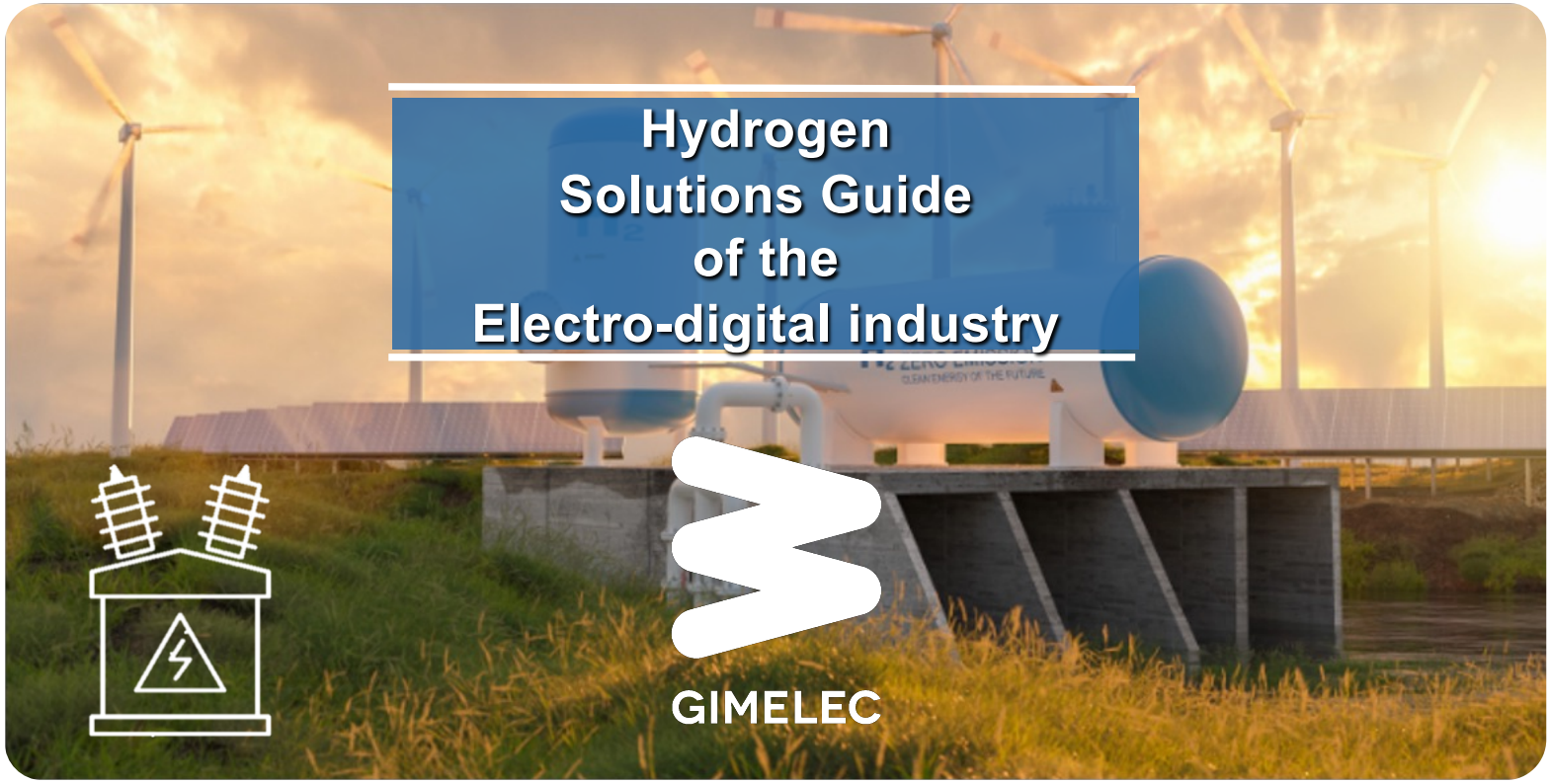


Power Supply for Electrolysis Solutions

and

Companies Directory

Introduction

About the GIMELEC Hydrogen Commission

GIMELEC Hydrogen Commission brings together more than 50 manufacturers and solution providers active across the entire hydrogen value chain, from production to transport, storage and use (industry, mobility, H_2-to-Power, etc.). Their solutions allow project developers to optimize the operation, safety, costs and environmental footprint of hydrogen installations.
https://gimelec.fr/hydrogene

About this guide

This publication is intended for project developers and integrators. It has been redacted by GIMELEC. The first part, edited as part of its partnership with France Hydrogène is a "white paper" identifying the challenges and constraints for electrolyser power supply; **the second part presents the solutions** to meet them and is a directory of GIMELEC companies.
GIMELEC companies offer solutions for electrolyser power supply, automation and instrumentation. This part of the guide is dedicated to power supply for electrolysis. Find the two other sections at the following link.

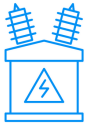
About GIMELEC

GIMELEC brings together companies from the French electronics and digital sector. Our 210 members design, manufacture and deploy electrification, automation and digitalisation solutions for industry, buildings, mobility, energy and digital infrastructures.
https://gimelec.fr

GIMELEC Hydrogen Guide reading grid

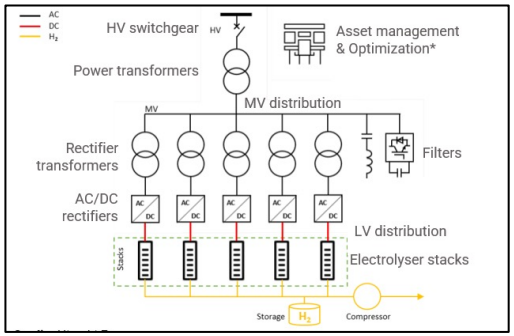
A 3-part publication to meet the challenges of power supply for electrolysis:

White paper



White Paper: What are the power supply challenges for electrolysis?

Objective: To present the challenges of RES or grid connection, the optimization scope for design, the hardware and digital solutions needed, the maintenance issues...



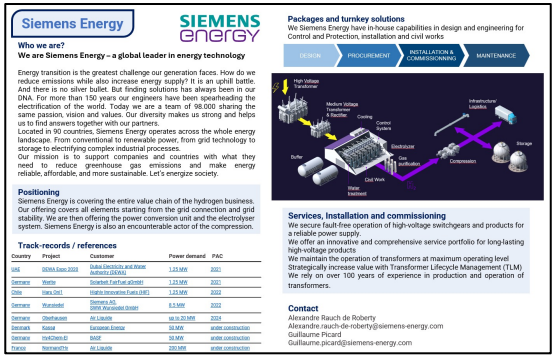
GIMELEC directory (this document)

PART 1 (p. 4-33) : what are the solutions to meet these challenges?

Objective: To provide an overview of the range of solutions offered by GIMELEC companies, classified by services and equipment families.

PART 2 (p. 34-48) : which companies are behind this solutions?

Objective: To provide an overview of each company's portfolio of solutions and expertise



PART 1

POWER SUPPLY SOLUTIONS FOR ELECTROLYSIS

GIMELEC

DIFFERENT SCOPES OF SUPPLY

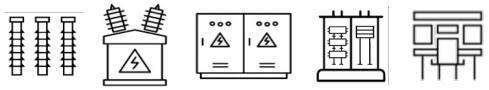
Different scopes of supply

There are several business models with different supply scopes depending on project, outsourcing and purchasing strategies.
Most GIMELEC members are positioned on all of these possible combinations, either singlehandedly or in joint consortia.

Value creation

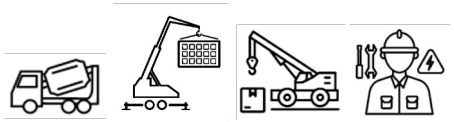
Loose products & bundles

- Switchgears (AIS / GIS / Hybrid)
- Power transformers
- Rectifier transformers
- Power electronics
- AC/DC Busbars
- Protection, control & monitoring



Packages & systems

- Engineered packages with construction management
- Engineered packages
- Power conversion units
- Grid connection solutions
- Modular containerized solutions
- Power quality solutions
- Consulting services
- High-voltage substations
- Digital substations



Services & full turnkey solutions

- System integration
- Installation & commissioning
- Turnkey EPC services

Integration level

Table of contents

PAGES

SERVICES & TURNKEY

Design & system integration

Design & concept studies

ABB
GE VERNOVA
HITACHI Inspire the Next
Schneider Electric
SIEMENS
SIEMENS energy

Project management

ABB
AEG POWER SOLUTIONS
Aventech connecting energies
comeca energy in motion
Danfoss
GE VERNOVA
HITACHI Inspire the Next
KEB
Schneider Electric
SIEMENS
SIEMENS energy

Containerized solutions

ABB
AEG POWER SOLUTIONS
Aventech connecting energies
comeca energy in motion
Danfoss
GE VERNOVA
HITACHI Inspire the Next
KEB
Schneider Electric
SIEMENS
SIEMENS energy

Installation, commissioning & maintenance

ABB
AEG POWER SOLUTIONS
GE VERNOVA
Danfoss
HITACHI Inspire the Next
KEB
Schneider Electric
SIEMENS
SIEMENS energy

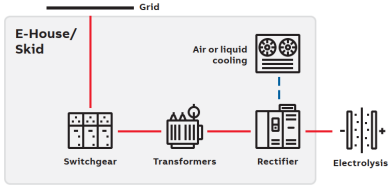
SERVICES & TURNKEY

ABB

ABB's modular design from MV to DC
Flexible for Indoor and Outdoor (E-house / Skid) Use

Complete mechanical, electrical, and control design, resulting in a simple, standardized package. The complete system is fully tested before delivery, allowing safe and easy integration.

Our engineering teams specialize in crafting power supply systems that meet your project requirements and site conditions (E-House or Outdoor Skid Solution). To maximize overall efficiency, we meticulously match rectifier technology with semiconductor components that seamlessly integrate with the grid whether it's IGBTs, thyristors, or diodes with DC choppers.



Benefits

- Quick and easy installation
- Project management services
- Design support with simulation capabilities
- Pre-assembled, pre-tested units
- Built-in safety features

Dedicated solutions for:

- Optimized reactive power compensation
- Harmonics (THD)
- DC ripple

References:

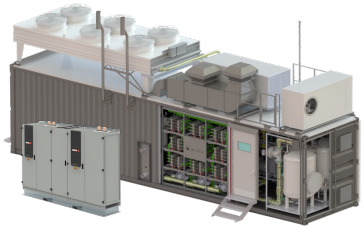
ABB rectifier system powers Mitsubishi Heavy Industries' hydrogen production technology development
ABB advanced power technology to play key role in green hydrogen pilot project

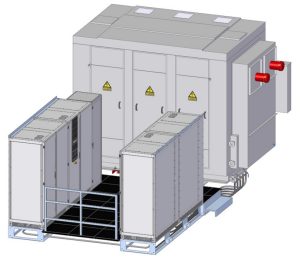
AEG POWER SOLUTIONS

AEGPS 's value proposition

Rectifier cabinet integrated directly into the electrical room of the electrolyzer OEM.
>30MW sold

Complete skid solution including MV transformer, cooling, rectifier dedicated to electrolyzer power supply.
20 x 5MW (Steel Application)





We offer flexible solutions including skid-mounted and containerized options for various applications

SERVICES & TURNKEY

Aventech

connecting energies

E-House

- Modular solution – Ready to Connect
- ISO container or specific sizings module
- Rectifier and HV/LV transformer
- MCC/PCC Switchboard
- Switchgear
- HVAC
- Extinguish system

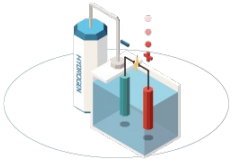
Services

- Engineering (standardization/design to cost)
- Manufacturing
- FAT
- Delivery on site
- Supervision

comeca

energy in motion

Our products portfolio includes solutions to power supply your electrolyzer. It can be containerized and can integrate a cooling system. Your production facility can also benefit of our smart automation solution.

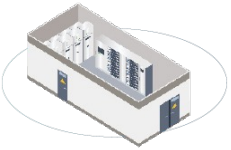


POWER CONVERSION

- Our rectifiers are distinguished by their excellent efficiency, high power factor and low rate of ripple or residual harmonics.

ELECTRICAL POWER DISTRIBUTION

- Our solutions portfolio includes switchboards, power distribution centers and motor control centers in withdrawable, disconnectable or fixed arrangement.

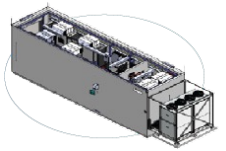


SMART AUTOMATION

- Real-time availability overview,
- Management and anticipation of energy consumption, alarm reporting.

MODULAR SOLUTION & COOLING

- We offer a containerized solution with an optimized cooling system, suitable for ATEX zones.



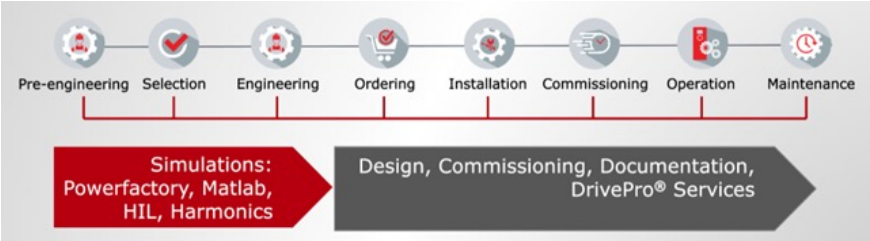
PROJECT MANAGEMENT AND SERVICES

- Our multi-skilled teams are coordinated by a single project manager who will be your contact until your installation is ready to launch.
- Our service team will then take over and ensure the sustainability and maintenance of your production tool.

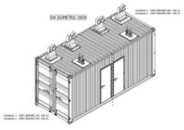
SERVICES & TURNKEY

AC to DC converters offering

Standard or customizable solutions for indoor or outdoor requirements:



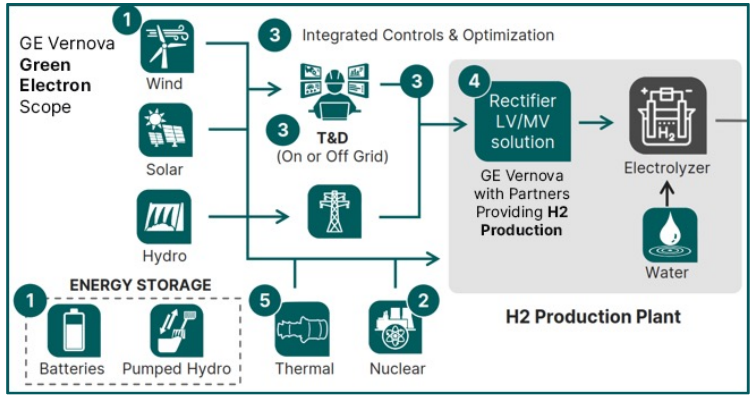
At Danfoss, we help you think beyond the electrolyzer to the system itself. By taking a holistic perspective on the entire ecosystem, we secure energy efficiency and system effectiveness that is both scalable and economically viable. With extensive expertise in Power-to-X systems and electrolysis for producing hydrogen, we tailor the solution to your specific needs. That way you get a plug-and-play system with maximum electrolyzer performance that evolves alongside your operations, at your pace. Danfoss technology has been developed and refined to deliver future-proof, guaranteed performance with many added features to lower risk and ensure a stable electrolyzer operation. You achieve better total economy and peace of mind for operational excellence of each electrolyzer in your electrolysis plant. Danfoss will provide you a grid-friendly, approved solution with impressive energy efficiency. Low harmonics and an adjustable power factor ensure that you have a competitive power supply for your electrolyzer at hand. With long experience in power conversion combined with a leading position in the world, Danfoss is your ideal partner for your investment in the hydrogen market.



References :

- Danfoss supplies power converters to 24 MW green hydrogen plant in Norway
- Revolutionizing green hydrogen production with Danfoss Drives in Denmark

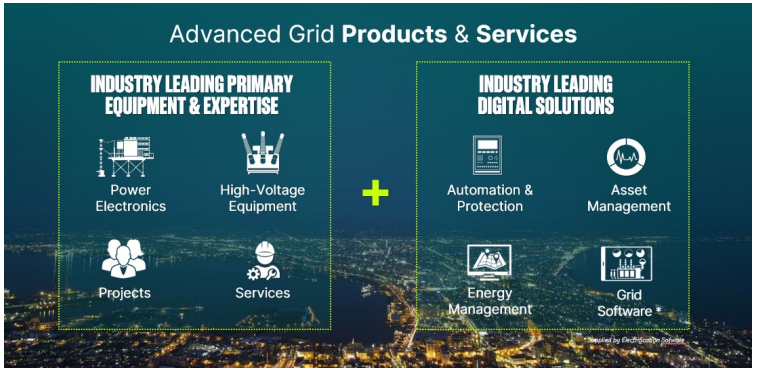
GE VERNOVA



3 **Grid Solutions**: AC/DC transmission & transmission equipment
Grid Automation: Integrated controls from electron to hydrogen production, grid connected or island mode

4 **Power Conversion**: LV/MV equipment & solution for H2 electrolyzer plant

With GE Vernova's wide array of products, solutions and services, we can help deliver an electrification solution to supply renewable energy to power an electrolyzer including an end-to-end portfolio from generation to production.



SERVICES & TURNKEY

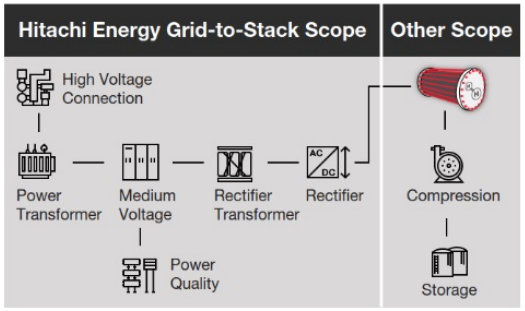
HITACHI
Inspire the Next

Hitachi Energy

Optimize your plant's complete electrical power supply system

Grid-to-Stack Hydrogen Solutions

Hitachi Energy is uniquely equipped as your partner of choice to holistically optimize the electrical system from grid connection to electrolyzer stacks. Seamless integration of state-of-the-art power, automation and protection equipment supports operational and maintenance efficiency and safety, while enhancing reliability and quality of power supply.



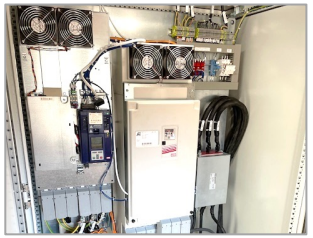
Integrated gas-insulated switchgear application for 145 - 420 kV Modular GIS in prefabricated housing

Integrated gas-insulated switchgear application (IGA) is a predesigned, standardized and fully integrated configuration based on Hitachi Energy's well proven GIS technology. The IGA provide substantial reduction of installation time compared to conventional substations. It is the ideal solution for customers in need of substations that can be quickly energized for grid expansions, backup or emergency power needs, and for short installation time requirements.
The IGA package comes with all primary and secondary equipment including control, protection, monitoring and communication completely installed in the prefabricated housing.

KEB

PROJECT MANAGEMENT

- A single Project Manager will follow your project with the support of a multi-skilled team.
- Monitoring from study to commissioning



INTEGRATION

- Cabinet or container solution
- Realization of electrical diagrams
- Commissioning by our teams

AUTOMATION

- Automation solution with real-time acquisition
- Industrial PC base with supervision
- A complete team of IT and automation specialists in support

STRATEGY

- With a full range of power converters together with the associated automation solutions, supported by more than 20 engineers, KEB can help you with complex projects.

SERVICES & TURNKEY

Schneider Electric

Rectifier solution design consulting

Rectifier technology being a key element for the performance of the electrolyser, Schneider Electric as an energy efficiency expert provides technology and design consulting services to achieve electrolyser 's performance and competitive cost of green hydrogen produced based on 3 technologies such as Diode Front End, Active Front End and Silicon Control Rectifier

Schneider Electric provides customized, modularized, scalable rectifier group solution design including

- Best-fit topology by application rating
- Integrated rectifier
- Cooling system design
- Automation (system + rectifier) based on proven and maintainable platform
- DC performance calculation and simulation
- Energy quality requirement and MV architecture analysis

Standard Power Module for gH2 process facility based on modular design concept

- Modular design concept: solutions can be adapted and scaled with minor changes
- Each E-house module for string is composed of ED equipment needed to feed electrolyser, such as (11/22/33)kV-MV, 400V-LV, Rectifier & UPS
- Modular solution allows expandability and easy transportation
- Easy installation of prefab interlocking sandwich panels
- Roof and walls fire rated 1 hour through fire rated sandwich panels
- Insulated through the roof and walls to provide acoustic and thermal insulation
- Heavy duty compressed fibre cement floor sheeting providing ease of fixings and workability for cable entry points

SIEMENS

E-house Substation, E-House Skid or Mobile E-House

- Customized solutions for all industrial applications and verticals
- Efficient equipment installation in controlled environment
- Testing and pre-commissioning off-site
- "Plug & Play delivery" for rapid deployment on-site

Benefits:

- Speed up of overall project lead times
- Reduced manhours and EHS risks on-site
- One single point of contact from ordering to execution
- Local and global E-House expertise
- Global footprint for site services and after-sales service

Services

A complete range of different service packages:

- Solution concept analysis and planning
- Implementation with a single project management and engineering expertise
- Commissioning and maintenance with long-term services agreements
- Plant operations can be focused on energy with performance monitoring and assurance and/or energy monitoring and flexibility or technical plant availability

SERVICES & TURNKEY

SIEMENS energy

EPC/Turnkey substations: Solutions and services for the entire life cycle

Siemens Energy is your partner of choice for high-voltage substations on budget and on time.
In-house capabilities in design and engineering for Control and Protection, installation and civil works.

- HV Equipment and engineering tailor-made to customer requirements.
- Dedicated team for erection on commissioning of the substation
- Limited interfaces
- Risk reduction
- Cost savings
- Controlled execution schedule

Prefabricated housing

Turnkey supply of HV/MV bays under a prefabricated approach based on a standard or tailored containers or skids

- Plug-in cable connection
- Protection and control system
- Auxiliaries equipments
- Easy lifting solution

Full assembly, parameterization and pre-commissioning tests in factory prior to shipment

Customer benefits

- Quicker connection and energization thanks to “plug & play” solution
- Risk reduction
- Confidentiality fully ensured throughout the implementation process
- Reduced works’ duration and interfaces during on-site activities

LOOSE PRODUCTS & BUNDLES

High-Voltage

Switchgears / HV products

- GE VERNOVA
- HITACHI Inspire the Next
- SIEMENS energy

Transformer

- celduc transfo
- GE VERNOVA
- HITACHI Inspire the Next
- SIEMENS energy

PAGES 15-18

Protection, Control and Monitoring

- ABB
- GE VERNOVA
- Schneider Electric
- SIEMENS

PAGES 19-20

Power Quality and Harmonic Filters

- Danfoss
- GE VERNOVA
- HITACHI Inspire the Next
- KEB
- Schneider Electric
- SIEMENS
- SIEMENS energy

PAGES 21-24

Rectifiers

Transformer

- celduc transfo
- HITACHI Inspire the Next
- Schneider Electric
- SIEMENS energy

Rectifier

- ABB
- AEG POWER SOLUTIONS
- comeca energy in motion
- Danfoss
- GE VERNOVA
- KEB

PAGES 25-29

MV Distribution

- ABB
- Schneider Electric
- SIEMENS

PAGES 30-31

LV Distribution

- ABB
- Aventech connecting energies
- comeca energy in motion
- MARECHAL ELECTRIC MARECHAL® TECHNOR® MELTRIC®
- Schneider Electric
- SIEMENS

PAGES 32-34

Switchgears / High-voltage products

GE VERNOVA

GE Vernova's GRiDEA Decarbonization portfolio

GRiDEA, GE Vernova's comprehensive suite of innovative solutions, is aimed at decarbonizing the electrical grid and supporting the transition to a more sustainable energy future.

As part of the GRiDEA decarbonization product portfolio, **our SF_6-free switchgear range** features the same ratings and same dimensional footprint as the state-of-the-art SF_6 equipment, with **a drastically reduced carbon footprint** over the life cycle compared with SF_6 products and other alternatives.

GE Vernova is designing and manufacturing most of its range of SF_6-Free switchgears in France.

Air insulated Switchgears (CO_2-O_2)

Gas insulated Switchgears (g^3)

HV Disconnectors

HITACHI Inspire the Next / Hitachi Energy

A complete portfolio, from products to service and maintenance

Gas-insulated switchgear (GIS)

Find the complete portfolio for all environments and applications in "Design & System integration" section.

Air-insulated switchgear (AIS)

Hitachi Energy focuses on the continual development of new technologies to increase the eco-efficiency, availability and reliability of AIS substation products and has a century of practical experience to rely on. AIS primary substation equipment contains of a portfolio up to 420 kV, including live tank circuit breakers, instrument transformers, disconnectors, surge arresters, monitoring and controlled switching.

Hybrid Switchgear for 72.5 to 420 kV

Plug And Switch System (PASS) switchgear is a compact hybrid switchgear fully assembled and tested in factory, for rapid installation and energization. The PASS product family covers voltages from 72.5 to 420 kV encloses all functions of a complete switchgear bay in a single module.

The hybrid design allows outdoor installation and a significant space saving compared to traditional AIS equipment.

WHAT ABOUT MAINTENANCE & SERVICE?

To avoid failures, Hitachi Energy in France offers a wide range of services, providing the most comprehensive coverage and maintenance throughout the high-voltage products lifecycle (installation, commissioning, diagnosis, spare parts, retrofit, monitoring…)

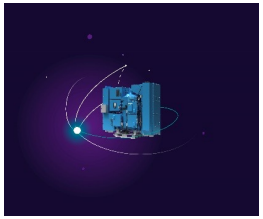
Switchgears / High-voltage products

SIEMENS energy

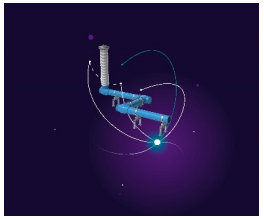
Ready for your Day Zero?

Zero SF6, Zero greenhouse gases - only clean air

8VN1 Blue GIS



8VM1 Blue GIS



Blue GIB

AIS product

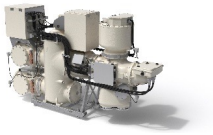
Our Blue circuit breakers with Zero F-gases and Zero harm make greener grids up to 145 kV achievable. Also for higher voltages up to 1100 kV we offer reliable live tank and dead tank circuit breakers as well as hybrid solutions combining different functions in a compact design, such as our Dead Tank Compact (DTC) and our Disconnecting Circuit Breaker (DCB).

Live tank circuit breakers

Dead tank circuit breakers

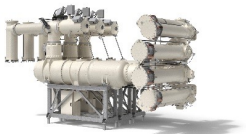
Disconnecting Circuit breaker

GIS product



8DN8 gas-insulated switchgear

8DN9 gas-insulated switchgear



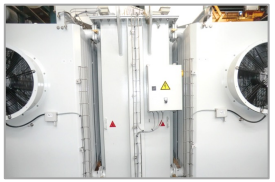
8DQ1 gas-insulated switchgear

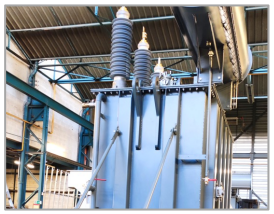
Power Transformers

celduc transfo

Unique tailored transformers for each project

With its integrated, on-demand and custom manufacturing 100% in France, celduc® can offer the best responsiveness and flexibility.
60 years of technical expertise in transformers design and construction with certified quality system.
Management of complex projects and adaptability to most exacting industrial organizations.
Expert knowledge of demanding regulatory environments : Ex, marine, offshore, etc.





- ONAN
- 20 MVA - YNd11 - 32kV-11kV
- OLTC ±10x1,5%
- Painting system : CX
- ATEX zone II certified

- ONAF
- 6,5 MVA - Dyn11 - 20kV-5,65kV
- DETC ±2,5% ±5%
- Painting system : C5-M

- OFAF
- 10MVA - YNd11 - 64kV-5,4kV
- DETC ±2,5% ±5%
- Painting system : C4-M

TECHNOLOGY

- Oil type transformers up to 30MVA, 72,5kV
- With DETC[1)] or OLTC[2)] if requested

Nota : 1) De-Energized Tap Changer **2)** On-load Tap Changer

GE VERNOVA

Grid Solutions' Power Transformer business designs, manufactures, tests and commissions all types of power transformers from medium to ultra-high voltage (1200kV AC and ±1100kV DC) and from small (5 MVA) to very large power ratings (2750 MVA) including :

Conventional Power Transformers

- Generator step-up & auxiliary transformers
- Small & Medium power transformers
- Large power transformers
- Autotransformers

Reactors

- Series reactors
- Earthing reactors
- Smoothing reactors
- Variable Shunt reactors

Special Transformers for Industry

- Electrical arc furnace (EAF) transformers
- Rectifier transformers
- Regulating transformers

Grid Solutions also provides bushings and advanced monitoring solutions for all types of applications

Power Transformers

HITACHI
Inspire the Next

A complete portfolio, from products to service and maintenance

Hitachi Energy

Hitachi Energy offers a complete range of power transformers and related components and parts. The Group has globally delivered more than 75,000 power transformers.

Main features:

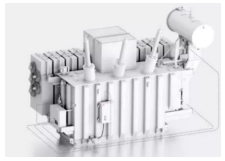
- Unit ratings: up to 1,500 MVA
- Primary voltage: up to 1,000 kV
- Load tap changers available
- Single-phase or three-phase

EconiQ™ Transformer

- 23% less of CO2eq emissions over the product lifecycle
- Reduced environmental impact
- Eliminating impact on surrounding ecosystems

TXpert™ Ecosystem

- Real-time surveillance & diagnosis
- Condition-based & predictive maintenance
- Remote access and asset management



CompactStar™ Transformer

- Premium, compact, and lightweight transformer
- Reduced overall TOC of offshore & urban substations
- Allow up to +30% capacity than conventional transformers

WHAT ABOUT MAINTENANCE & SERVICE?

To avoid failures, Hitachi Energy in France offers a wide range of services, providing the most comprehensive coverage and maintenance throughout the transformer lifecycle (installation, commissioning, diagnosis, spare parts, retrofit, monitoring…)

SIEMENS energy

We connect energy systems and bring power from where it's generated to where it's needed.

We are covering the full range of voltage up to 800KV and the full range of power up to 1300MVA

Various methods of cooling can be used depending on the individual service conditions to guarantee reliable and problem-free operation over many years. The most noteworthy are the ONAN, ONAF, OFAF, and ODAF oil-air cooling and OFWF and ODWF oil-water cooling systems

Large power transformers

are expertly engineered to convert voltage levels and optimize power plants and transmission networks.

Medium power transformers

bridge the gap between transmission and distribution networks worldwide, a key player in the global energy transition.

Key facts

Worldwide #1 market position in power transformers
Technology leadership more than 100 years
12 factories in 8 countries

Protection, Control and Monitoring

ABB

Distribution automation

- Modular Protection relays , Centralized protection, Virtualized protections, Digital substation, monitoring , Arc protection systems…

GE VERNOVA

GridBeats™

GridBeats™ is a portfolio of software-defined automation solutions designed for grid digitalization. It provides customers better visibility, faster deployment, increased resilience and enhanced operations. Currently, it comprises five solutions: Integrated Digital Substations, Energy Asset Performance Management, Device Management, Cybersecurity and Zonal Autonomous Control.

Distribution and industry protections

Multilin Agile is a compact, high-performance protection and control solution for distribution and industrial applications. It provides protection, monitoring & control functions, flexible configuration capabilities, with high level of cybersecurity.

Metering, power quality and PMU

The EPM family proposes IEC61000-4-30 Class A Power Quality, Phasor Measurement Unit (PMU), revenue metering class (0.2%) and transient fault disturbance recording.

Critical Infrastructure Communication

Communication systems using switches, power line carrier, optical networks and wireless solutions. Designed to be secure, flexible, and tailored to meet customers' objectives.

Automation solutions

PowerNode offers a variety of applications that can be adapted to existing or new installations including industry and power generation automation.

Monitoring & Diagnostics

Primary asset management software solutions, on-line DGA device monitoring, circuit breakers and switchgears monitoring solutions.

Protection, Control and Monitoring

Schneider Electric

Protection Relay

- Powerlogic P5/P7
- Modular conception, multi-protocole, IEC 61850 Ed2, Cybersecurity (P7 : IEC 62443 SL2)

Insulation monitoring

- IT system to improve safety installation
- Vigilohm to monitor the current leakage of the electrolyzers and ensure the safety through fault localisation

Thermal protection relay

- Monitoring of the core and winding temperature of transformers
- Smart relay

Advance protection

- **PowerLogic A1/A3** Arc flash detection and protection
- **PD100**: partial discharge

Easergy sensor

- **CL110**: wireless temperature & humidity measurement of your connections to detect loosening.
- **HeatTag**: Anticipated detection of cable heating

SIEMENS

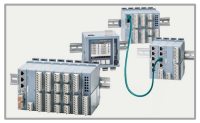
PROTECTION – SIPROTEC 5

With modularly designed hardware and software and its high-performance DIGSI 5 engineering tool, the SIPROTEC 5 product family of field devices is perfect for protection, control, monitoring, and measuring applications in electrical energy systems. It includes the universal protection relay and is capable to interface with SIPROTEC Digital Twin, a cloud-based platform that enables system optimization, upgrades and fault analysis for a virtual commissioning, saving time and costs.

PROTECTION – Reyrolle

Provides the total protection requirements of distribution markets and industrial applications – ranging from overcurrent protection via transformer protection and voltage control to a full spectrum of auxiliary and trip relays.

CONTROL – SICAM A8000



- Suitable for rough ambient conditions thanks to mechanically stable modules and an extended temperature range from -40 to +70 °C
- High voltage strength up to 5 kV (IEC 60255) for use directly in substations
- Automation functions (IEC 61131-3), e.g., for controlling a regulated distribution transformer or for load control

CONTROL – SICAM 8 Power Automation Platform

Software solution enabling the integration of different application modules (like SICAM HMI, controllers) for expandability possibility. It servers as base for different application, like Load Shedding, Generation/ Microgrid Control for renewable integration

MONITORING the energy system – Electrification X

One integrated IoT suite to master all challenges of the energy transition incl. different feature sets, from asset management to allow continuous monitoring of electrical assets to Sustainability Energy Management to monitor the energy mix.

Power Quality and Harmonic Filters

Danfoss Advanced Active Filter AAF 007

> 98.2% filter efficiency using advanced SiC technology

The Danfoss Advanced Active Filter AAF 007 is designed to reduce harmonic distortion of central or decentrally installed Danfoss drives. The newest-generation SiC switches give unmatched high efficiency with 60% lower power losses compared to similar filters and effective elimination of high-order harmonics. The filter is compatible with all drives in the Danfoss product portfolio, and is delivered pre-configured and tuned from factory, ready to use with the accompanying current transducers.

Line voltage and filter current

3 x 380-480 V AC, 35 A/ 55 A/100 A/ 150 A modules. Maximum 600 A with 4 x 150 A modules mounted in parallel.

Harmonic mitigation: Danfoss Advanced Active Filter AAF 007 | Danfoss

GE VERNOVA

HV Compensation & Filtering Products and solutions

GE Vernova's Power Quality Products offer a broad scope of reactive power compensation and harmonic filtering solutions that help customers to improve the performance of their installations through energy savings and better power quality, enabling end users to reduce their cost of ownership and the environment impact of their operations.

Open rack as well as Metal Enclosed bank & filters available.

HV & MV Harmonic filters

Air Core Reactors

Series & shunt capacitor banks

Power Quality and Harmonic Filters

HITACHI
Inspire the Next

Hitachi Energy

Improving power quality for grid efficiency and reliability

Hitachi Energy offers a proven portfolio of Power Quality solutions to support grid operators and large industrial power consumers alike.
Hitachi Energy's solutions improve the power quality of electrical networks by eliminating disturbances and improving power factor in line with the grid requirements.
Its teams of power quality specialists can provide end-to-end support to customers, from the diagnosis of power quality issues through to design, installation, commissioning and after sales service.

Capacitor banks, improve the power factor in the network

Harmonic filters, filter the harmonics in the system to acceptable levels; improve voltage stability & lower network losses

Static Var Compensation (SVC), steady-state and dynamic voltage control of power distribution & transmission systems

Shunt reactors, is an absorber of reactive power, thus, increasing the energy efficiency of the system

Low and High Power STATCOM, dynamic voltage control of power distribution & transmission systems for power system applications

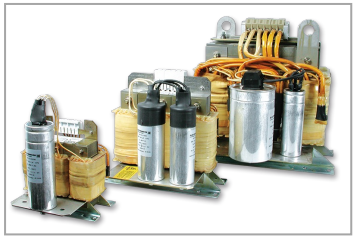
SVC + STATCOM (hybrid solutions), easy extension of dynamic range, superior contingency handling & lower total losses

KEB

Filter portfolio

HIGH-FREQUENCY FILTERS

- Mains-bound, high-frequency interference suppression
- AC and DC standard filters with reduced leakage current
- Also available in variants for IT networks



HARMONICS FILTERS

- Passive solution for reducing network harmonics
- Reduce the THDi to < 8 % and the PWHD to < 15 %
- Compact design

COMMON MODE FILTERS

- Reduce symetrical and asymetrical interference.
- Create a sinusoidal voltage and current at the drive controller output
- A defined DC network can be created in conjunction with AIC

TECHNOLOGY

- Full range of AC and DC filters portfolio
- Harmonics filters, THDI < 8%, 1,5...250 kW
- LCL filter 3x400/480V, 9,5A...460 A

Power Quality and Harmonic Filters

Schneider Electric

LV Active Harmonic filter

AccuSine PCS+
- Up to 300 A per cabinet
- Up to 690V

Power factor correction

AccuSine PFV+
- Up to 690 kVAR
- Up to 690 V

VarSet
- 400V/415V 50/60Hz
- Up to 1150kVAR

UPS Galaxy VS / VL / VX

Provide energy for the safe stop operation of your electrolysers whatever the situation during power outage

Power monitoring expert

Allows tracking of real-time power conditions to help improve efficiency and reliability, providing full visibility into your power system.

Power quality meter

PM8000 - Monitor seamlessly the harmonic content of your installation to prevent degradation or penalties with your energy provider.

SIEMENS

SICAM PQS – data collection and archiving

Central collection and archiving of all fault records and power quality data from field level devices, irrespective of their manufacturer.

SICAM Q100

Multifunctional measuring device is used for acquisition, visualization, evaluation, and transmission of electrically measured variables such as alternating current, alternating voltage, frequency, power, harmonics, etc.

SICAM Q200

Network analyzer for the high-definition acquisition and assessment of the power quality in electrical power supply systems. It offers algorithms and functions for energy management applications. The device supports continuous acquisition and analysis of all relevant parameters. These results help to identify and implement quality programs to ensure the supply quality.

SICAM PQ Analyzer – monitoring and analysis

With comprehensive evaluation options for archived PQ measuring data and fault records. It includes measured value testing compared to Power Quality Standards and individually specified limits (Grid Code Evaluation) for target-oriented analysis and reports.

SIPROTEC Fault Recorder

The complexity of electrical power systems has increased, making the monitoring of wide areas essential, where fault recorders and phasor measurement units (PMUs) play an important role to understand the conditions in the wide area while analyzing the fault location, protection behavior, and system stability as well as monitoring the phasor measurement.

Power Quality and Harmonic Filters

SIEMENS energy

An innovative portfolio of technology to meet today's transmission challenges

Flexible AC transmission systems help to stabilize grids to meet todays' challenges in power transmission. Stay ahead with Siemens Energy long-term, flexible and sustainable innovations based on proven power electronics to shape future grids.

SVC PLUS® (STATCOM)

SVC PLUS FS® (E-STATCOM)

Synchronous condenser

Siemens Energy is active worldwide and has proven experience with all technical and environmental challenges in transmission grids. Even industries worldwide rely on solutions from Siemens Energy to optimize their power supply for smooth operation and compliance to utility regulations. With Flexible AC transmission system projects executed up to the highest voltage level over the whole FACTS portfolio Siemens Energy can call oneself world market and technology leader.

Fixed series capacitor (FSC)

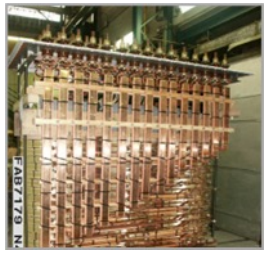
Mechanically switched capacitors (MSC and MSCDN)

Unified power flow controller (UPFC PLUS®)

Rectifier Transformers

celduc transfo

Expert in multi-windings transformers for electrolysers and industrial applications



- ONAN
- 13 MVA
- 15 secondaries with specific delta vector groups
- 11kV-630V

- ONAN
- 10,6 MVA
- D d0-22,5°d0-7,5°d0+7,5°d0+22,5°
- 20kV-1,85kV
- Painting : C5-M system

- ONAN
- 2,6 MVA
- D d0-22,5°d0-7,5°d0+7,5°d0+22,5°
- 500V-40V

TECHNOLOGY

- Oil type transformers up to 30MVA, 72,5kV
- With DETC[1)] or OLTC[2)] if requested
- Multi-secondaries and adapted to specified harmonics spectrum

Nota : 1) De-Energized Tap Changer **2)** On-load Tap Changer

HITACHI Inspire the Next

A complete portfolio, from products to service and maintenance

Hitachi Energy

Hitachi Energy's rectifiers transformer are incorporated in a containerized solution converting AC current to DC for H2 production through water electrolysis.

- **Applications range** from large aluminum electrolysis to medium size operations
- The transformers may have a **built-in or separate voltage regulation unit**
- **Rectiformers (rectifiers transformers) can be supplied as a single tank solution** for applications up to a rating of ~160 MVA, but for larger ratings, transport limitations normally require that two transformers be supplied as separate units

Full rectifier transformer portfolio

- From small containerized up to large scale solutions
- Solutions for AFE, DB, DSS rectifiers & multi-winding units
- Combined with a diode or thyristor rectifier

Wide current, voltage and power ranges:

- Power from 1 up to 350 MVA
- Installed base of over 20,000 MVA
- Frequency 50 & 60 Hz
- HV Voltage from 6 up to 220 kV
- LV Voltage from 0.08 to 1.5 KV
- LV Current from 4 to 200 KA

Rectifier Transformers

Schneider Electric

Trihal transformer

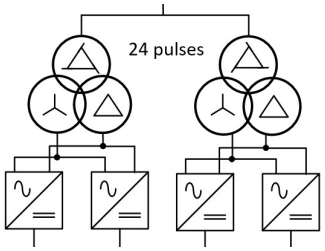
- Up to 20MVA AN / 25MVA AF
- State of the art performances
  E4 C4 F1 <5pC
- EcoDesign for reduced opex
- Sustainable
  Up to 96,5% recyclable
- Up to 36kV HV insulation
- Class F or H

Transformer HTB/HTA Monitoring

- EcoStuxure Transformer Expert

Thermal protection relay

- Monitoring of the core and winding temperature
- Smart relay



Transformer for Rectifiers

12 pulses:
- 3 windings secondaries
- Vector group: Dy5d6

24 pulses:
- Extended delta
- 2 x 3 windings transformers

Sensors

- Thermal monitoring MV and LV connexion
- Monitoring of the core and winding temperature
- Wireless thermal sensor for connexions
- PT100 Sensors

SIEMENS energy

We provide key assets at the first and last step of power grids

Siemens Energy complies with the laws and regulations affecting distribution transformers

Key facts

- Worldwide #2 Position in Distribution Transformer (DT)
- Technology leader in respect to (DT) Offshore Wind applications
- 12 factories in 10 countries

Main products	Ratings	Frequencies	
GEAFOL / CARECO dry type distribution and converter transformers	up to 50 MVA up to Um 72,5 kV	16,7 / 50 / 60 Hz	
Fluid-Immersed Distribution Transformers	up to 5 MVA up to 36 kV	50 or 60 Hz	

AC/DC rectifiers

Rectifier portfolio

DCS880

- Thyristor-based
- Up to 20 MW+
- Voltage DC: 10V up to 1500 V
- Air-cooled
- THDi: Rectifier and plant configuration dependent
- Power factor: 0.90-0.95
- Small footprint, 4500 kW/m2
- 6-, 12-, 18-, 24-pulse
- Indoor/Outdoor in container

ACS880

- IGBT- or Diode with DC chopper-based
- Up to 10MW
- Voltage DC: 600 up to 1000 v
- Air-cooled or Liquid-cooled
- THDi < 3%
- Power factor: 0.99-1.00
- Ultra-low harmonic AC voltage
- Low to none reactive power
- Indoor/Outdoor in container 6m and 12m

Outdoor IGBT

- IGBT-based
- Up to 10MW
- Voltage DC: 850V up to 1500V
- Air-cooled
- THDi < 3%
- Power factor: 0.99-1.00
- Ultra-low harmonic AC voltage
- Low to none reactive power
- Indoor/Outdoor skid-mounted 6m and 12m

Unirec H2

Air cooled module

- DC Current modules up to 4.5 kA, Scalable up to 18 kA
- Compact footprint
- Withdrawable rectifiers options

AEG POWER SOLUTIONS

<2 MW
Rectifier module

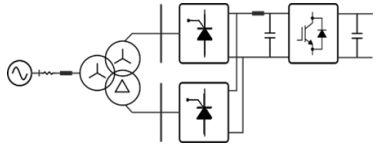
<4 MW
Power Frame Solution

<16 MW
Power Block Solution

AEG Power Solutions provides the optimal technologies to address any customer needs!

3 Levels Active Front End
Up to 1500Vdc/2000A per module

6/12P Diode + DC/DC chopper
Up to 1000Vdc/3000A per module



Our solutions are designed to optimize renewable energy use, promoting sustainable hydrogen production.

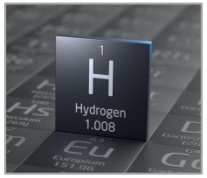
AC/DC rectifiers

comeca

energy in motion

ALLHYDRE product range

Our rectifying solutions stand out for their excellent efficiency, high power factor, and low ripple rate or residual harmonics. Leveraging Comeca's expertise across domains - like thermal engineering, electronics, and system integration - our **ALLHYDRE** range offers highly versatile, scalable, and containerisable solutions designed to support all electrolyser technologies.



ALLHYDRE LAB

- Allhydre LAB is a single-phase switching rectifier up to 2.4 kW dedicated to small installations or experiments.

ALLHYDRE MOB

- Allhydre MOB is a three-phase switching current IGBT rectifier with a maximum capacity of 240 kW per module and up to 1,2 MW.

ALLHYDRE PRO

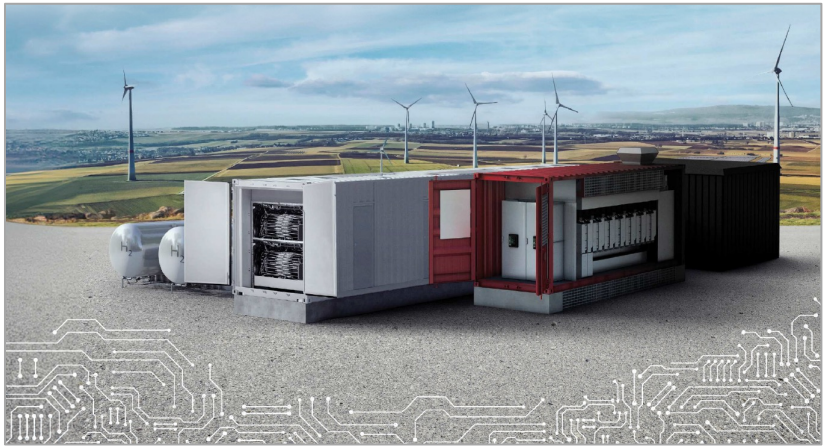
- Allhydre PRO is an IGBT power brick designed solution allowing high flexibility current and voltage output, up to 700V or up to 2800A for a max operation of 1 MW.

ALLHYDRE PRIME

- Allhydre PRIME is a modular power IGBT solution to meet power needs from 1.2 to 5 MW or their multiples with a max output voltage of 1500V and a THDi < 5% .

Danfoss

iC7-Hybrid



Open up for intelligent power conversion

The iC7-Hybrid power converter is your ticket to join the energy transition. Tap into energy savings with hybrid and pure electric solutions in marine power conversion. Enhance smart grid applications such as energy storage, shore supply, charging and electrolysis.

Supply voltage and power range

- Voltage rating:
  - 3 x 380-500 VAC, 460-800 VDC
  - 3 x 525-690 VAC, 640-1100 VDC
  - Higher voltage on request up to 1500 VD
- Current rating: 236-8000 A
- Power range: 0.25 - 9.5 MVA and beyond

iC7-Hybrid | Danfoss

AC/DC rectifiers

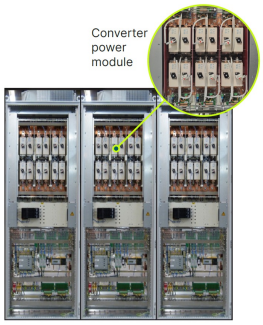
GE VERNOVA

Power Conversion's high-current rectifier systems are an optimized and flexible solution to meet large scale solutions for many heavy industrial processes such as electrochemical, hydrogen production and other specialized applications. Our offering will support configurations from 0 kA to 45 kA of DC output current.

Thyristor-based solutions

Our Powersemi PW water-cooled rectifier solutions are optimized for large-scale electrolyzer stacks at 25 MVA, whereas our Powersemi PA air-cooled rectifier solutions enable building blocks from 5 to 10 MVA.

- High power density using press-pack SCR (thyristor)
- Varied uses for DC and synchronous drives
- High reliability as designed for n-1 operation with rated current
- 12/24/48 or higher
- Ready for container installation



Air-cooled rectifier

IGBT-based solutions

Our IGBT solution for electrolyzers allows for an elimination of harmonic filters or compensation as well as providing additional ancillary grid services. The degradation of electrolyzer stacks is managed through our fully integrated solutions enabling smooth operation and reduced maintenance throughout the life cycle of the electrolyzer system. The IGBT solution is designed as an active front end (AFE) and is connected at the output of the DC link with the electrolyzer stacks for a typical building block from 1 to 10 MVA.


Water-cooled rectifier

- Reliable, robust, and proven design with reduced installation time
- High flexibility through a variety of ratings
- High grid quality eliminating the need for harmonic filters and allowing for provision of ancillary services

KEB

Module F5-AIC AC/DC

- Low harmonic active rectifier
- Power factor correction (PFC) and cos φ regulation
- Stabilised, controlled DC voltage

Inverter F6 DC/AC

- AC/AC or DC/AC conversion
- Air or liquid cooling
- Switching frequency up to 16 khz

Module R6 AC/DC

- Passive rectifier
- 6-pulse thyristor technology
- DC protection and monitoring

TECHNOLOGY

- A full range of AC/DC or DC/AC converter, AIC technology (ACTIVE-INFEED-CONVERTER)
- Wide current, voltage and power ranges: up to 1005 kVA, 400 VAC, 840 VDC

Medium-voltage distribution

ABB

Primary Distribution

AIS UniGear ZS1,ZS2 - GIS ZX range

- For primary distribution, up to 36 kV.
- Manufactured and supported on 6 continents.
- Approved for specific applications such as marine, seismic and nuclear.
- Available in digital version (Sensors, monitoring…)

Secondary Distribution

AIS Unisec (24kV Max) - GIS Safeplus (36 kV Max)

- Suitable for marine conditions, high seismic risk areas and low temperature environments
- Space-efficient design, compact functional units
- Modular, flexible design: simple, easy installation, operation and maintenance.

Schneider Electric

PRIMARY SWITCHGEAR

PIX and Mcset

- AIS
- Modular
- Withdrawable vacuum CB
- Up to 24kV
- Up to 4000A & 5000A / 31,5kA

F400

- AIS
- Modular
- Withdrawable Vacuum CB
- Up to 36kV
- Up to 2500A / 31,5kA

MV motors soft starter & drives

ATV

- From 3,3kV to 13,8kV
- From 300kVA to 25MVA

SECONDARY SWITCHGEAR

SM Airset

- AIS
- Modular
- 24kV
- Up to 1250A / 20kA

RM AirSet Ring Main Unit

- GIS
- Compact
- Up to 24kV
- 630A / 20kA

Premset

- 2SIS
- Up to 17,5kV
- Up to 1250A/25kA
- IEC/UL

Medium-voltage distribution

SIEMENS

PRIMARY SWITCHGEAR

Blue GIS – SF6 Free

- Up to 12 kV/ 40 kA/ 2750 A
- Up to 24kV/ 25 kA/ 1250 A
- Insulating medium based on the components of the ambient air
- Switching principle based on vacuum technology
- Proven GIS design

NXAIR Air-insulated switchgear (AIS)

- Up to 17.5 kV/ 50 kA/ 4000 A; up to 24 kV/ 25 kA/ 2500 A; up to 36 kV/ 31.5 kA/ 2900 A
- Air as insulating medium always available
- Marine certification
- SIQuench® for active arc effect mitigation system

SECONDARY SWITCHGEAR

Blue GIS – SF6 Free

- Up to 12 kV / 20 kA / 630 A
- Up to 24 kV / 20 kA / 630 A
- Insulating medium based on the components of the ambient air
- Sensor-based system that can be controlled at different levels

PRIMARY & SECONDARY SWITCHGEAR

8DA10/8DB10/ NXPLUS/ 8DDJH Gas-insulated switchgear (GIS)

- Up to 40.5 kV/ 40 kA/ 5000 A
- Hermetically sealed primary enclosure
- Busbar and circuit breaker are single-pole encapsulated in different vessels (IP65)
- 8DA10/ 8DB10 with two- and three-phase short circuits not possible because of single-phase encapsulation

Low-voltage distribution

ABB

MNS 3.0 Front Access – MCC / PCC Up to 6300A and 100kA

Standards : IEC/TR 61641 Ed.3 complying with criteria 1 to 7 – IEC 61439-2

Module connectivity versions : Withdrawable - Plug-in including compact - Fixed

Busbar configurations : L and U turn configurations - Back-to-back – Duplex - Power Delivery Units (PDU)

MNS Rear – MCC/ PCC Up to 7300A and 100kA

Standards : IEC/TR 61641 Ed.3 complying with criteria 1 to 7 – IEC 61439-2

Module connectivity versions : Withdrawable – Fixed

Access : to cable terminals from the rear to modules from the front

Control Cabinet – Customized solution

Design Engineering Built to print or Built to Spec - Prototyping

Industrialization Lean Manufacturing - Testing - High Complexity level

Aventech connecting energies by Reipa

LV Switchboard - OMERYS

- MCC/PCC – Fix & Withdrawable
- Modular Panel/ Reliabe & Sustainable Design
- Continuity of Service
- Up to 6300A
- IS333 – Form 4b
- Specific test/ Short circuit courant Test / Busbar

Customized Electrical Panel

- Electrical distribution
- Control & Command
- Automation (PCU, Safety,..)
- Scada

Gas Process/Electrical Cabinet

- Instrumentation
- Piping LP/HP
- Gas Manifold
- Specific enclosure and certified equipments for ATEX environment

Low-voltage distribution

comeca

energy in motion

Distribution Boards and Smart Motor Control Centers dedicated to continuous process

Withdrawable technology resulting from our Oil & Gas and off-shore experience. Large portfolio of solutions and panels.
FFF (IS111) to WWW (IS333).

When smart solutions are required for critical motor starters , GemStart ensures continuity of services and predictive maintenance of motors for pumps or ventilation in ATEX zones.

Key benefits

When reliability, operational safety, service continuity and lifespan matters.

We provide plant and personal protection by proven internal arc withstand.

Our designs are verified with multi-brand components according to IEC 61439-1 & -2 and beyond these requirements as for example environmental or seismics when required.

MARECHAL ELECTRIC

MARECHAL® TECHNOR® MELTRIC®

Low voltage electrical connection systems

- For industrial environments
- Safe areas or hazardous areas (ATEX zones 1, 2, 21, 22)

Plug and socket-outlet

- Up to 660 A / 1 100 V AC/1 500 V DC

Switch-disconnector

- Up to 18,5 kW

Single pole connector

- Up to 1 250 A / 1 000 V AC/1 500 V DC

Multipins connectors

- Up to 37 contacts

Electrical boxes

- Junction boxes & distribution boxes
- Fire resistant boxes

Lighting for ATEX areas

- LED linear, floodlight and well glass lighting fixtures

Low-voltage distribution

Schneider Electric

Air Circuit Breaker

- Up to 6300A ac & 1000 V ac
- Up to 4000A and 1500 Vdc
- Optional motorisation

MCCB

- Up to 3200A
- Up to 690V ac
- Optional motorisation

LV motors soft starter & drives

- Control water feed pumps of your electrolysers
- High power drive for H2 compression

Switch and disconnector

- ComPact INS up to 2500A
- Compact NSX/NA up to 630A
- Optional motorisation

Busway

- Save time and space
- Up to 1000Vdc
- Up to 10kA

iPMCC: the digital control layer for BlokSet and Okken

- Intelligent Power & Motor Control Center
- Water feed pumps of your electrolysers
- High power drive for H2 compression

SIEMENS

SIVACON S8plus Power

Complete portfolio of AC/DC Busbars with SIVACON 8PS trunking systems

- 800 A to 6 300 A with high short-circuit rating
- Design verified switchgear and control gear assembly according to IEC 61439-1/-6
- Safe connection to SIVACON S8 switchboards and transformers
- High degree of protection and fire safety
- Reliable operation due to high operating voltage and full load at high ambient temperature (40 °C)

Distribution Board and Motor Control Center

- Up to 690 V / 150 kA (Icw) / 7 010 A
- Integrated solution for intelligent power distribution with links to automation and energy management systems
- Design verified power switchgear and control gear assembly according to IEC 61439-2 in single-/double-front designs (Marine Certification available)
- High level of safety for personnel and switchboard: arc fault test according to IEC/TR 61641 and optional, active, and resettable arc fault protection system
- Combination of different mounting designs: withdrawable, fixed mounted, and plug-in

TECHNOLOGY

- Flexible, modular, cost-efficient, and space saving solution
- Preventive maintenance supported by diagnostic information

PART 2

COMPANIES DIRECTORY

GIMELEC

GIMELEC H_2 COMMITEE : Solution Providers

Company pages – summary

ABB

Who we are?

ABB is a technology leader in electrification and automation, enabling a more sustainable and resource-efficient future. The company's solutions connect engineering know-how and software to optimize how things are manufactured, moved, powered and operated.

Positioning

Following our purpose and leveraging our strong positions in Electrification, Motion, Process Automation and Robotics & Discrete Automation, we aim to create superior value for all our stakeholders. ABB can be your partner for any H2 Power Supply solution for electrolyzers plants at any stage: concept, pre-FEED, FEED stage, project execution and after sales support with long-term service agreement (LTSA).

DESIGN | PROCUREMENT | INSTALLATION & COMMISSIONNING | MAINTENANCE

Track-records / references

ABB is one of the world's leading suppliers of power electronics.
Since 1958, we have supplied over 750 rectifier systems for chemical plants worldwide. Today, we remain committed to advancing DC power supplies for green hydrogen production, enabling decarbonization efforts in heavy industries and contributing to a low-carbon future.

ABB advanced power technology to play key role in green hydrogen pilot project

ABB rectifier system powers Mitsubishi Heavy Industries' hydrogen production technology development

Design

IGBT, Diode, Thyristor-based rectifiers for electrolyzers
Include air and liquid cooling

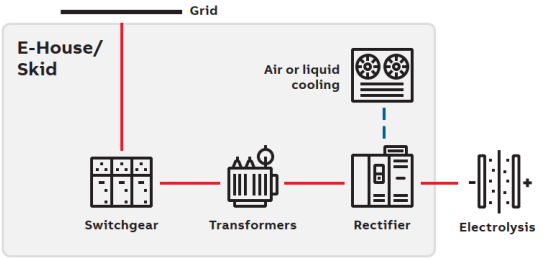
Products

IGBT, Diode, Thyristor-based rectifiers
Power supply system

Packages and turnkey solutions

We design holistically for perfect fit and complete package performance including third party products

Packaged solution: Switchgear, transformers, rectifiers and control systems



Services

On-site services: supervision of installation, commissioning, training, spares & consumables
Digital: Remote Assistance; ABB Ability™ rectifier condition monitoring, EMS
Extending lifetime, Life cycle assessment, upgrades, retrofits and modernization
Performance: engineering and consulting, inspection and diagnostics, workshop repair, Long-Term Service Agreement (LTSA), Maintenance

More than 1,200 field service engineers, together with over 600 service partners and approximately 50 workshops

Contact

sebastien.meunier@fr.abb.com

AEG PS

AEG POWER SOLUTIONS

Who we are?

AEGPS is committed to advancing the green hydrogen market, providing a unique offering in electrolysis processes. For over 75 years, we have been taking on all industries, all environments and all challenges. Our impressive portfolio of power supply and power conversion systems, ranging from AC and DC UPS, battery chargers, rectifiers, inverters and converter systems, including services and maintenance, makes us **a world leader** in power conversion and storage.
In AEG Power Solutions, we **Power** a **Sustainable** future !

Positioning

DESIGN | PROCUREMENT | INSTALLATION & COMMISSIONNING | MAINTENANCE

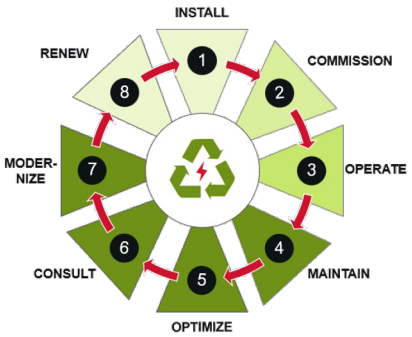
Track-records / references

More than **250MW installed** process power supply for hydrogen production !

- **100MW** Under execution (Green Steel – Germany)
- **16 MW** delivered (Grid support - French Guyana)
- **+30MW** of Power conversion to a German ELX OEM system since 2020
- **16MW** of Power conversion to Danish main ELX OEM

Services

- 52 Service Partners worldwide
- **120 Service engineers**
- Complete Service offering
- 24/7 Maintenance



Design

Our products portfolio covers all technologies: Multipulse diode, 3-Level AFE, 6/12P diode + dc/dc chopper. **AEG Power Solutions** has the product that fits your needs !

Products

DC3 (1 module)
6/12P diode + dc/dc chopper
Output voltage: up to 1000Vdc
Output current: up to 3200Adc
Modularity: Up to 8 modules together !
Leaflet here

DC4 (1 module)
Full IGBT: 3-Levels AFE
Output voltage: up to 1500Vdc
Output current: up to 2000Adc
Modularity: Up to 8 modules together !
Leaflet here

Packages and turnkey solutions

We offer complete turnkey solution to power your electrolyser!

Example of 8MW Power conversion system for an electrolyzer OEM

Contact

Thibault MURCIA – Product Manager Energy Transition
thibault.murcia@aegps.com

Aventech

Who we are?

Expert in engineering, manufacturing and industrialization of electrical equipments in harsh environment
Being an industrial system integrator and electrical panels builder, we support our client from the design of their solution up to the execution project.
We have 50 years of experience in the industry, renewable energies (solar, BESS, Wind turbine, Hydroelectricity), electrical network and mobility (railway and EV mobility).
Our company works on specific unique projects and/or standardized/high volume productions for big deployment in Europe and overseas.

Positioning

DESIGN → PROCUREMENT SUPPLY CHAIN → MANUFACTURING INDUSTRIALIZATION → FAT PACKING DELIVERY SAT

Track-records / references :

- **MCPHY** (Electrical and control panel for fueling station)
- **ATAWEY** (Electrical and Control panel for fueling station)
- **ATAWEY** (E-House : Turnkey containerized fueling station for compression)
- **INOCEL** (Turnkey containerized solution for fuel cell)

Design :

Electrical and mechanical engineering (enclosure electrical cabinet, structure for E-House, Piping, HVAC, Extinguish system...)

Products :

LV Switchboard **OMERYS** (modular electrical panel for new energies market, industry and mobility)

Packages and Turnkey solutions

Based on ISO container, specific E-House or skid, we can build a turnkey solution ready to connect including electrical and process of our client (Electrolyser, PAC, rectifier, LV equipments, Water treatment, pipping...)

Stand alone product : LV Switboards for outdoor conditions or inside production areas

Services

- Engineering
- Sourcing/Procurement (every featuring)
- Management of suppy chain (inbound & outbound flows)
- Lean Manufacturing
- Standardization & Industrialization
- Control & Test
- Supervision on site

Contact

arthur.adalsberg@aventech-e.com

celduc® transfo

Who we are?

Since 1962, we have been industry leaders in the design and manufacture of power transformers and custom-tailored transformers. Our extensive experience allows us to engineer, produce, test, and install transformers that precisely meet our customers' unique requirements. Our products are renowned for their durability and reliability, making them ideal for use in challenging environments such as industrial sites, offshore locations, and ATEX zones.

We strive to be highly responsive and flexible, adapting to the specific technical and logistical needs of each project and customer. Our transformers are fully designed and manufactured in France, at our historic facility in Sorbiers.

Positioning

We excel in creating multi-secondary transformers, which are widely used to feed power rectifiers. Our expertise makes us exceptionally well-suited to supply both power transformers and rectifier transformers for electrolyze applications.

We also actively contribute to the energy transition and hydrogen development by supplying transformers for powering motors and compressors in large chemical industries. Our transformers are extensively used in processes where hydrogen is produced, stored, or transferred.

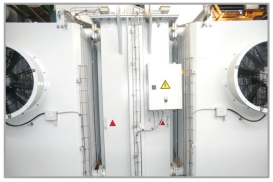
DESIGN | PROCUREMENT | INSTALLATION & COMMISSIONNING | MAINTENANCE

Track-records / references

- Rectifier transformer integrated in Bernard Bonnefonds solution to feed John Cockerill electrolysis stack
- Many projects for multi-secondaries transformers to feed rectifiers for ABB, GE Vernova…

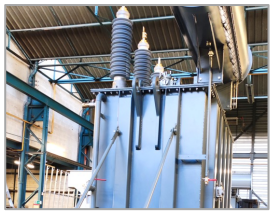
Design

Tailor-made transformers, based on customers' specifications
Capacity to endure high harmonic content
Rugged design to operate in harsh environments (corrosion, heat…)
Mastering different cooling methods : ONAN, ONAF, OFAF, OFWF…


Products

Power transformers
Rectifier transformers
Special transformers, multi-secondaries : 12-pulse, 24-pulse…
From ~100kVA to ~30MVA – 72,5kV
Oil type – copper windings



Services

Technical support
Installation and maintenance support

Contact

cmondesert@celduc.com
www.celduc-transfo.com

Comeca

Who we are?

We are creators of energy management solutions, a French group with 8 international locations. As a multi-brand integrator, we provide our customers with the best solutions to their needs by combining power electronics and conversion solutions. With COMECA, you will have the guarantee of peace of mind, efficiency and longevity of your installations.
Our solutions contribute to decarbonization and are already used by more than 2,000 customers around the world. They are present in the sectors of energy production & distribution, severe off-shore or on-shore environments, rail and port infrastructures and electric vehicle charging.

Positioning

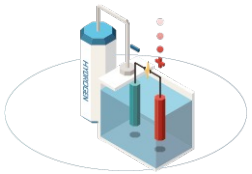
DESIGN | PROCUREMENT & PRODUCTION | INSTALLATION & COMMISSIONNING | SERVICES OVER LIFE CYCLE

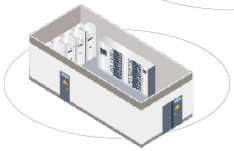
We offer a wide range of solutions for powering the electrolyser, whether the rectifier alone or the rectifier-transformer assembly. Our range provides an efficient response to the needs of mobility, industry and mass production.

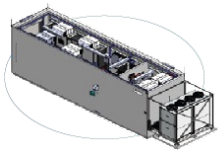
We can also study and manufacture specific rectifiers and DC/DC converters, for unique project or repetitive production.

Our control panels and our low-voltage withdrawable panels are the solution to the requirements of safety, reliability and continuity of services for all motors on production sites.

The assemblies can be integrated on request into prefabricated or containerized stations.







Track-records / references

France
- CMI : 12 rectifiers 4 x 374 kW & 8 x 412 kW
- AREVA : 2 rectifiers 540 kW
- COFELY INEO : 1 rectifier 400 kW
- ELOGEN : 2 rectifiers 280 kW and 150 kW
- ENHYWERE : rectifiers 180 kW and Ctrl cabinets
- QAIR : Hyd'Occ project 20 MW.

Spain
- SGL : 5 rectifiers for a total power of 2 MW

Romania
- ACI : 2 rectifiers 750 kW

South Korea
- SOJEON : 2 rectifiers 2 MW and 3 MW

Services

Supervision and anticipation: Via local interface, remote monitoring, remote maintenance or control and supervision system,

Prediction of the aging of the converter/electrolyzer couple,

Installation, commissioning of our equipment, training, technical assistance, preventive and corrective maintenance.

Management of obsolescence and spare parts.

Contact

e.gourier@comeca-group.com
https://hydrogene.comeca-group.com

DANFOSS

Who we are?

Danfoss Power Electronics and Drives Drives is a global leader in AC/DC and DC/DC power conversion, as well as variable speed control for electric motors. With the world's largest portfolio of power converters, iC7 drives, VLT® drives, and VACON® drives at your fingertips – and backing from a partner whose legacy has been built on decades of passion and experience – your journey to a better future is only just beginning.

With more than 35 millions converters delivered since 1968, with 9 factories for drives in the world, with offices in more than 80 country, we are ready for GW electrolyzer projects.

Positioning

DESIGN | PROCUREMENT | INSTALLATION & COMMISSIONNING | MAINTENANCE

Danfoss provides rectifier solutions for all electrolyzer technologies with a large range current up to 6000 A and voltage up to 1500 VDC.
Dedicated high voltage solutions can be studied on request for large project.
Solutions could be suitable for indoor or outdoor installations.
Technologies used are selected to meet low–harmonic and high efficiency requirements.
Rectifiers installations will be managed by Danfoss Partners or Danfoss customers.
Rectifiers commissioning and services will be managed by Danfoss.

Track-records / références

- Europe (under NDA) : 2024 - 200 MW for PEM electrolyser
- Denmark : 2022 - 20 MW for alkaline electrolyser,
- UK : 2023 - 2 MW for PEM electrolyser,
- Austria : 2023 - 3 MW for alkaline electrolyzer
- France : 2023-2024, 3 MW for SOEC electrolyzer

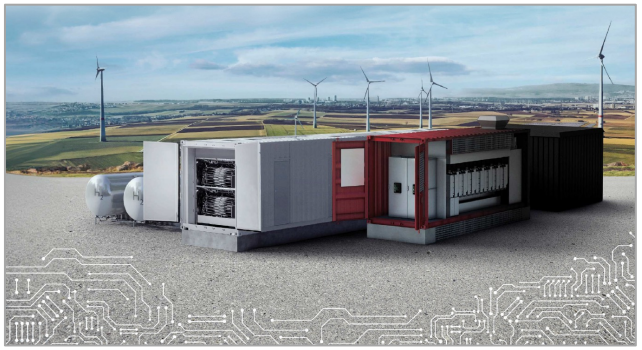
Design

Based on power modules manufactured in large series, Danfoss Drives could provide standard solutions or customized solutions, according the specific requirements of the project. The scope of supply could be discussed on project case.

Products

Solutions are based on different of power modules manufactured in large series :

- iC7 Hybrid : iC7-Hybrid | Danfoss
- iC7 automation air cooled system module : iC7-Automation | Danfoss
- VACON® NXP Grid Converter : VACON® NXP Grid Converter | Danfoss
- VACON® NXP DC/DC Converter : VACON® NXP DC/DC Converter | Danfoss
- VACON® 3000 Enclosed Drive : VACON® 3000 Enclosed Drive | Danfoss



Packages and turnkey solutions

As converter manufacturer, Danfoss is mainly focused on the rectifier part. It could be provided in IP00 modules for OEMs or System Integrators. It could be also provided indoor or outdoor for installer or final customer.
Transformers from external manufacturer could be managed on certain case by Danfoss or by partners or customers.

Services

Danfoss **DrivePro®** Lifecycle Services is a collection of tailor-made products designed around customers needs.
From optimized spare part packages to condition-monitoring solutions, we deliver customized service offerings to support your business through the different lifecycle stages of your power converters.

Contact

pascal.paucod@danfoss.com

GE VERNOVA

GE VERNOVA

Who we are?

GE Vernova Inc. is a purpose-built global energy company that includes Power, Wind, and Electrification segments and is supported by its accelerator businesses. Building on over 130 years of experience tackling the world's challenges, GE Vernova is uniquely positioned to help lead the energy transition by continuing to electrify the world while simultaneously working to decarbonize it. GE Vernova helps customers power economies and deliver electricity that is vital to health, safety, security, and improved quality of life. GE Vernova is headquartered in Cambridge, Massachusetts, U.S., with approximately 75,000 employees across 100+ countries around the world. Supported by the Company's purpose, The Energy to Change the World, GE Vernova technology helps deliver a more affordable, reliable, sustainable, and secure energy future.

GE Vernova's Grid Solutions business electrifies the world with advanced grid technologies and systems, enabling power transmission and distribution from the point of generation to point of consumption, and supporting a decarbonized and secured energy transition.

Positioning

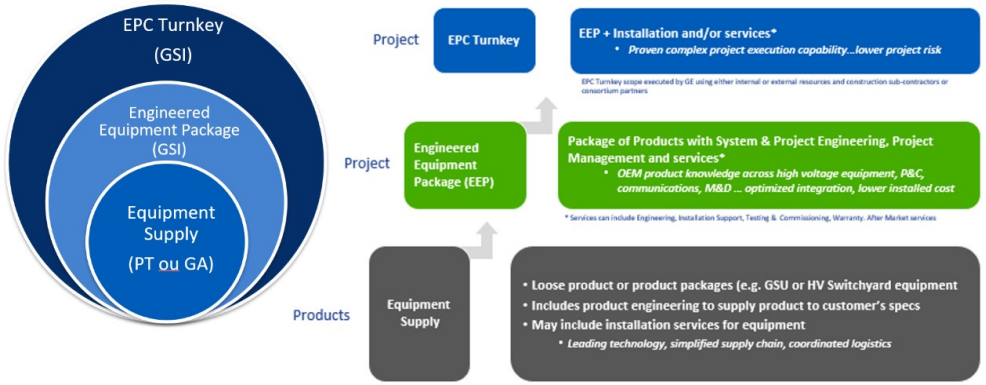
Decades of experience in the electrolysis industry combined with our team's collective knowhow enables us to clearly understand your specific needs. We know that you have unique requirements and constraints regarding equipment, economics, service continuity, power factors and harmonics content: decisive factors in the design and installation of your solution. Our team of global experts works hand-in-hand with you throughout the project to ensure the long-term viability and reliability of your H_2 power plant.

Design

Our experts have the answers to your project requirements: from early plant and network analysis, through elaboration of detailed design, total cost of ownership and life-cycle assessment, to installation, commissioning and servicing.

Packages and turnkey solutions

By selecting a turnkey solution, you are selecting a solution that enables achievement, efficiency and profitability. We provide the engineering and project management services to deliver HV substations on a Engineered Equipment Packages (EEP) basis, and/or on a Engineer, Procure and Construct (EPC) basis with all related support services.



Products

We provide the overall mix of HV products and equipment for the delivery of substations with outstanding performance: from "Grid to Stack", including gas- or air-insulated HV switchgears, power transformers, automation and control, as well as rectifiers and special power transformers equipment to deliver DC supply to the electrolyser stacks.

Services

Engineering and design studies
Long term service agreement for Maintenance
Digital substation

Contact

www.gevernova.com/grid-solutions
Contact us @ https://www.gevernova.com/grid-solutions/contact.htm

Hitachi Energy

HITACHI
Inspire the Next

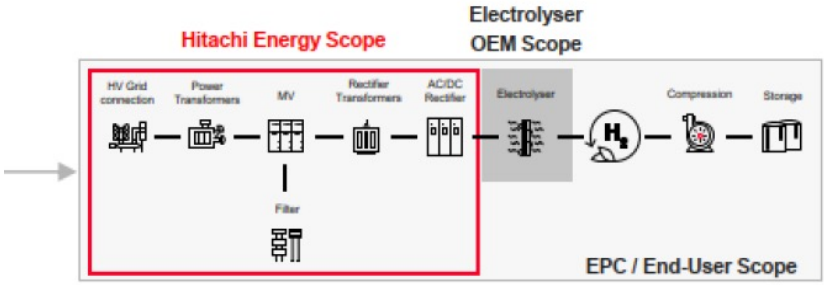
Hitachi Energy

Who we are?

Hitachi Energy is a global technology leader that is advancing a sustainable energy future for all. The company has a proven track record and unparalleled installed base in more than 140 countries, serving customers in utility, industry, transportation, data centers and infrastructure sectors.
With innovative technologies and services including the integration of more than 150 gigawatts of HVDC links into the power system, Hitachi Energy helps to make the energy value chain more efficient, making electricity more accessible to all. Together with stakeholders across sectors and geographies, we enable the digital transformation required to accelerate the energy transition towards a carbon-neutral future. Headquartered in Switzerland, Hitachi Energy employs 45,000 people in 60 countries and generate business volumes of around $13 billion USD.

Positioning in H2 sector

Hitachi Energy ambitions to be a key player in the Green Hydrogen value chain, using its positioning in Renewables, Industries and Utilities as enabling foundations, with presence on both power supply to electrolyzer side and fuel cell-based clean replacement to power generators.



Contact

Hitachi Energy France
23 avenue Carnot
Massy 91300, Essonne, France
Email : contact-us@hitachienergy.com
Web: https://www.hitachienergy.com/

Reference case : Ovako, Sweden

Early concept optimization studies followed by the delivery of a Grid-to-Stack solution powering a 20 MW electrolyzer, featuring prognosticating software enabling to reduce electrolyzer downtime.

Studies

Over 30 FEED studies performed for project up to 2GW

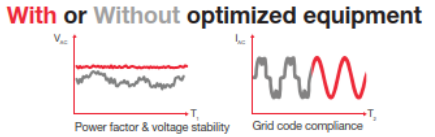
Project planning & optimization based on 120 years of grid connection experience

Optimizing overall design and total cost of ownership during pre-FEED/FEED studies, while mitigating risks associated with long lead time items.

Concept Studies → Pre-FEED & FEED → Project Execution → Operation → Maintenance

Power conversion & quality

Identifying and implementing the appropriate **converter technology** in combination with **reactive power** and **harmonic compensation solutions**, for balanced **efficiency** and costs, relying on in-house made semiconductors.



Cost optimization

Maximizing safety and performance, and reducing total cost of ownership requires a holistic design approach that considers:

- Electrical safety
- Electrolyzer ratings
- Plant operation philosophy
- Grid code requirements

AC			
	$	$$	$$$$
	$$	$$	$$$
	$$$	$$	$$

System Performance

Ensuring safety during operation & maintenance through a well-designed system and the use of robust equipment.

Service and Lifecycle Support

Increasing reliability & efficiency through Service Level Agreements and Asset Performance Management solution, Lumada APM Software that enables condition-based operation & maintenance.

KEB

Who we are?

- manufacturer and systems supplier of drive and automation solutions for more than 50 years
- corporate headquarters in Barntrup, East Westphalia, Germany
- managed by its owners
- 1,550 employees around the world
- high level of advisory/service expertise
- 14 national companies/representative offices worldwide

Positioning

Based on our complete portfolio of inverter products, we are able to offer frequency inverter or AIC solutions to control all types of motors or for energy conversion, combined with our automation products (industrial PC and HMI) and our HELIO and NOA software for supervision, remote monitoring, data acquisition and processing. We also offer a full range of passive filters (radio frequency and harmonic filters).

DESIGN | PROCUREMENT | INSTALLATION & COMMISSIONNING | MAINTENANCE

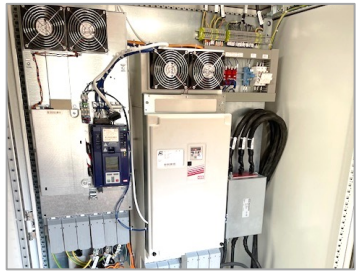
Products

- CONTROL & AUTOMATION : HMI Touch Panel, Automation Controller, Industrial PC, I/O, Monitors, functional safety
- DRIVE TECHNOLOGY : Drive Controller, frequency inverter, Active-Infeed-Converter
- FILTERS : mains and motor chokes, Harmonics filters, HF filters for AC or DC, Sine-wave filters, common mode filters
- MOTORS & GEARS : Helical gears, Worm gear, Bevel gear, three-phase asynchronous motors and permanent magnet servo motors.




Packages and turnkey solutions

We can design integrated solutions in cabinets or containers for complex projects, develop automation programs and HMI interfaces, and ensure commissioning and maintenance, with the support of a multi-disciplinary technical team.

Services

The full range of our power converter and automation solutions is based on a modern real-time bus communication interface. Using our remote supervision and monitoring tools, this ensures the monitoring of installations as well as the collection and analysis of data for preventive maintenance, using our NOA platform. Our technical teams work on commissioning, software development for PLC and HMI, technical support and product training. In addition, an after-sales service is available to offer product maintenance and spare part supply.

Contact

info@keb.fr

MARECHAL ELECTRIC

MARECHAL ELECTRIC
MARECHAL® TECHNOR® MELTRIC®

Who we are?

Since it was founded in 1952, MARECHAL ELECTRIC has established itself as a major player in the field of electrical power connections for industrial and hazardous environments. With over 70 years of expertise, the Group is now recognized worldwide for its innovative and highly safe electrical solutions that meet the needs of the most demanding industries.

MARECHAL ELECTRIC is an independent French group with a strong international presence. With subsidiaries, production sites, sales offices, and a solid network of partners on five continents, the company maintains long-term relationships with more than 15,000 customers and supplies more than 120 countries.

Our manufacturing facilities, located in South Africa, Germany, Australia, USA, France, and Italy, are ISO 9001 certified.

Our commitment to innovation is reflected in a constant investment of 5% of our turnover in research and development, enabling us to offer products that are always at the forefront of international safety standards (IEC, IECEx, CENELEC, ATEX).

Positioning

LV distribution

- Safety electrical supply (genset / UPS)
- Electrical module (low voltage converter / transformer)

Electrolyser

- Water module (pumps connections)
- Hydrogen Module (ATEX certified connections)

Track-records / references

Supplier for hydrogen stations projects, led by McPHY and ATAWAY.

Design & products

MARECHAL ELECTRIC, world specialist in electrical connectors from 5 A to 1 250 A, lighting and customized solutions for industrial and hazardous environments (zone 1, 2, 21, 22), offers a complete range of products under the MARECHAL® and TECHNOR® brands.

Our flagship product, the DECONTACTOR™, incorporates a patented technology that provides load disconnection up to 250 A, eliminating any risk of arcing and providing optimum safety for users.

We offer a wide range of:

- Separable switch-disconnector up to 18.5 kW,
- Plugs & socket-outlets up to 660 A / 1 100 V AC & 1 500 V DC,
- Single pole connector up to 1 250 A / 1 000 V AC / 1 500 V DC,
- Multipin connectors up to 37 contacts,
- Junction and distribution electrical boxes,
- LED linear, floodlight and well glass lighting fixtures.

Contact

MARECHAL ELECTRIC S.A.S. Headquarter
5 avenue du Chemin de Presles
94410 Saint-Maurice – France

www.marechal.com

@ : contact@marechal.com

Schneider Electric

Who are we?

Our mission is to be the trusted partner in **Sustainability and Efficiency**.

We are a **global industrial technology leader** bringing world-leading expertise in electrification, automation and digitization to smart **industries**, resilient **infrastructure**, future-proof **data centers**, intelligent **buildings**, and intuitive **homes**. Anchored by our deep domain expertise, we provide integrated end-to-end lifecycle AI enabled Industrial IoT solutions with connected products, automation, software and services, delivering digital twins to enable profitable growth **for our customers**.

We are a **people company** with an ecosystem of 150,000 colleagues and more than a million partners operating in over 100 countries to ensure proximity to our customers and stakeholders. We embrace **diversity and inclusion** in everything we do, guided by our meaningful purpose of a **sustainable future for all**.

We are a global industrial technology leader in electrification, automation and digitization.

We are a recognised ESG leader (Environmental, social, and governance).

Positionning

Distribution MV & LV

- MV switchgear
- Distribution transformers
- Secure power (UPS)
- LV electrical distribution
- Programmable Logic Contrôler (PLC)
- Instrumentation

End to end design

Our teams are here to support and advise you in all the phases of your project from pre-feed to the production and predictive maintenance.

EcoStruxure at every level

Contact

stephane.baux@se.com

SIEMENS

SIEMENS

Who we are?

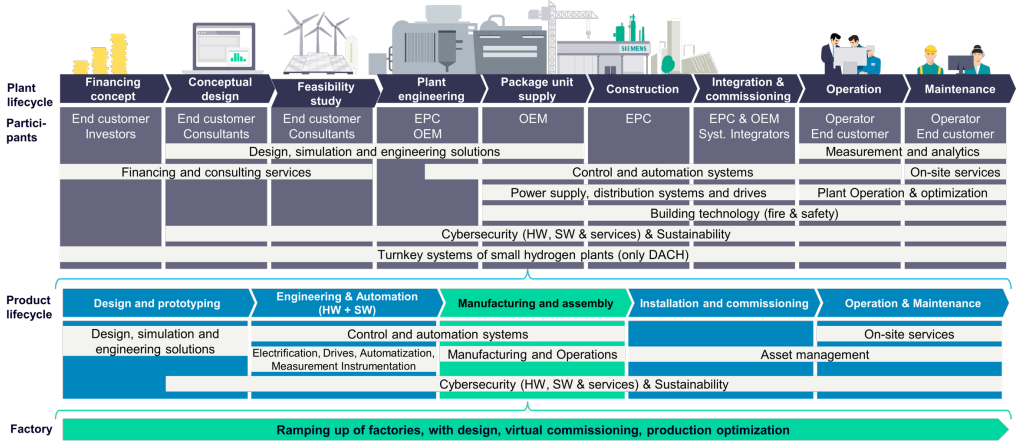
SIEMENS is a technology company focused on industry, infrastructure, transport, and healthcare.
From more resource-efficient factories, resilient supply chains, and smarter buildings and grids, to cleaner and more comfortable transportation as well as advanced healthcare, we create technology with purpose adding real value for customers.
By combining the real and the digital worlds, we empower our customers to transform their industries and markets, helping them to transform the everyday for billions of people.

Positioning in H2 ecosystem

SIEMENS is a strong partner across the entire hydrogen value chain, where Clean Hydrogen marks an essential piece in the transition towards a more sustainable energy future. As Sustainability is key part of the company strategy, business activities and investment decisions, Siemens is committed to support making hydrogen a business for its customers – futureproof, profitable and at scale.
Our industry expertise across applications in the hydrogen value chain positions us a strong partner of OEMs, EPCs, Operators, End Customers, Governments and Municipalities.
Building on our expertise in digitalization, automation and electrification we are dedicated to support our customers along their hydrogen journey and project lifecycle.
Our solutions cover everything from first pilots and aims to scalable & standardized blueprints including the generation of green electricity and grid connection, as well as hydrogen production, storage, transportation, and utilization with electrification, automation and digitalization concepts tailored to hydrogen requirements.

Track-records / references

The path of Wunsiedel – one of Germany's biggest plant
Switching and protection technology for hydrogen filling stations
GeoPura, Hydrogen-based Energy-as-a-Service
aeSolutions – Expertise in Hydrogen Manufacturing
Siemens and Shell sign MoU to advance low-carbon, highly efficient energy solutions
Green Aviation Fuel, Fully Automated Production



Design

From conceptual design up to engineering for a plant design point-of-view as well as for products, like electrolysers, with simulation tools for different levels of digital twins.

Products

From individual product elements, e.g. protection relays, remote terminal unit, PLCs, network devices, low-voltage drives, circuit breakers, to systems, e.g. medium-voltage switchgears, low-voltage switchboards, control systems and automation.

Packages and turnkey solutions

SIEMENS is able to provide a complete engineered package, e.g. e-houses, and intelligent substation for hydrogen stations.
Additionally, SIEMENS has full expertise in delivering turnkey projects for hydrogen production plants in Germany, Austria and Switzerland.

Contact

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Electrification and Automation
Mozartstr. 31c
91052 Erlangen Germany
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Siemens Energy

Who we are?

We are Siemens Energy – a global leader in energy technology

Energy transition is the greatest challenge our generation faces. How do we reduce emissions while also increase energy supply? It is an uphill battle. And there is no silver bullet. But finding solutions has always been in our DNA. For more than 150 years our engineers have been spearheading the electrification of the world. Today we are a team of 98.000 sharing the same passion, vision and values. Our diversity makes us strong and helps us to find answers together with our partners.
Located in 90 countries, Siemens Energy operates across the whole energy landscape. From conventional to renewable power, from grid technology to storage to electrifying complex industrial processes.
Our mission is to support companies and countries with what they need to reduce greenhouse gas emissions and make energy reliable, affordable, and more sustainable. Let's energize society.

Positioning

Siemens Energy is covering the entire value chain of the hydrogen business. Our offering covers all elements starting from the grid connection and grid stability. We are then offering the power conversion unit and the electrolyser system. Siemens Energy is also an encounterable actor of the compression.

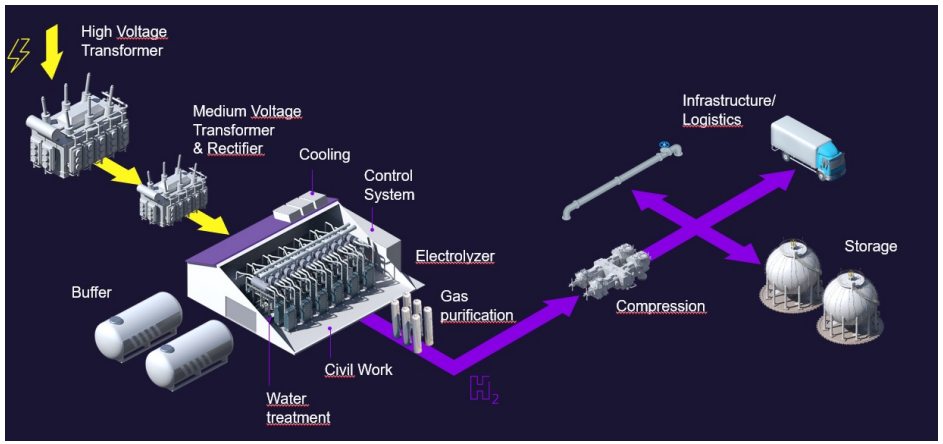
Track-records / references

Country	Project	Customer	Power demand	PAC
UAE	DEWA Expo 2020	Dubai Electricity and Water Authority (DEWA)	1.25 MW	2021
Germany	Werlte	Solarbelt FairFuel gGmbH	1.25 MW	2021
Chile	Haru Oni1	Highly Innovative Fuels (HIF)	1.25 MW	2022
Germany	Wunsiedel	Siemens AG, SWW Wunsiedel GmbH	8.5 MW	2022
Germany	Oberhausen	Air Liquide	up to 20 MW	2024
Denmark	Kassø	European Energy	50 MW	under construction
Germany	Hy4Chem-El	BASF	50 MW	under construction
France	Normand'Hy	Air Liquide	200 MW	under construction

Packages and turnkey solutions

We Siemens Energy have in-house capabilities in design and engineering for Control and Protection, installation and civil works

DESIGN | PROCUREMENT | INSTALLATION & COMMISSIONNING | MAINTENANCE



Services, Installation and commissioning

We secure fault-free operation of high-voltage switchgears and products for a reliable power supply.
We offer an innovative and comprehensive service portfolio for long-lasting high-voltage products
We maintain the operation of transformers at maximum operating level
Strategically increase value with Transformer Lifecycle Management (TLM)
We rely on over 100 years of experience in production and operation of transformers.

Contact

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