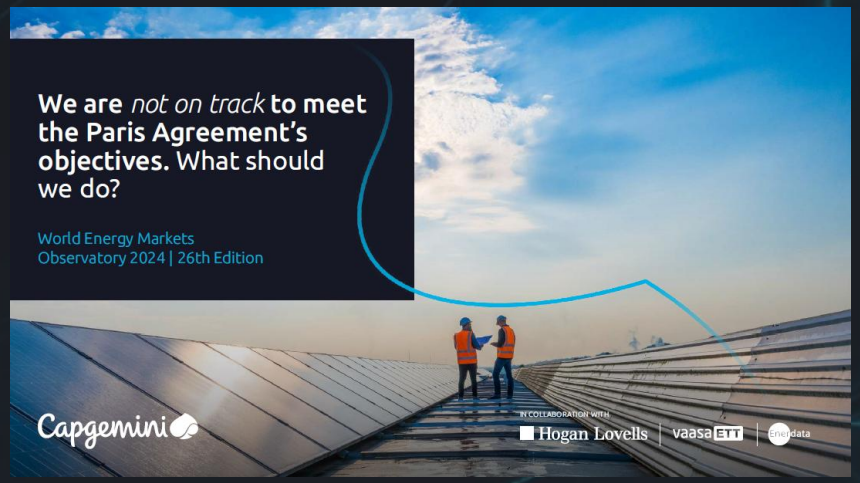
Technology partners

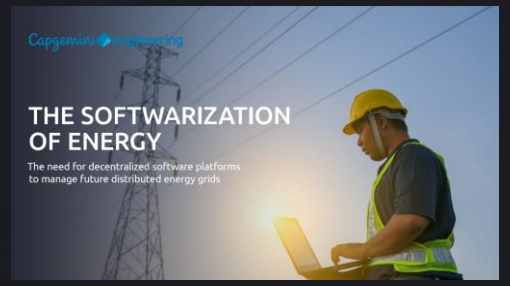
- Smart Nuclear Facility
- PLM in Energy
- AI in Energy

Thoughts

The power of data



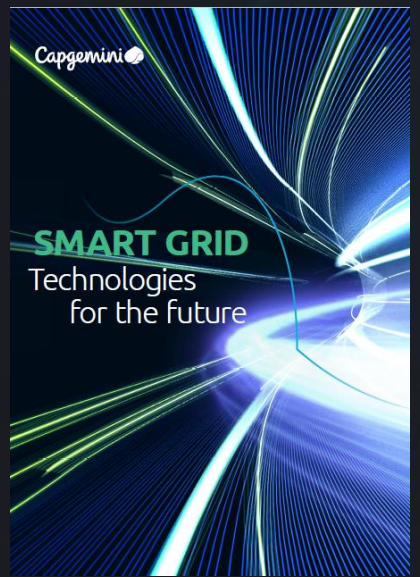




Hydrogen

Nuclear

Infrastructure



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