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R&D and IP Strategy Briefing

Hitachi Energy R&D Strategy

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CTO, Hitachi Energy

Today's Key Messages

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1

Electricity will be the backbone of the entire energy system

- Tomorrow's Power System will be a "System of Systems"
- In the global Power System of 2050, we need four times of today's generation capacity, and we will need to transfer three times as much electrical energy

2

Market leadership enabled by technology and global approach

- Sustainable products and solutions, power electronics and digitalization are fundamental technology areas enabling the Future Power System
- Hitachi Energy is building its global market leadership position on innovation and a total organizational global approach

3

One Hitachi synergies

- One Hitachi can help accelerate the energy transition in Japan and further strengthen Hitachi Energy's global technology and market leadership position for the Energy System of the future

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Hitachi Energy R&D Strategy

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1. Hitachi Energy heritage
2. Energy system 2050: Towards a carbon-neutral energy system
3. Market leadership enabled by technology and global approach
4. Hitachi Energy core technology areas for the Power System evolution
5. One Hitachi synergies

1-1. Hitachi Energy heritage

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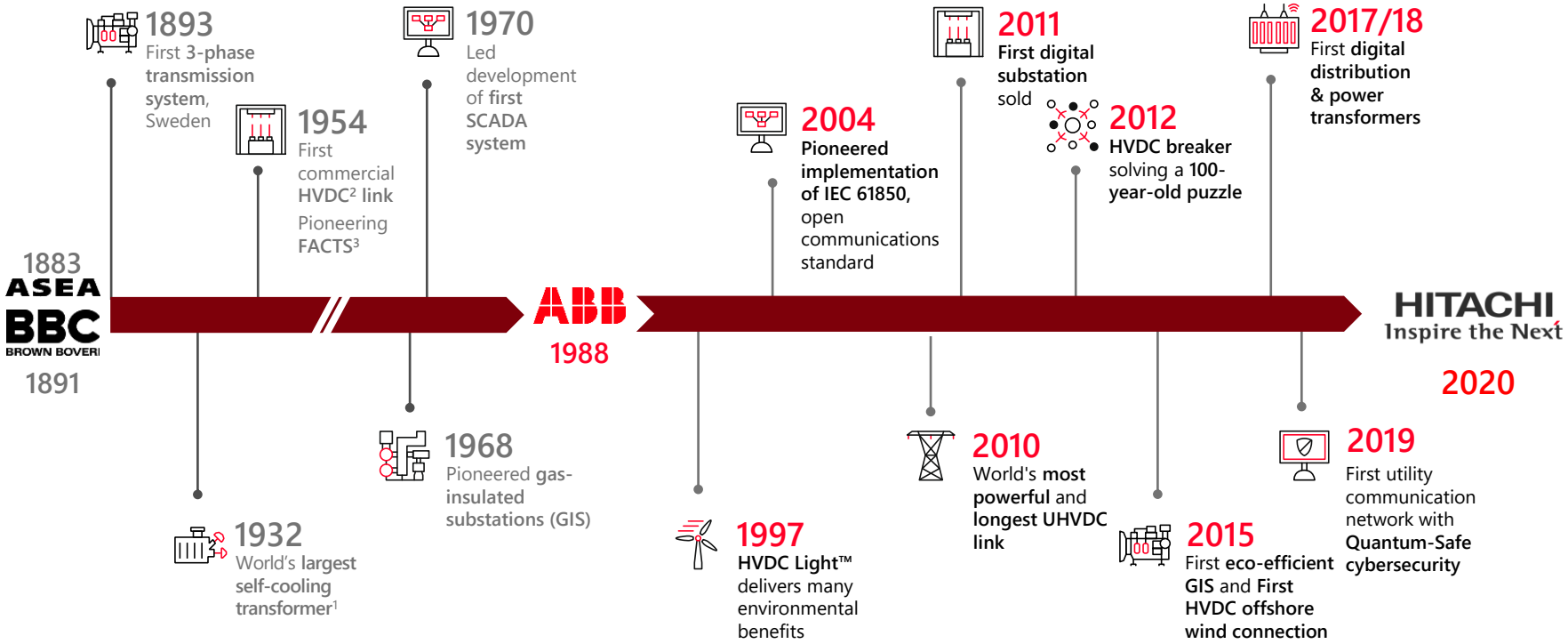

*1 HVDC: High Voltage Direct Current
*2 FACTS: Flex AC Transmission system
*3 UHVDC: Ultrahigh-voltage direct current

1-2-1. Record-breaking HVDC technology from Hitachi Energy

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1 st

First ever large-scale HVDC interconnection in the Middle East and Africa

3.6 GW

Dogger Bank Wind Farm

Connecting the world's largest offshore windfarm to the UK

720 km

North Sea Link

World's longest sub-sea electricity interconnector

1,100 kV

Changji-Guquan

The world's most powerful UHVDC converter transformer

525 kV

NordLink

One of the world's most powerful interconnectors

800 kV

North-East Agra

The world's first multi-terminal UHVDC transmission link

In operation

In final trial, commercially operational

Recently awarded

Customer handover years:
North-East Agra 2017, Changji – Guquan 2019, NordLink 2020,
NSL 2022, Dogger Bank 2023-2025, Saudi Arabia – Egypt 2025/2026

1-2-2. Record-breaking technology from Hitachi Energy

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Sutong Project Transmission Line

Transmission line under the Yangtze river

ewz Oerlikon Substation

Gas-insulated switchgear installation with eco-efficient gas mixture

Oman Electricity Transmission Company

One of the first utility communication networks to be based on Quantum

SIMCOA Operations

Internal power transformer robotic inspection service improving human and environmental safety

Burj Khalifa

Delivering a reliable power supply to the world's tallest building

Topacio, ExxonMobil, Equatorial Guinea

Commercial subsea transformer

2-1. Energy system 2050: Towards a carbon-neutral energy system

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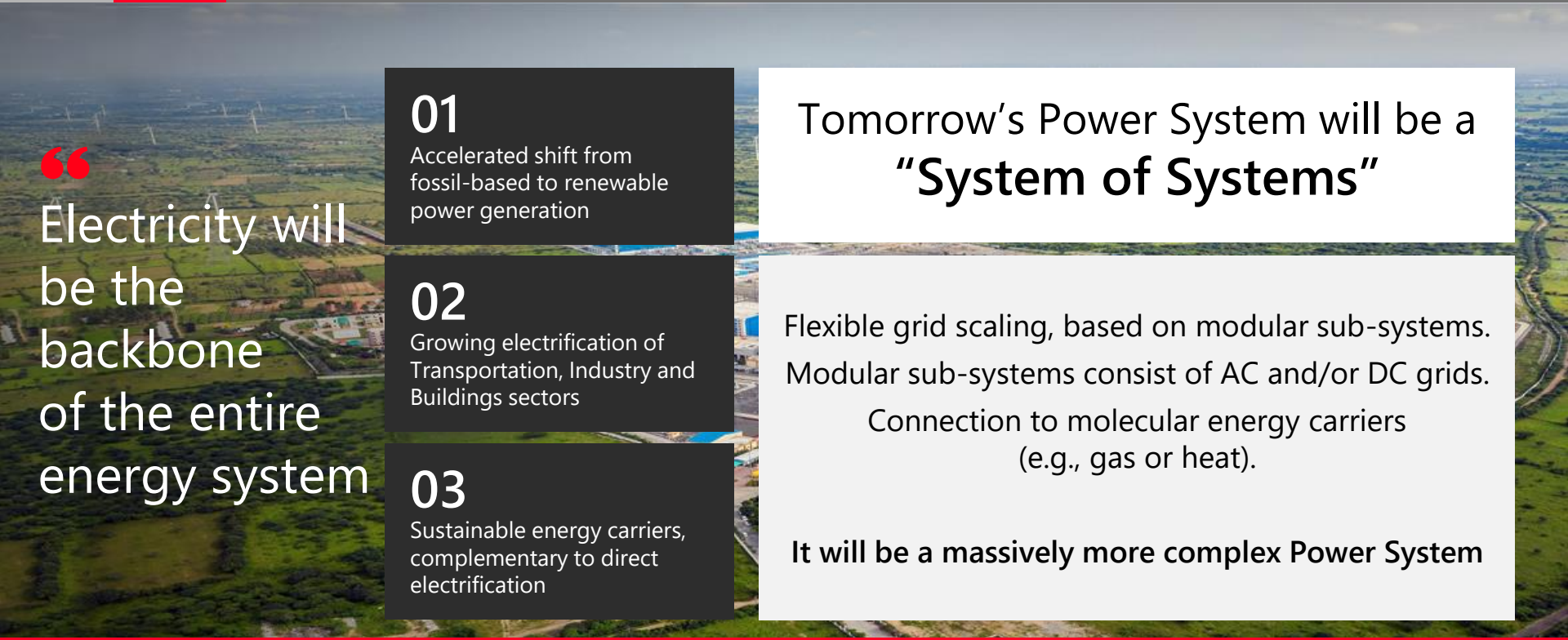

"Electricity will be the backbone of the entire energy system

01
Accelerated shift from fossil-based to renewable power generation

02
Growing electrification of Transportation, Industry and Buildings sectors

03
Sustainable energy carriers, complementary to direct electrification

Tomorrow's Power System will be a
"System of Systems"

Flexible grid scaling, based on modular sub-systems.

Modular sub-systems consist of AC and/or DC grids.

Connection to molecular energy carriers (e.g., gas or heat).

It will be a massively more complex Power System

In the global Power System of 2050, we need four times of today's generation capacity and we will need to transfer three times as much electrical energy

2-2. Energy system 2050: Hitachi Energy growth opportunities

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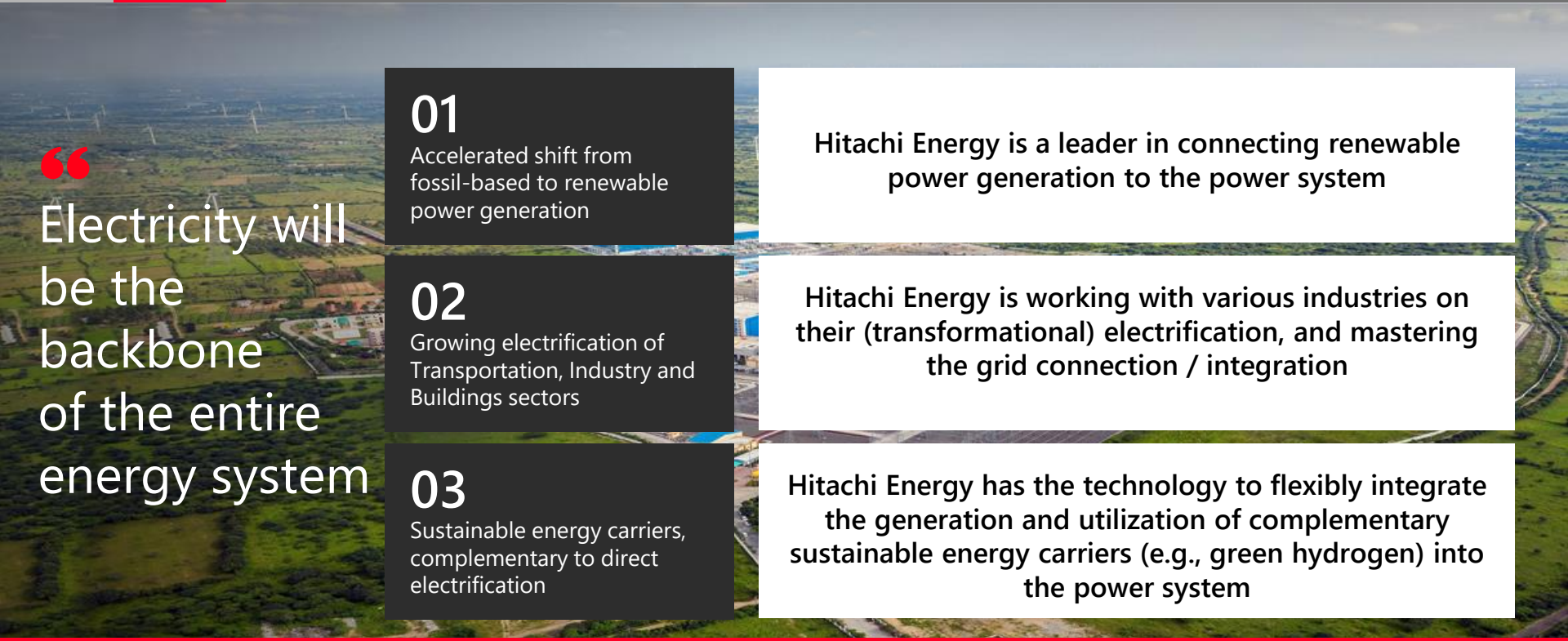

"Electricity will be the backbone of the entire energy system

01
Accelerated shift from fossil-based to renewable power generation

Hitachi Energy is a leader in connecting renewable power generation to the power system

02
Growing electrification of Transportation, Industry and Buildings sectors

Hitachi Energy is working with various industries on their (transformational) electrification, and mastering the grid connection / integration

03
Sustainable energy carriers, complementary to direct electrification

Hitachi Energy has the technology to flexibly integrate the generation and utilization of complementary sustainable energy carriers (e.g., green hydrogen) into the power system

In the global Power System of 2050, we need four times of today's generation capacity and we will need to transfer three times as much electrical energy

3-1. Market leadership enabled by technology and global approach

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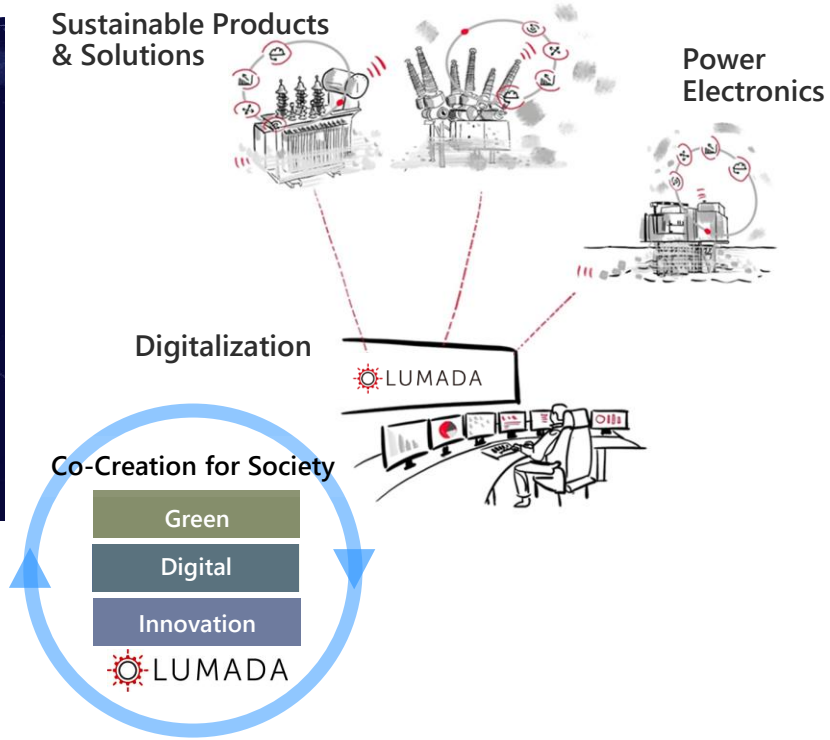
Key aspects of global technology leadership

- **Anticipating future customer needs** – one company technology and portfolio roadmap driven by total organization across all functions
- **Diversity of thought** – balancing a global footprint with strong regional presence close to customers/markets
- World leading developments in **core technology areas**
- **Partnership & collaboration** for complementary cutting-edge technology development
- Strategic protection of **Intellectual Property**

Fundamental technology areas for the Power System evolution



3-2. Global Hitachi Energy R&D organization

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Technology functions

- Technology licensing & controlling
- Market Innovation
- Portfolio management
- R&D processes and quality
- Product security

Product development

- Grid Automation
- Grid Integration
- High Voltage Products
- Transformers

Research

- North America (US & Canada)
- Sweden
- Switzerland & Germany
- Poland
- China

2000+
R&D experts
in 20+ countries

>4%
yearly R&D investment

~200 researchers
in 7 countries

3-3. Global Hitachi Energy Research organization

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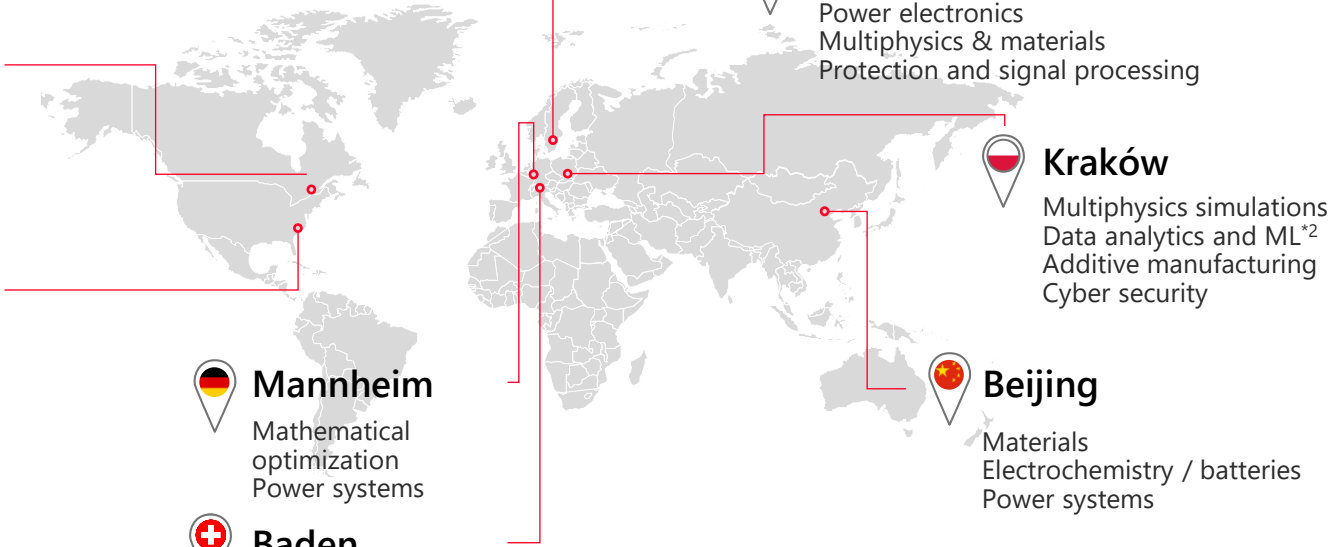
5 Research centers, 7 countries, 200 researchers



Montreal
AI
Cyber security
UX*1

Raleigh
Power systems
Micro grids

Västerås
Power electronics
Multiphysics & materials
Protection and signal processing

Kraków
Multiphysics simulations
Data analytics and ML*2
Additive manufacturing
Cyber security

Mannheim
Mathematical optimization
Power systems

Baden
Circuit breakers
Semiconductor packaging
Reliability
Software, AI, power systems

Beijing
Materials
Electrochemistry / batteries
Power systems

*1 UX: User Experience
*2 ML: Machine Learning

4-1. Core technology areas in Hitachi Energy R&D

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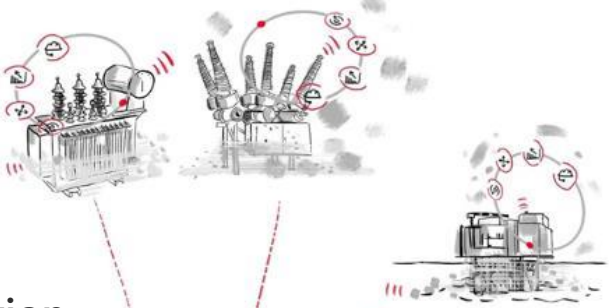
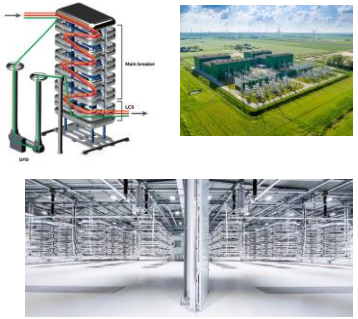
Sustainable Products & Solutions

- High-voltage switchgear and current interruption (e.g., EconiQ 420kV circuit breaker)
- Insulation coordination and thermal design in gaseous, liquid and solid materials (e.g., EconiQ, OceaniQ and dry-type Traction Transformers)
- Power Semiconductors and packaging (e.g., BIGT*1 for HVDC)





Digitalization

- Numerical methods and machine learning
  - Large scale optimization
  - Forecasting
  - Digital twin performance prediction
  - Power system protection and control algorithms
- SW expertise: from embedded to enterprise to IoT to high performance computing
- Mission critical networking – fiber optic and wireless communications
- Energy automation system design – across the whole energy value chain

Power Electronics

- HVDC systems towards meshed HVDC grid with interoperability (e.g., Caithness-Moray-Shetland connection in Europe)
- HVDC breaker (e.g., PROMOTioN project in Europe)
- Grid-forming converter control and converter topologies for high power (e.g., modular-multi-level in Dogger Bank project, UK)
- High availability HVDC and Statcom converter control (continuous development of platform)
- Statcom and energy storage (e.g., Oersted Innovationsfonden demonstrator project, DK)

*1 BIGT: Bi-mode Insulated Gate Transistor *2 PROMOTioN: PROgress on Meshed HVDC Offshore Transmission Networks

4-2-1. Technology leadership examples

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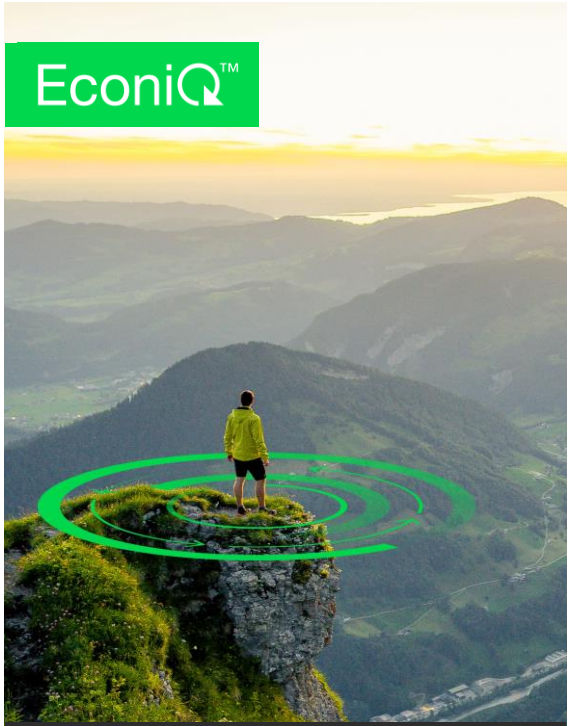


A game-changing technology that eliminates sulfur hexafluoride (SF_6) with reliable and scalable solutions for the lowest carbon footprint

The world's first eco-efficient 420 kV circuit breaker

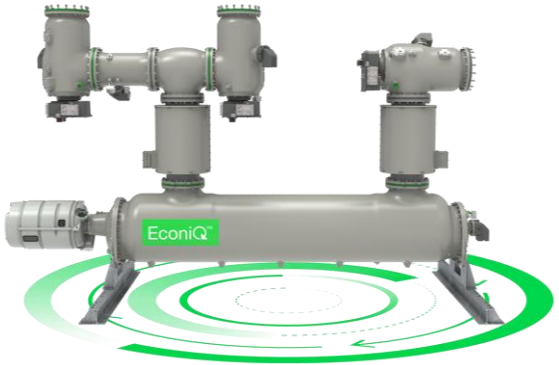
Unlocks the widest range of EconiQ switchgear applications

Breakthrough in the industry for SF_6-free solutions for higher voltage levels

Reliable and scalable technology

Eliminates the carbon footprint of the insulation gas

Accelerates the energy transition toward a carbon-neutral future



4-2-2. Technology leadership examples

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Game-changing floating technologies

Hitachi Energy now has a complete range of transformers and reactors for floating applications

01 Lightweight, resilient designs specifically created for floating offshore applications

02 Compact, reliable solutions that reduce costly maintenance

03 Modular, smart solutions co-developed with leading offshore energy trailblazers

60+ meters
depth or seabed not suitable for bottom-fix

15+ meters
waves with associated vibrations and shocks

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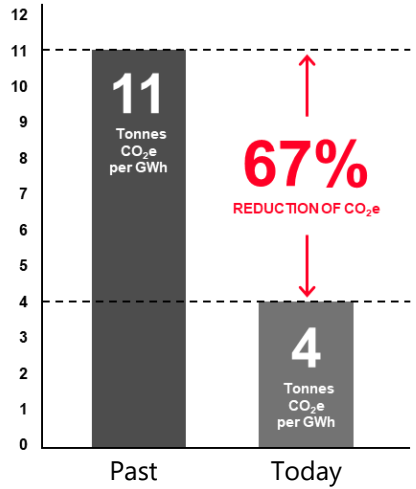
HVDC Light® enabling a carbon-neutral interconnected energy system

Environmental benefits from HVDC Light® connectors

Constantly innovating to reduce power losses, the carbon footprint has been reduced by two thirds in the latest generation HVDC Light® saving millions of tons of CO_2 emissions over lifetime



UK – France IFA 2 HVDC interconnector avoids 1.2 million tons of CO_2/year by connecting UK to low carbon energy sources in France

Dogger Bank HVDC system connects efficiently 3.6 GW of offshore wind power to the UK grid, reducing 200t of CO_2 emissions per GWh

4-2-4. Technology leadership examples

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Lumada Inspection Insights

Video-based insights

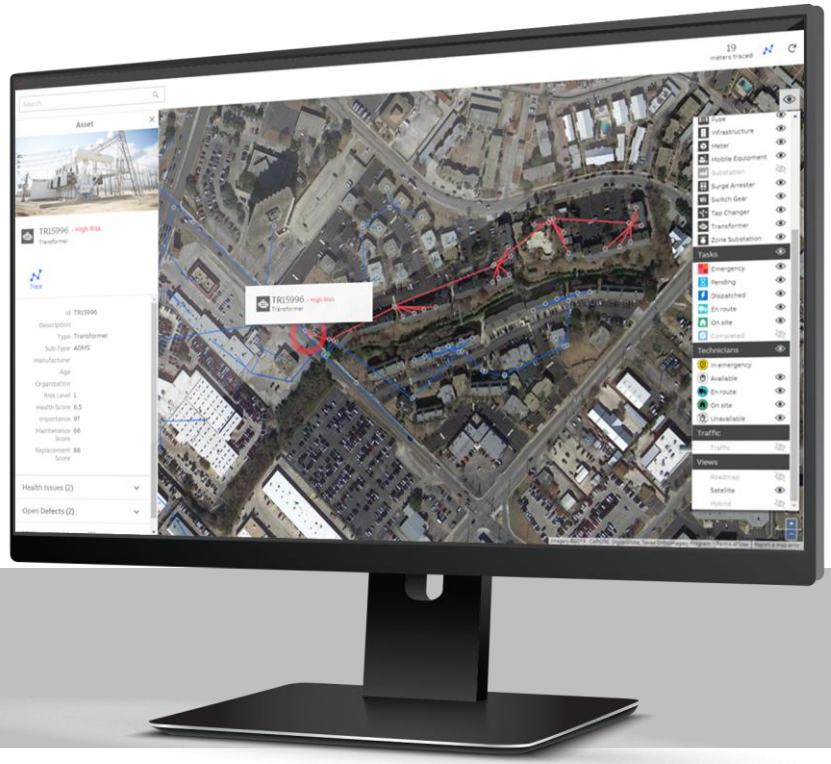
e.g., substation / infrastructure inspections

Image-based insights

e.g., transmission line inspections

Satellite-based insights

e.g., vegetation management



Map enabled actionable insights from images and analytics connected to asset inspections, asset management & control, and field service operations.

5-1. One Hitachi synergies around the Lumada Growth Cycle

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LUMADA FSM
Field Service Management

LUMADA EAM
Enterprise Asset Management

LUMADA APM
Asset Performance Management

Lumada Inspection Insights

Maintain
Prioritize and streamline remediation to reduce impact

Plan
Identify risks & opportunities to operation and environment

Understand the customers' management challenges

Predictive Maintenance

Design Thinking

Operate, maintain and assess for the next step

LUMADA

AI Tools/Methodologies/ Use Cases/Solutions

Develop solutions with IT/OT/products

Remote/Automation

Digital Twin

Implement solutions

Operate
Assess risks to operation and environment

Build
Implementation of predictive analytics (AI, ML) and inspection technologies

Energy Trading and Risk Management Software

Chartis RiskTech Quadrant® Category Leader ETRM systems, 2021

EnergyRisk Software Rankings 2022 Winner — Ranked #1 in 35 categories

Digital Twin

5-2. Implementing the Lumada Growth Model by digitally-enabled Services for System-lifecycle Management

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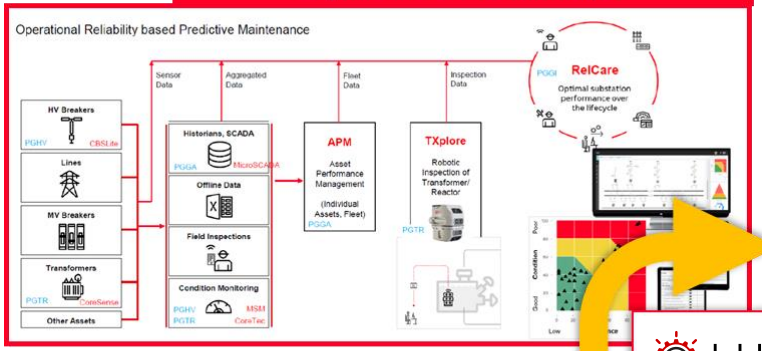
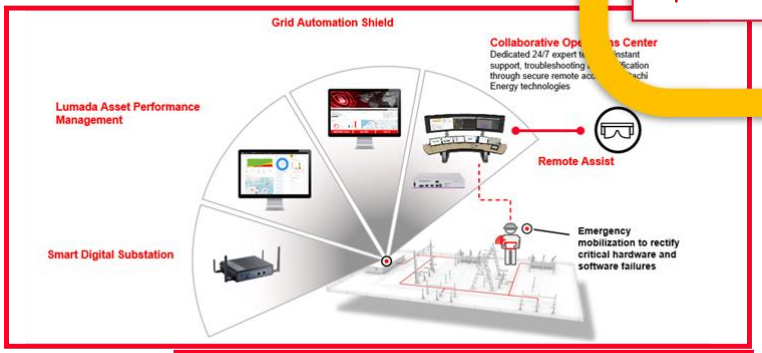
Maintain — e.g. RelCare Partnerships



Plan — e.g. EconiQ Consulting

LUMADA

Operate — e.g. Collaborative Operation Centers



Build — e.g. Twin-based planning

5-3. One Hitachi synergies

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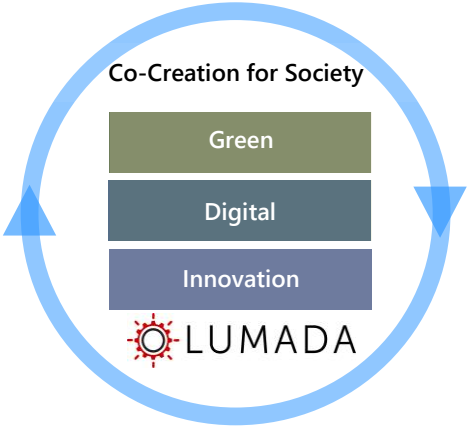
One Hitachi technology and market synergies for even stronger future leadership position

- Combination of Hitachi Energy Lumada EAM, FSM & APM[*1] with AI for image and video processing from Hitachi Digital, leading to **Lumada Inspection Insights**
- Data integration capabilities from Hitachi Vantara for **Lumada APM,** demonstrated and applied to Bengalla mining
- GlobalLogic & Hitachi Energy developing together next generation of Lumada suite of asset & work management solutions
- One Hitachi offering/solution across **(battery) energy storage, advanced distribution management system and energy management** demonstrated at ELES in Slovenia
- World leading HVDC and active power quality solutions supporting the energy transition in Japan, e.g., in Higashi-Shimizu substation project
- Extensive **R&D collaboration across one Hitachi** is creating the foundation for cutting edge future products, systems and services



One Hitachi can help accelerate the energy transition in Japan and further strengthen Hitachi Energy's global technology and market leadership position for the Energy System of the future

*1 EAM: Enterprise Asset Management, FSM: Field Service Management, APM: Asset Performance Management


Hitachi Social Innovation is
POWERING GOOD

Cautionary Statement

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Certain statements found in this document may constitute “forward-looking statements” as defined in the U.S. Private Securities Litigation Reform Act of 1995. Such “forward-looking statements” reflect management’s current views with respect to certain future events and financial performance and include any statement that does not directly relate to any historical or current fact. Words such as “anticipate,” “believe,” “expect,” “estimate,” “forecast,” “intend,” “plan,” “project” and similar expressions which indicate future events and trends may identify “forward-looking statements.” Such statements are based on currently available information and are subject to various risks and uncertainties that could cause actual results to differ materially from those projected or implied in the “forward-looking statements” and from historical trends. Certain “forward-looking statements” are based upon current assumptions of future events which may not prove to be accurate. Undue reliance should not be placed on “forward-looking statements,” as such statements speak only as of the date of this report.

Factors that could cause actual results to differ materially from those projected or implied in any “forward-looking statement” and from historical trends include, but are not limited to:

- economic conditions, including consumer spending and plant and equipment investment in Hitachi’s major markets, as well as levels of demand in the major industrial sectors Hitachi serves;
- exchange rate fluctuations of the yen against other currencies in which Hitachi makes significant sales or in which Hitachi’s assets and liabilities are denominated;
- uncertainty as to Hitachi’s ability to access, or access on favorable terms, liquidity or long-term financing;
- uncertainty as to general market price levels for equity securities, declines in which may require Hitachi to write down equity securities that it holds;
- fluctuations in the price of raw materials including, without limitation, petroleum and other materials, such as copper, steel, aluminum, synthetic resins, rare metals and rare-earth minerals, or shortages of materials, parts and components;
- credit conditions of Hitachi’s customers and suppliers;
- general socioeconomic and political conditions and the regulatory and trade environment of countries where Hitachi conducts business, particularly Japan, Asia, the United States and Europe, including, without limitation, direct or indirect restrictions by other nations on imports and differences in commercial and business customs including, without limitation, contract terms and conditions and labor relations;
- uncertainty as to Hitachi’s ability to response to tightening of regulations to prevent climate change
- uncertainty as to Hitachi’s ability to maintain the integrity of its information systems, as well as Hitachi’s ability to protect its confidential information or that of its customers;
- uncertainty as to Hitachi’s ability to attract and retain skilled personnel;
- uncertainty as to Hitachi’s ability to continue to develop and market products that incorporate new technologies on a timely and cost-effective basis and to achieve market acceptance for such products;
- exacerbation of social and economic impacts of the spread of COVID-19;
- the possibility of disruption of Hitachi’s operations by natural disasters such as earthquakes and tsunamis, the spread of infectious diseases, and geopolitical and social instability such as terrorism and conflict;
- estimates, fluctuations in cost and cancellation of long-term projects for which Hitachi uses the percentage-of-completion method to recognize revenue from sales;
- increased commoditization of and intensifying price competition for products;
- fluctuations in demand of products, etc. and industry capacity;
- uncertainty as to Hitachi’s ability to implement measures to reduce the potential negative impact of fluctuations in demand of products, etc., exchange rates and/or price of raw materials or shortages of materials, parts and components;
- uncertainty as to the success of cost structure overhaul;
- uncertainty as to Hitachi’s ability to achieve the anticipated benefits of its strategy to strengthen its Social Innovation Business;
- uncertainty as to the success of acquisitions of other companies, joint ventures and strategic alliances and the possibility of incurring related expenses;
- uncertainty as to the success of restructuring efforts to improve management efficiency by divesting or otherwise exiting underperforming businesses and to strengthen competitiveness;
- the potential for significant losses on Hitachi’s investments in equity-method associates and joint ventures;
- uncertainty as to the outcome of litigation, regulatory investigations and other legal proceedings of which the Company, its subsidiaries or its equity-method associates and joint ventures have become or may become parties;
- the possibility of incurring expenses resulting from any defects in products or services of Hitachi;
- uncertainty as to Hitachi’s access to, or ability to protect, certain intellectual property; and
- uncertainty as to the accuracy of key assumptions Hitachi uses to evaluate its employee benefit-related costs.

The factors listed above are not all-inclusive and are in addition to other factors contained elsewhere in this report and in other materials published by Hitachi.