

INTERNAL

HITACHI
Inspire the Next

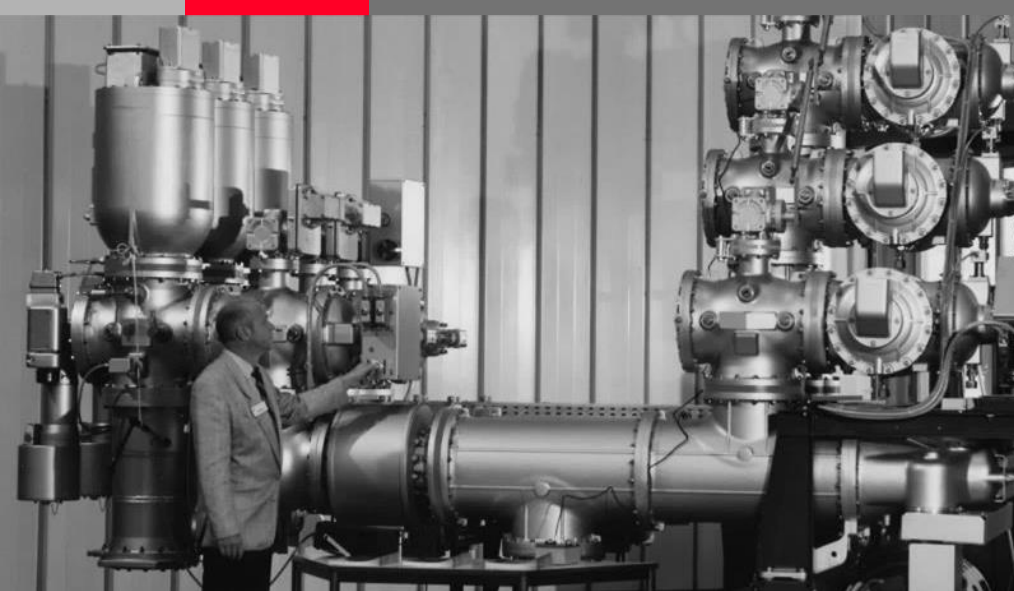
EconIQ™

EconIQ™ LTA - high-voltage technology and innovation

Advancing a sustainable future for all

Business Unit High Voltage Products: Our heritage of innovation

HITACHI
Inspire the Next



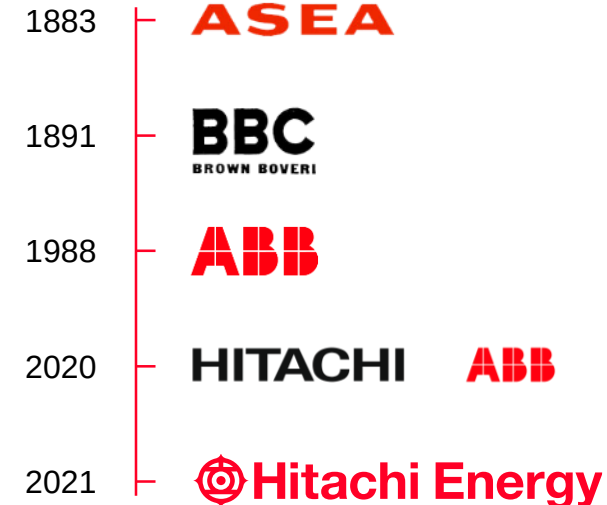
A legacy of
excellence.

A heritage of
commitment.



OUR JOURNEY

- As a global leader, we revolutionized high-voltage technology and pioneered many world's firsts to bring safety, reliability and efficiency to power networks around the globe.
- At Hitachi Energy, we are committed to advancing the world's energy system to be more sustainable, flexible and secure.
- We continue to build on this remarkable heritage to tackle today's challenges and advance a **sustainable energy future for all.**



Business Unit High Voltage Products: Our heritage of innovation

A legacy of excellence. A heritage of commitment.

1968



Gas-insulated switchgear (GIS) 170 kV

1978



SF6 circuit-breaker 420 kV

1980



Zinc oxide surge arrester portfolio

1987



GIS 800 kV

1995



High energy density film capacitors

1996



Active harmonic filter technology

2015



Eco-efficient GIS 170 kV

2014



Mixed technology switchgear 1200 kV

2013



EconIQ™ live tank breaker (LTA) 72.5 kV

2012



Generator circuit-breaker (GCB) 250 kA

2008



GIS 1100 kV for ultra high-voltage grids

1999



Hybrid switchgear PASS 145 kV

2017



Spark Prevention Unit to reduce wildfire hazards

2019



EconIQ™ LTA 145 kV

2020



Gas-insulated lines (GIL) 1100 kV

2021



EconIQ™ high-voltage portfolio

2021

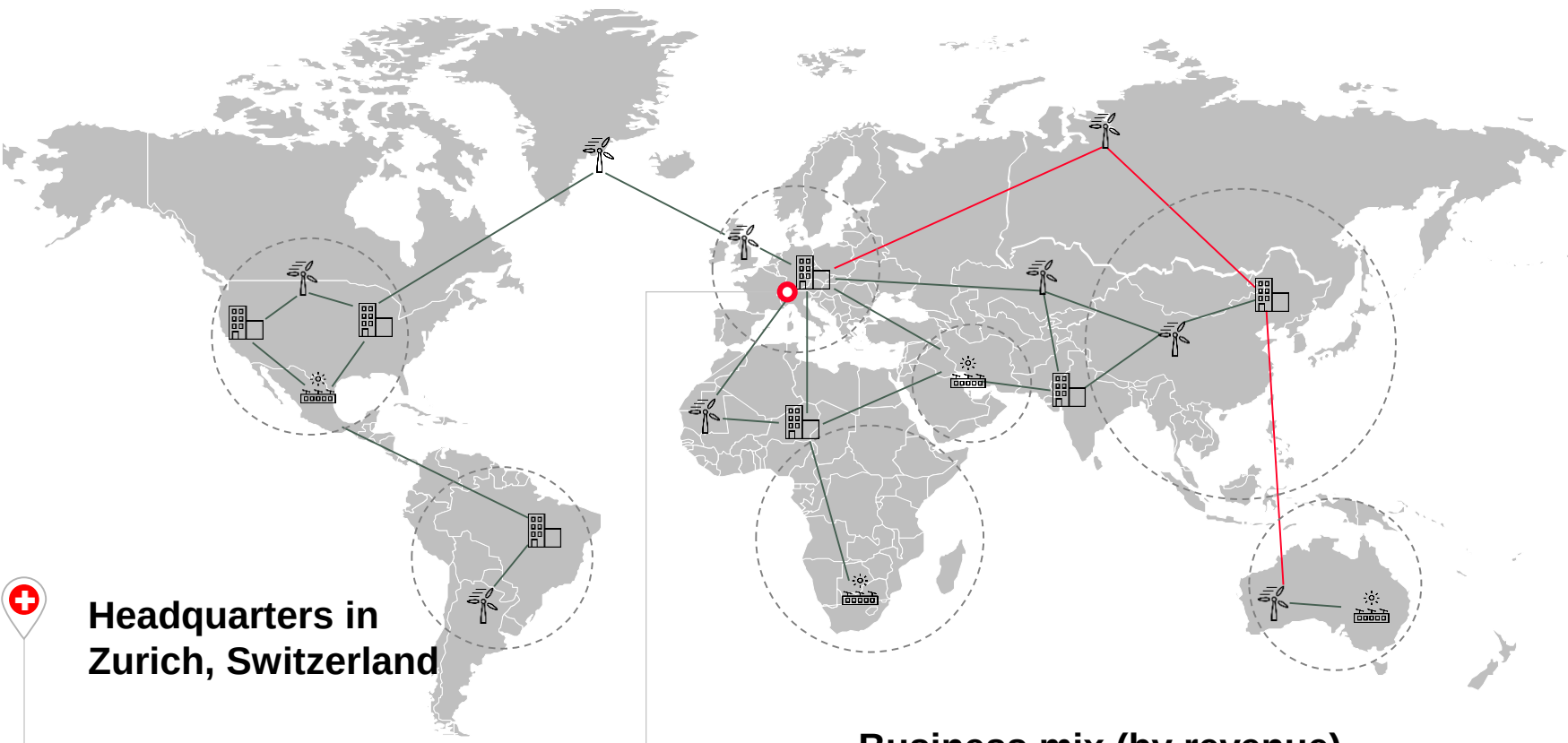


Digital Kit, a fully immersive remote support

2022



World's first eco-efficient 420 kV circuit-breaker



Business mix (by revenue)

38,000 employees

90+
countries with
200 offices

~250
years' heritage
combined

5,500
sales employees
& field engineers

2,000
engineers &
scientists in R&D

Four Business Units

Grid
Automation

High Voltage
Products

Grid Integration

Transformers

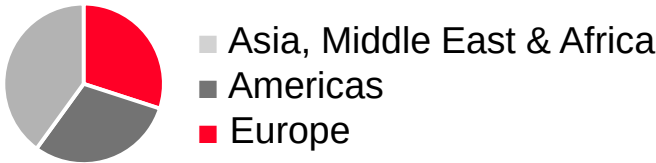
Customers



Offering



Geographies



EconIQ™ Live Tank Breaker LTA

SF6-Free – Towards a sustainable energy future	04
Regulation in the EU	06
EconIQ™ - Our promise towards a carbon-neutral future	08
Eco-efficient EconIQ™ LTB – LTA Brief product introduction and benefits	20
Gas Handling	27
Operations	31
Success stories	35
References & Links	43

Sustainability

SF6-Free – Towards a sustainable energy future



Our Targets

Planet

Carbon-neutral in our own operations

- ↓ 50% CO₂ emissions along the value chain
- ↓ 50% waste disposed
- ↓ 25% freshwater use
- ↓ 25% hazardous substances and chemicals

People

- Zero harm
- Top quartile health absence rates
- Life-long learning culture
- Increase female diversity from 19% to 25% by 2025

Peace

- Zero incidents of corruption and bribery

Partnerships

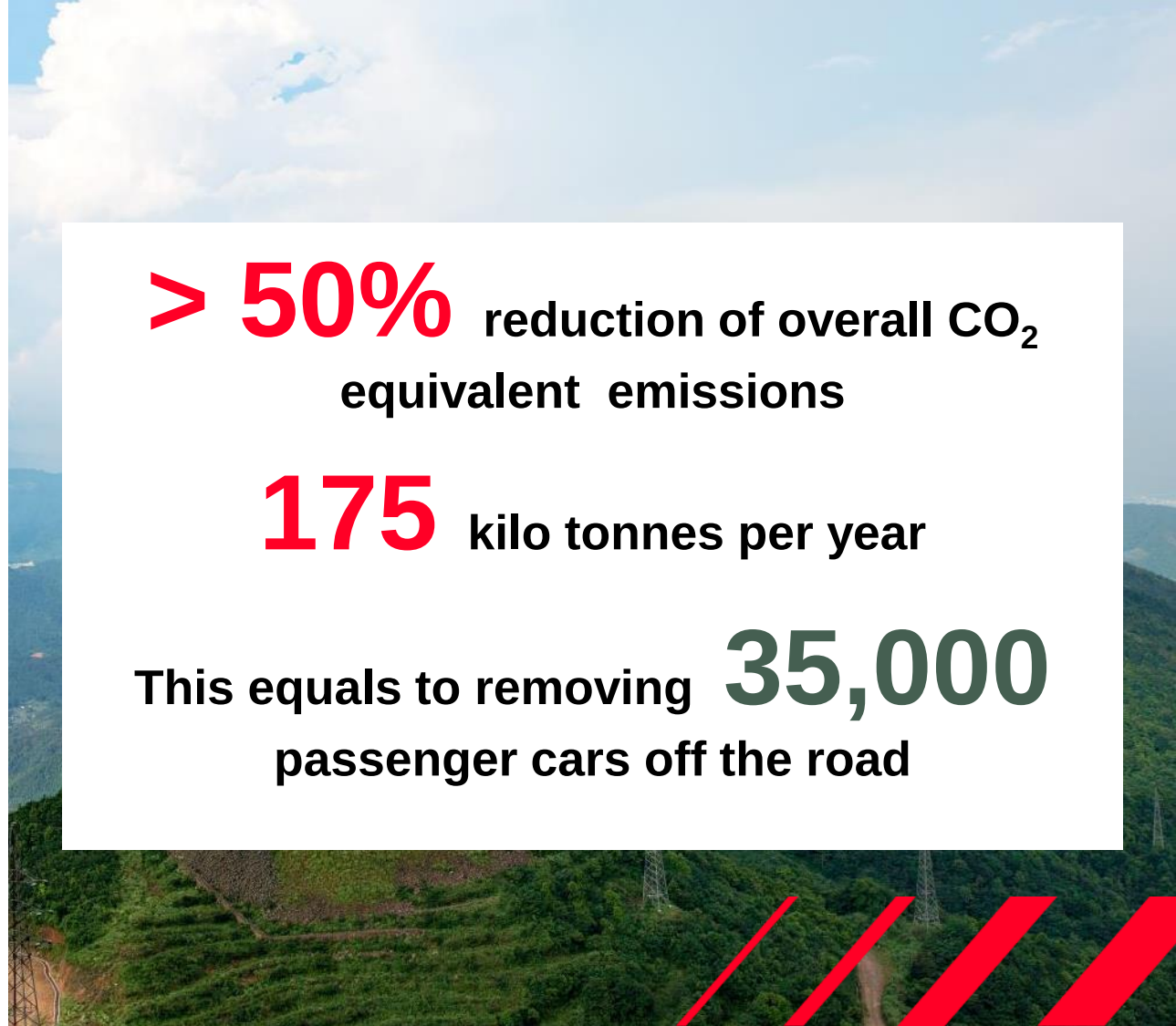
- Increase involvement in multi-stakeholder partnerships



Achieved
our first-step target of

100%

Fossil-free electricity
in own operations



> 50% reduction of overall CO₂
equivalent emissions

175 kilo tonnes per year

This equals to removing **35,000**
passenger cars off the road

Sulfur hexafluoride (SF₆) – a greenhouse gas



Reliable dielectric gas
and limited amount of
alternatives



SF6 emissions doubled
from 1994 – 2013



2.5% of EU GHG
emissions caused by SF6



SF6 emissions in Europe were
the equivalent of

6.73

megatonnes of CO2 in 2017



This represents the volume of
greenhouse gas emissions from

1.3m

cars for a year



There was an

8.1%

increase in SF6 emissions across
Europe in 2017

SF6 is the world's most potent greenhouse gas

Global warming potential of greenhouse gases over 100-year timescale (GWP₁₀₀)

Sulfur hexafluoride (SF ₆)	25,200
Tetrafluoromethane (PFC-14)	6,630
Nitrous oxide (N ₂ O)	265
1,1-Difluoroethane (HFC-152a)	138
Methane (CH ₄)	28
Carbon dioxide (CO ₂)	1

GWP measures the relative warming impact of one unit mass of a greenhouse gas relative to carbon dioxide. A GWP₁₀₀ value of 28 therefore means one tonne of methane has 28 times the warming impact of one tonne of carbon dioxide over a 100-year timescale.

Source: Our World in Data, IPCC

ENERGY MONITOR

Econiq™

Regulation in the EU

Hitachi Energy welcomes the EU's proposal on new F-gas regulation driving grid decarbonization while ensuring reliability

On October 19, the European Council and the European Parliament released the Proposal for a Regulation of the European Parliament and of the Council on fluorinated greenhouse gases, **which mandates a phase-out of SF6** in new high-voltage switchgear.

Within high-voltage, **the agreement allows for the use of eco-efficient gas mixtures**, typically comprising 3-5 percent of an F-gas, to fulfill specifications for technical performance or if space is limited.

In addition, **it considers the overall carbon footprint of a product over its complete lifetime**, factoring, for example, a lesser use of raw materials.



Econiq™ technology is the way forward as the solution with the lowest carbon footprint in the world.

Econiq™

Our promise towards a carbon-neutral future

“

Eco-efficient portfolio for sustainability designed to reduce environmental impact towards a carbon-neutral energy future

01

EconIQ™ portfolio has exceptional environmental performance compared to conventional solutions

02

The SF₆-free gas mixtures for high-voltage switchgear is the first big step in the EconIQ™ portfolio

03

EconIQ™ SF₆-free solutions create significant customer value

Creating value for our customers towards a carbon-neutral future



Collaborating with our customers & partners to reduce carbon footprint



Working towards a standard and scalable solution for the industry



Ensuring future-proof life cycle investments



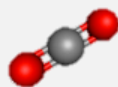
Enabling more efficient use of energy and resources

LTA

For LTB application, we are using $\text{CO}_2 + \text{O}_2$ to replace SF_6 in all LTB applications for insulation and switching.



Eco-efficient gas mixture



CO_2
Carbon Dioxide



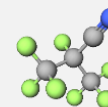
O_2
Oxygen

Metal Enclosed (MEB)

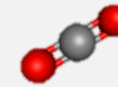
C_4FN is a synthetic gas + $\text{CO}_2 + \text{O}_2$ it will be our eco gas to replace SF_6 in all our metal-enclosed switchgear (GIS, DTB, PASS) for insulation and switching.



Eco-efficient gas mixture



4% C_4FN
Fluorinated Nitrile



CO_2
Carbon Dioxide



O_2
Oxygen

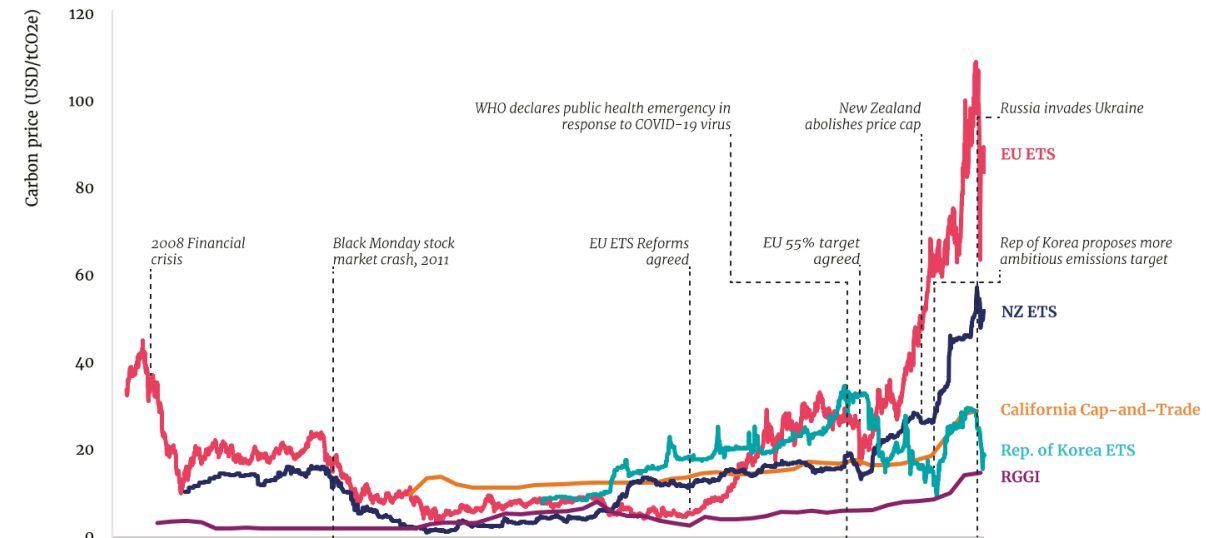
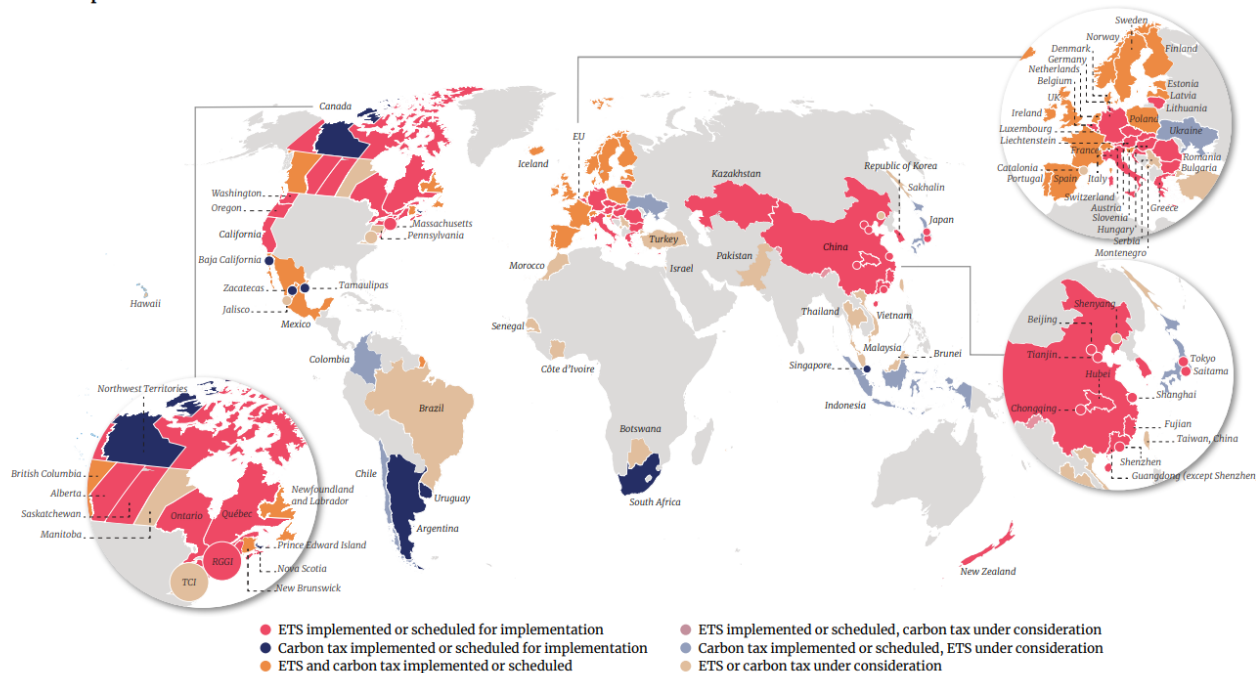
Based on **well-proven**
gas circuit-breaker
technology

The EconIQ gas circuit-breaker remains as compact as the conventional SF_6 solution.

Why EconiQ?

- Lower **CO2 footprint** during operation
- Prices for **carbon permits and offsets** is expected to increase drastically in the coming years due to the Paris Agreement
- Become a **sustainability role model** in the market – How much is it worth to be respected among your business partners?
- Climate related **laws and regulations becomes stricter** and stricter with the severity of the climate crisis
- As climate crisis deepens the more common will **climate related court cases** be

FIGURE 1
Map of carbon taxes and ETSs



EconIQ high-voltage roadmap: Advancing a sustainable energy future for all

EconIQ™

A game-changing technology that eliminates sulfur hexafluoride (SF₆) with reliable and scalable solutions for the lowest carbon footprint.

EconIQ high-voltage portfolio		Available now		2023	2024	2025
Live tank breaker (LTB)		72.5 kV	145 kV		420 kV	245 kV
Dead tank breaker (DTB)		420 kV		72.5 kV 145 kV	550 kV	245 kV
Plug and Switch System hybrid switchgear (PASS)				72.5 kV 145 kV		245 kV
Gas-insulated switchgear (GIS)		72.5 kV* 145 kV*	420 kV		550 kV	245 kV
Gas-insulated line (GIL)		420 kV			550 kV	245 kV
Retrofill for GIL (Service)		420 kV				

Accelerating eco-efficient innovation

Pioneering technologies such as the EconiQ™ SF₆-free high-voltage portfolio is needed to advance a sustainable energy future.



Scalable and robust

Game-changing technology for SF₆ alternatives to reduce environmental impact



Technology of the future

Enabling customers and industry to reduce carbon footprint and rapidly transition to eco-efficient solutions

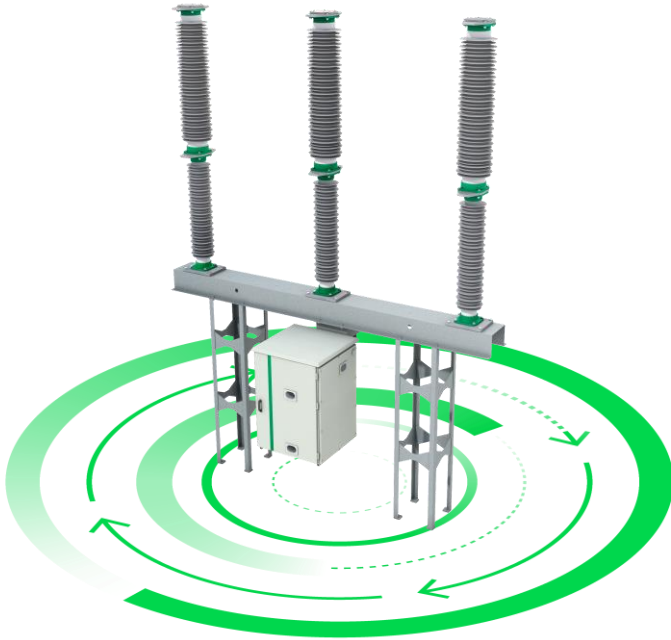
EconIQ high-voltage portfolio (today)		Building our EconIQ portfolio for the future	
	Live tank breaker LTA 72.5 kV		Live tank breaker (LTB) 245 kV, 420 kV
	Live tank breaker LTA 145 kV		Dead tank breaker (DTB) 72.5 kV, 145 kV, 245 kV, 550 kV
	Disconnecting circuit-breaker (DCB) LTA 72.5 kV		Plug and Switch System hybrid switchgear (PASS) 72.5 kV, 145 kV, 245 kV
	Dead tank breaker (DTB) 420 kV		Gas-insulated switchgear (GIS) 245 kV, 550 kV
	Gas-insulated switchgear (GIS) ELK-04, 72.5 kV, 145 kV, 420 kV		Gas-insulated lines 245 kV, 550 kV
	Gas-insulated current transformer 145 kV, 170 kV		
	Gas-insulated line 420 kV		
	Retrofill for GIL (Service) 420 kV		

Eco-efficient EconiQ LTB – LTA

Brief product introduction and benefits

Comments on technical performance

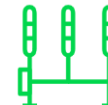
- 145 kV / 40 kA / 3150 A / 50 Hz live tank breaker using a **mixture between CO₂ and O₂**
- Increased gas pressure and contact gap allows **dielectric performance comparable to an SF₆ breaker**
- Gas **not classified as toxic** after exposure to high arc energy input according to GHS
- All tests according to IEC 62271-100 has been passed by the LTA 145 breaker
- Ensure **compliance with current and future legislations**



Things you need to know about EconIQ LTA



~ 200 installations
worldwide



LTA is as 100%
reliable as SF₆ breaker



Eco-efficient CO₂-
based gas mixture



Future-proof to
environmental
regulations

Scalable eco-efficient Live Tank Breakers

Combining the reliability and experience from gas type Circuit Breakers with the use of carbon dioxide (CO₂) and oxygen (O₂) as an eco-efficient insulation gas mixture

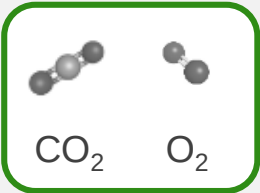


Type	LTA 72.5D1	LTA 145D1	DCB-LTA 72.5D1
Rated voltage	72.5 kV	145 kV	72.5 kV
Rated current	2750 A	3150 A	2750 A
Rated short-time withstand current	31.5 kA	40 kA	31.5 kA
Rated frequency	50 Hz	50 Hz	50 Hz
Ambient temperature	-50/+40 °C	-50/+50 °C	-50/+40 °C
Gas-mixture	CO ₂ + O ₂	CO ₂ + O ₂	CO ₂ + O ₂

Maximize environmental benefits

- Lower lifecycle CO2 footprint by almost 40%
- Nearly eliminate climate impact from gas leakage
- Dielectric losses equal to LTB 145 D1/B
- GWP for gas mixture < 1 CO2 eq (typical of natural gases)

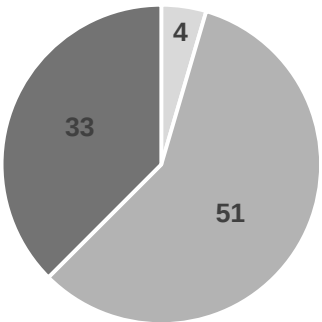
Eco gas mixture



“
The best choice for
our customers and
the society

Life Cycle Assessment (LCA) Example: Carbon footprint of LTA 145 kV

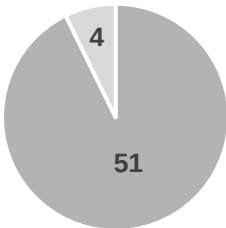
SF₆ LTB 145
88 tons CO₂ eq.



Legend

Insulation gas losses Materials Power losses

EconIQ LTA 145
55 tons CO₂ eq.



Power losses
over lifetime

Game changing technology for SF₆ alternative to reduce environmental impact



Reduction in carbon footprint
throughout the total lifecycle



Over a decade of innovation
in eco-efficient technologies



Longest field experience
worldwide



Future proof
Compliant to future environmental regulations



Scalable to ultra-high voltage
for both interruption and insulation



Same footprint
as SF₆ Circuit Breakers



High-voltage eco-efficient portfolio for a carbon neutral energy future

Eco-efficient EconiQ LTB – LTA

Gas handling

Gas details

- Gas mixture: 1.08 MPa CO₂ / 0.12 MPa O₂
- Filling pressure: 1.20 MPa (vs 0.70 MPa SF₆)
- Alarm/Blocking pressure: 1.04 / 1.00 MPa
- Total mass of gas is equivalent to SF₆ breaker

Gas		SF ₆	CO ₂
Molecular weight		146.06	44.01
Density	kg/m ³	5.9	1.8
Chemical stability		Stable	Stable
Dielectric strength	%	100	34



**Game changing technology
for SF₆ alternatives to reduce
environmental impact**

Commissioning and site testing

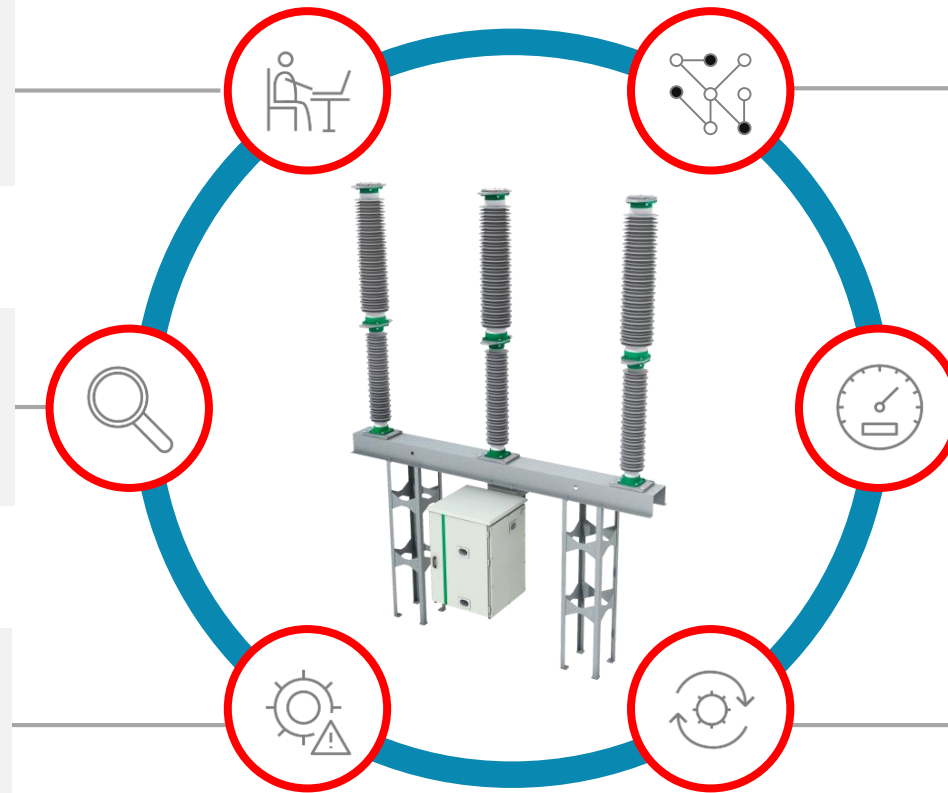
- Same erection process as in traditional breakers

Monitor

- Density switch
- Temperature compensated

Detect

- Leakage Detector
- Traditional leak detectors will not perform for CO₂



Gas filling

- Gas filling is made directly from 2 gas bottles (90% CO₂ and 10% O₂)

Service: fill, recover, refill

- Shall be done with the same method as gas filling

Recover / Disposal

- Used gas is pumped into a tank for used gas or released to the air through a filter

Eco-efficient EconiQ LTB – LTA Operations

Installation and commissioning

Overall, same procedures as for our conventional SF₆ circuit breakers

- Same erection process as with conventional breakers
- Basic testing of contact resistance and operating times

Inspection and maintenance

Same inspection and maintenance program as for conventional SF₆ circuit breakers

- Overhaul of complete circuit breaker and operating mechanism after 30 years or 10,000 mechanical operations



Eco-efficient EconiQ LTB – LTA

Success stories

Worldwide references

~400

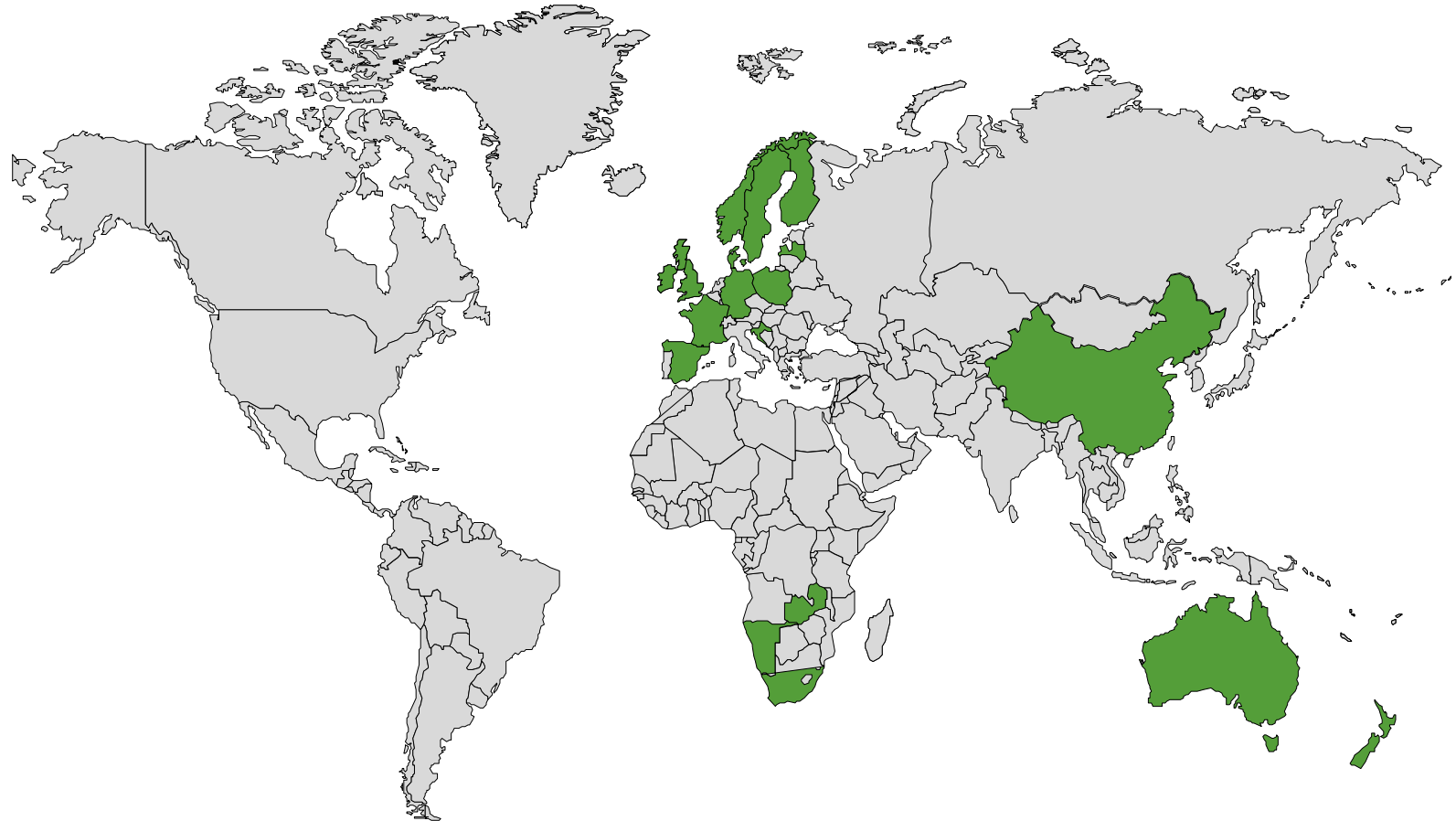
Units
orders received

10+

Countries worldwide
with installed units

145

kV solution
available



Fingrid is decarbonizing its outdoor breaker installations



The **46 years old Heinola substation** is Fingrid's first to install the SF₆-free breaker

EconiQ LTA, 145 kV



~ 200 installations worldwide



Eco-efficient CO₂-based gas mixture



LTA is as 100% reliable
as SF₆ breaker



Future-proof
to environmental regulations



Challenge

Sweden is one of the nations that is leading the way in developing a sustainable low-carbon economy, with targets towards net zero greenhouse gas emissions by 2045.

Solution

EconIQ Live Tank Breaker (LTA) for 145 kV will be installed at Vattenfall Distribution substation in Skövde, Sweden. The technology significantly reduces carbon footprint while enhancing reliability.

Impact

With EconIQ's game-changing technology, it significantly reduces the carbon footprint throughout the total lifecycle, helping Sweden in their journey towards carbon-neutrality.



Challenge

Tranås Energi was replacing its aging 30-year-old SF₆ Circuit Breakers and was searching for an eco-efficient alternative.

Solution

Live tank circuit-breaker (LTA) based on CO₂ technology reduces carbon footprint by 100%. Almost 100% of reduction in global warming potential (GWP) compared to SF₆ without any compromise on quality and reliability.

Impact

Our technology help minimize the substation's environmental impact and regulatory procedures for SF₆ such as gas handling, monitoring and inventory management will be avoided.

EconIQ breaker contributes to Norway's journey towards carbon-neutrality

HITACHI
Inspire the Next



“

We are excited to join forces with Hitachi Energy to bring new and innovative EconIQ technology that reinforces our strategy for sustainable operations.

Atle Isaksen

Head of Grid Development, BKK Nett

Challenge

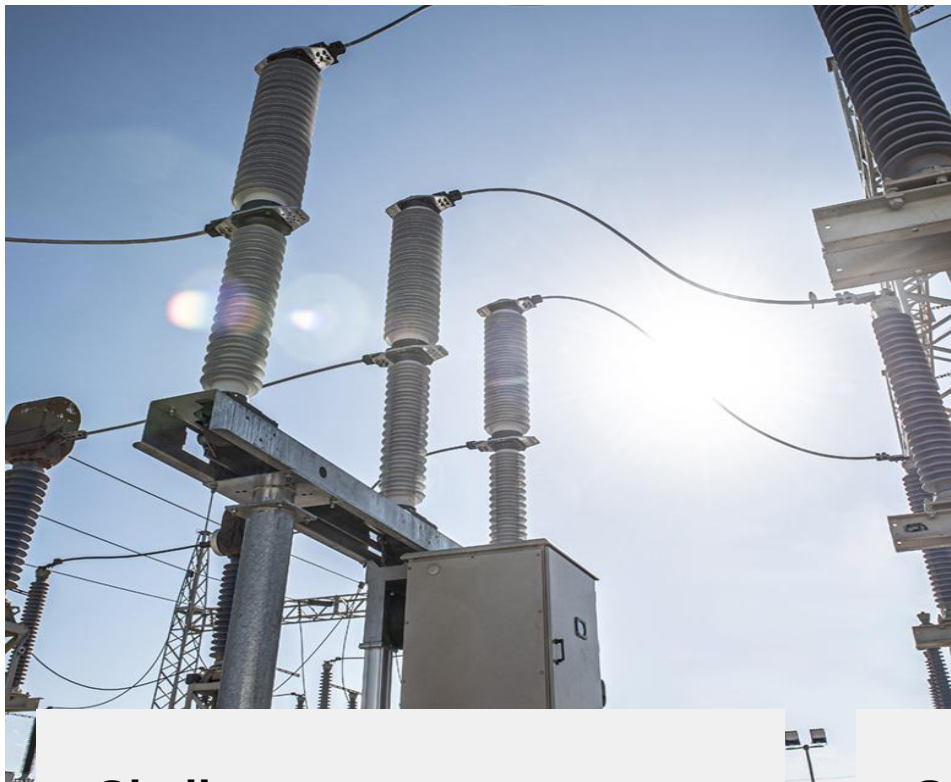
Rebuilding a substations with an eco-efficient sulfur hexafluoride (SF₆) alternative to meet the growing electricity demand and support Norway's decarbonization plans

Solution

The eco-efficient EconIQ™ Live Tank Breaker (LTA) is a reliable solution to eliminate 100% of the CO₂ equivalent emissions related to the insulation gas and strengthens the Norwegian grids

Impact

Contributing to Norway's plans to cut at least 50 percent of its greenhouse gases by 2030 with the target to achieve carbon-neutrality by 2050



Challenge

Spain's first eco-efficient EconIQ high voltage Circuit Breakers as part of a substation refurbishment in the southern region of Murcia.



Solution

The innovative EconIQ LTA uses carbon dioxide (CO₂) as insulation gas mixture instead of sulfur hexafluoride (SF₆), and helps Iberdrola reduce carbon emissions.

“

Our aim is to be carbon-neutral by 2050. We understand clearly that climate change is a real problem, which is why we are approving a strategy to reduce our CO₂ emissions

Ignacio S. Galan,
Chairman and CEO of Iberdrola.

Impact

LTA for 72.5 kV and 145 kV will help accelerate efforts to make the grid carbon-neutral while enabling the reliable operation of substations in Murcia region.



HITACHI
Inspire the Next 