

Hybrid Power Solutions Portfolio Presentation

September 2022



Globalization

Demographic change

Urbanization

Climate change

Digitalization

are drastically changing
our environment.

**At the same time,
we expect a 25% increase
in global energy demand by 2040.**

This will present
enormous challenges
for the environment

facing changing requirements by
regulations and customer expectations

ensuring energy availability by
a broader grid independency

The **challenges** are many

securing future for production sites
by ensuring optimized OPEX

but the **solution is powerfully** simple

Hybrid Power Solutions

*the power
to decarbonize
is yours*



Hybrid power solutions leverages various potentials...

the combination with existing assets

the easy-made control of complex energy systems

the integration of renewables



... and enables us to integrate multiple technologies to one optimized energy system ...

Renewables

- Wind Off-/Onshore
- Solar PV
- Solar CSP (ST)
- Hydro
- Biomass-Waste (ST)
- Geothermal (ST)

Thermal

- Gas (Gas turbine, Steam Turbine, RICE)
- H₂ (Gas turbine, Steam Turbine, RICE, Fuel Cells)

Storage Technology

BESS/Electrochemical

- Li-Ion Batteries (SIESTART, etc.)¹
- Flow Batteries (Vanadium Redox)

Mechanical Storage

- Pumped Hydro
- Compressed Air Energy Storage (CAES)
- Liquid Air Energy Storage (LAES)

Chemical Storage (incl. Fuel Cell)

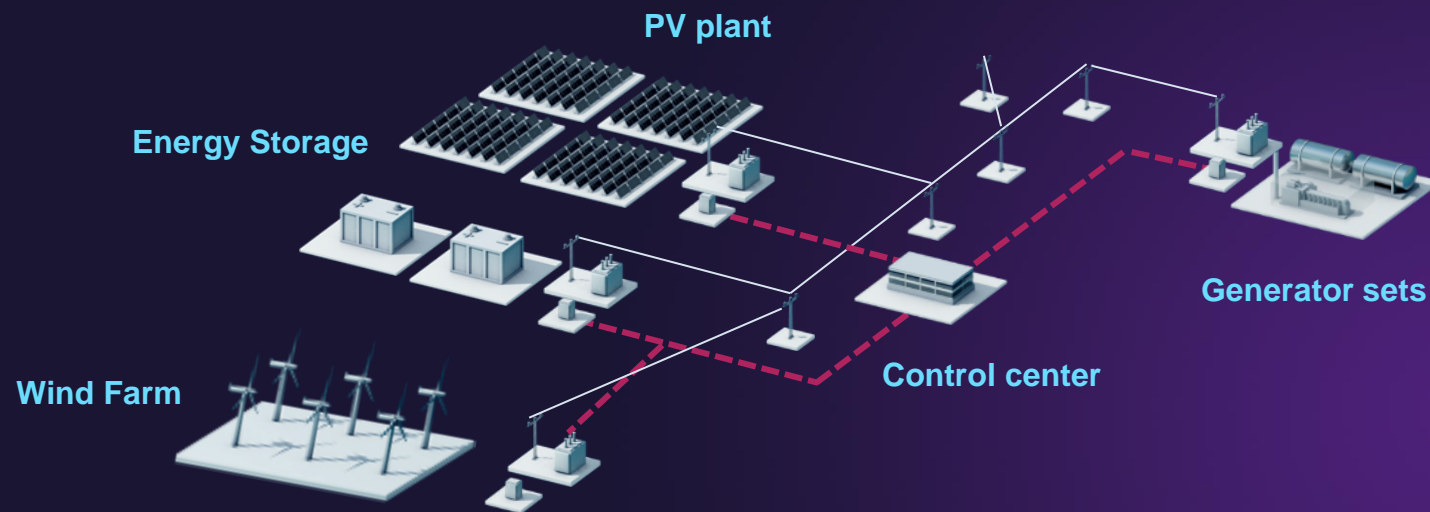
- Hydrogen/Power-to-fuel (Silyzer)/Fuel Cell

Electrical Storage

- Capacitors (FACTS)¹

Thermal Storage

- High-temp. sensible heat (incl. Molten, Salt, Concrete/Energy Nest, Stones/ETES)
- Low-temp. sens. Heat (Hot/Cold Water)



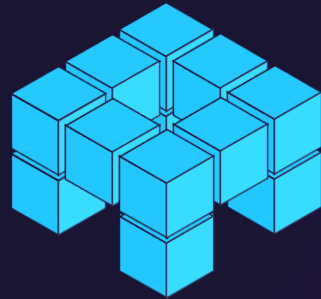
¹ Short-term storage only

... for increasing flexibility and adaption to market needs

Renewables generation



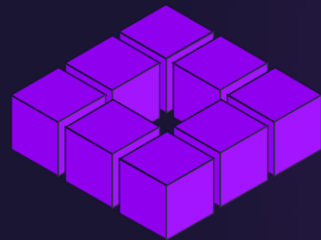
- Zero emissions
 - Sustainable
- ... but not reliable**



Gas-fired power generation



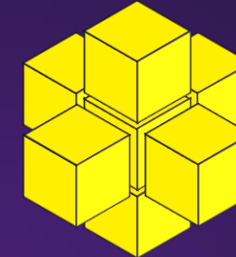
- Dispatchable
 - Reliable output
- ... but not sustainable**



Energy Storage



- Instant output
 - Dispatchable
 - Zero emissions
- ... but not continuous**



With Hybrid power solutions as decarbonized energy system you are...



Powerfully independent

for your remote location or in case you have limited access to grid



Powerfully profitable

by reduction of OPEX and LCoE, to secure the competitiveness of your production site



Powerfully sustainable

by meeting your decarbonization targets in an increasingly complex energy market



Powerfully reliable

with higher availability on energy generation to increase grid availability & reliability

...able to benefit along the complete value chain



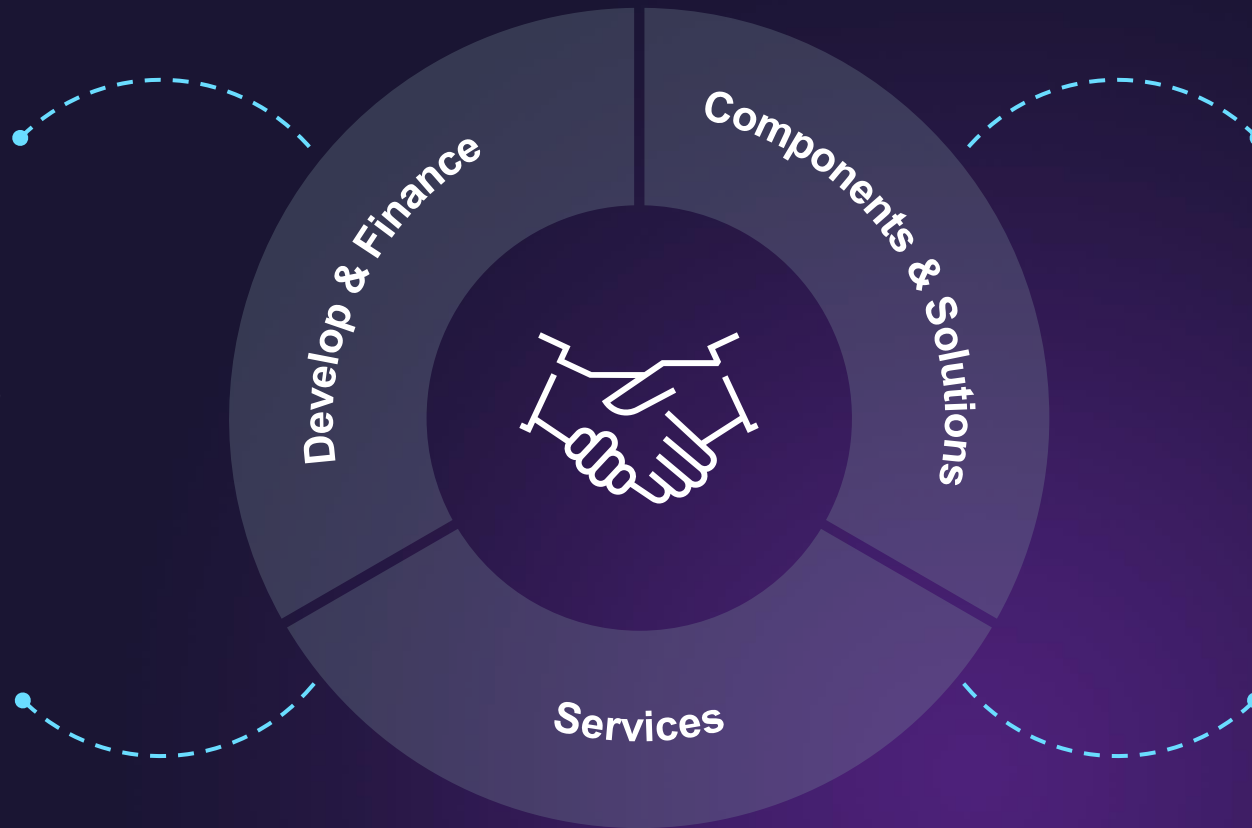
Hybrid power solutions address various market segments with a customized and decarbonized solution



Island/Remote communities



Municipalities/communities



Industry/Manufacturing



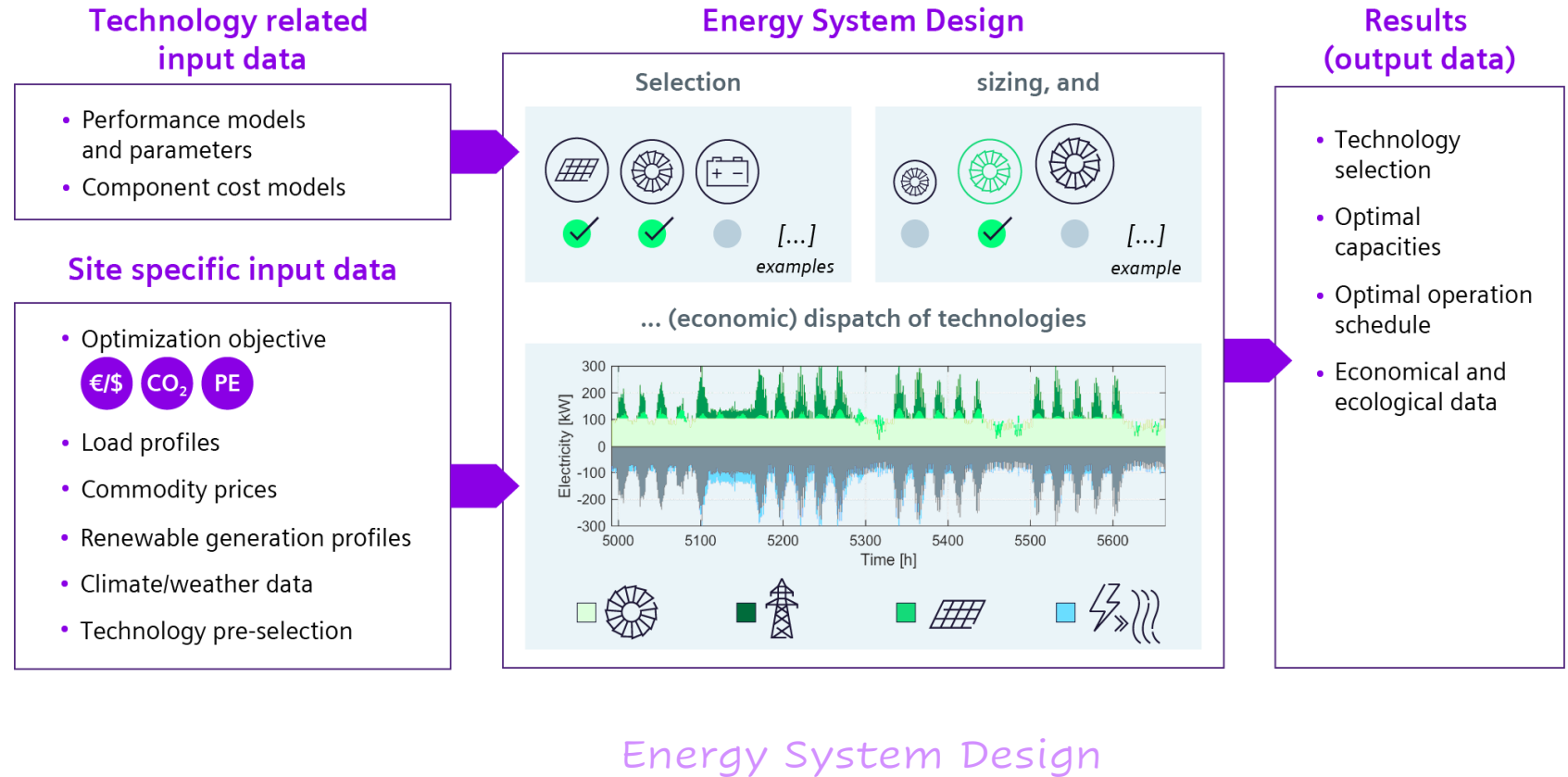
Mining

Co-creating your hybrid power solutions starts with **your needs** and **our value proposition** to...

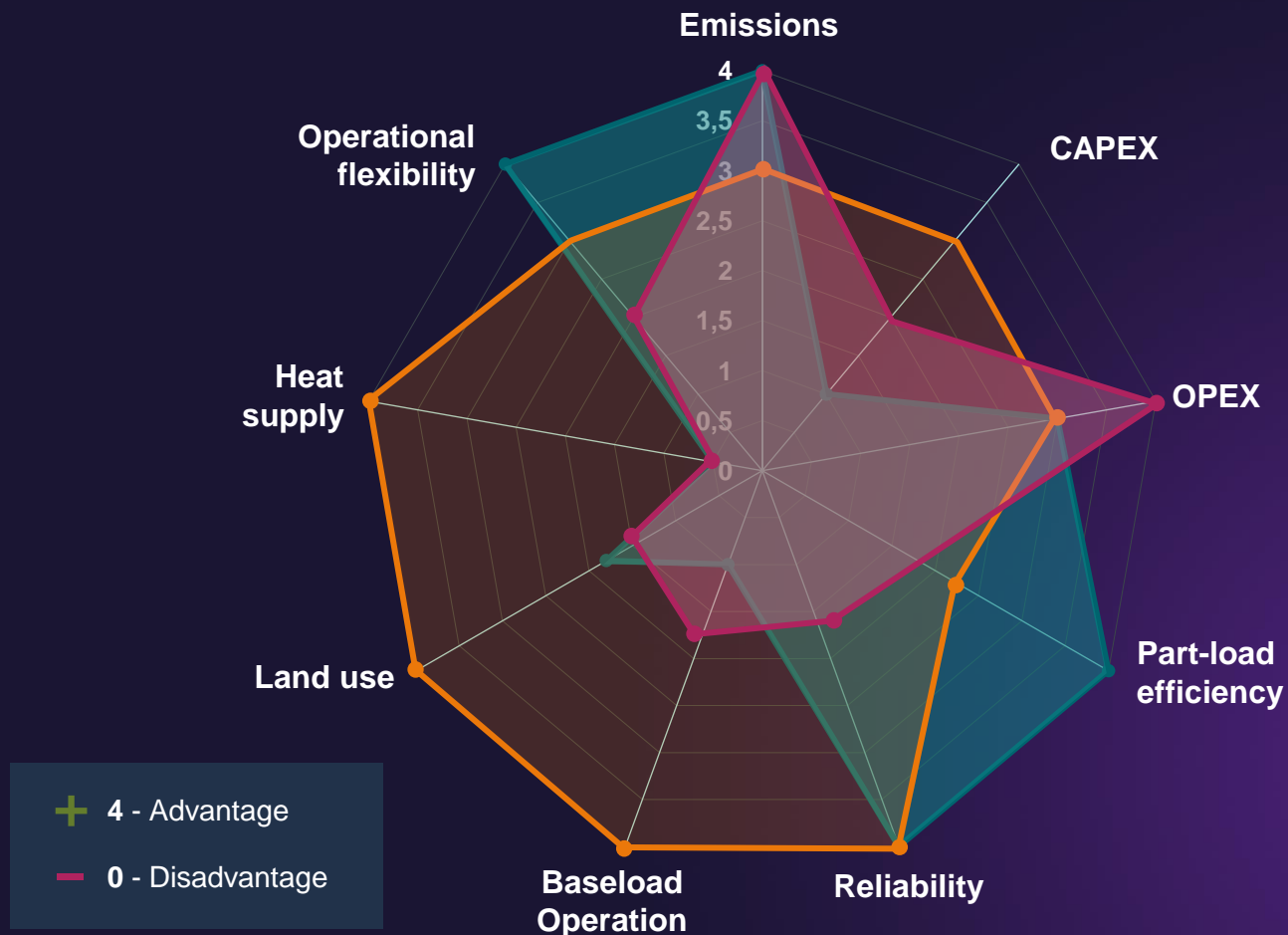
...create the **best fitted energy solution** for any specific customer application

...display the efficient **maximization of renewable energy sources**

...**integrate existing assets** in the overall energy management system / microgrid



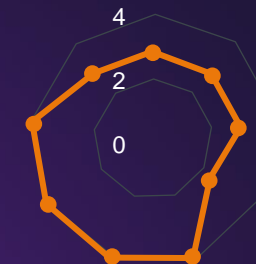
... find the right combination for leveraging the different strengths of each technology



Battery storage



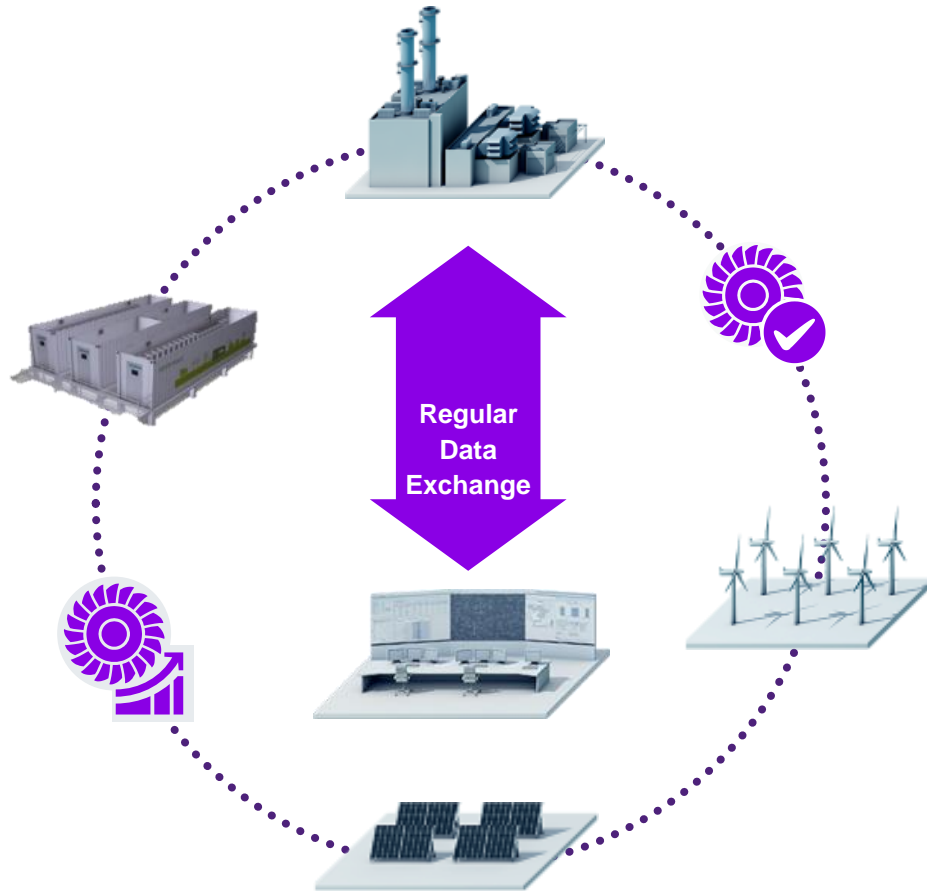
Gas turbines



Onshore wind / PV solar



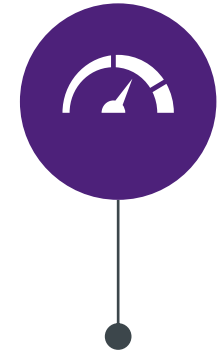
Hybrid power solutions using modern control systems for simplified and flexible operation



Suited for all types of systems –
easily integrating different technologies across an entire system



Enhanced plant reliability –
allowing data to be collected in real time to identify and react more efficiently



Improved performance –
innovations that provide the right tools for flexibility and maximized capabilities

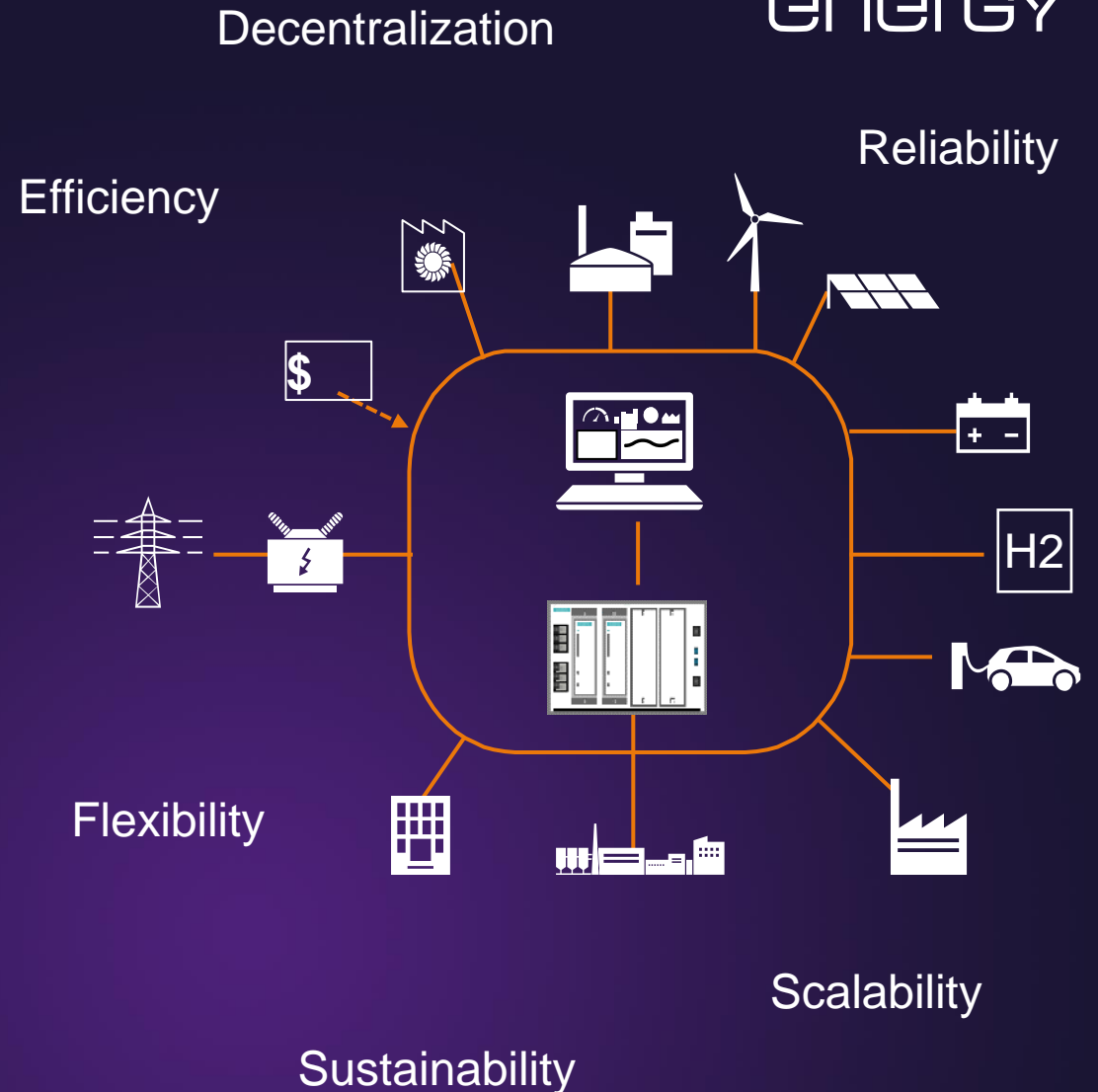
as the hybrid control system is the microgrid brain

Per definition and standards, **microgrids** are entities which manage their own **decentralized** power production and consumption and are capable of **island operation mode**.

Depending on the business case, many microgrids, always run in **on-grid mode**

Managing a microgrid with multiple different decentralized resources requires a **hybrid microgrid controller** to provide automated and at the same time optimal operation for the customer

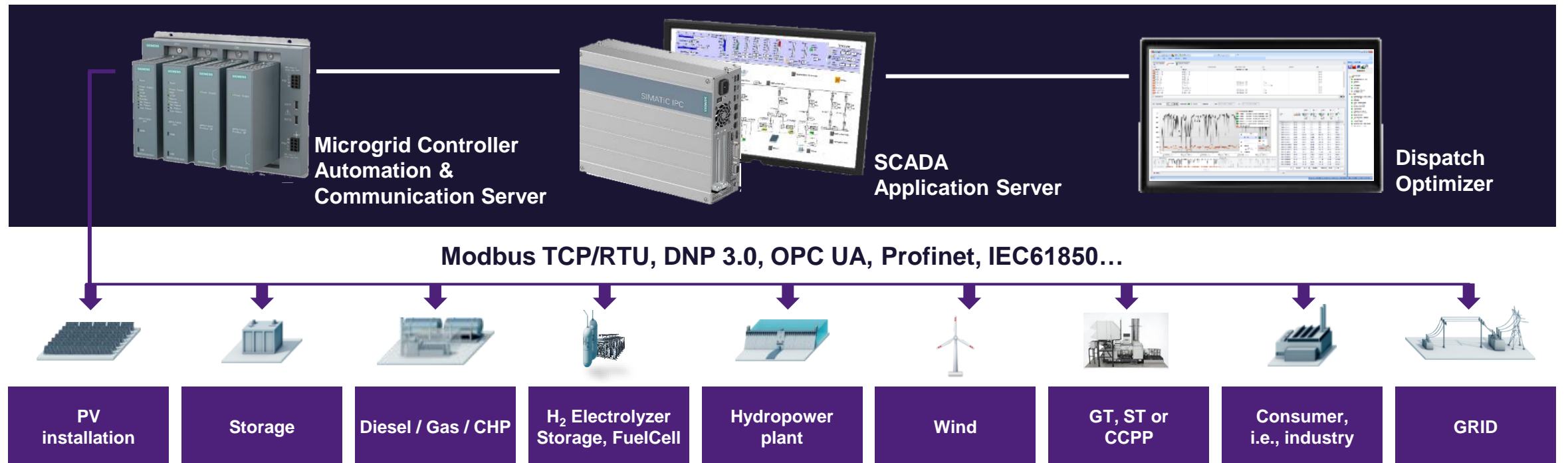
[Omnivise Hybrid Control](#)



Omnivise Hybrid Control combines all elements in 1 system



T3000 Microgrid Controller	SCADA Application Server	Dispatch Optimizer
<p>Manages all assets in real time. With integrated microgrid control functions, automated 24/7 operation is provided.</p>	<p>Provides SCADA functions for monitoring and engineering of a microgrid, enabling the operator full overview and control.</p>	<p>Calculates an optimal economic dispatch based on load and generation forecasts, as well as financial and technical params.</p>



O&M for Hybrid Power Solutions save OPEX by our Integrated Service Concept across all systems

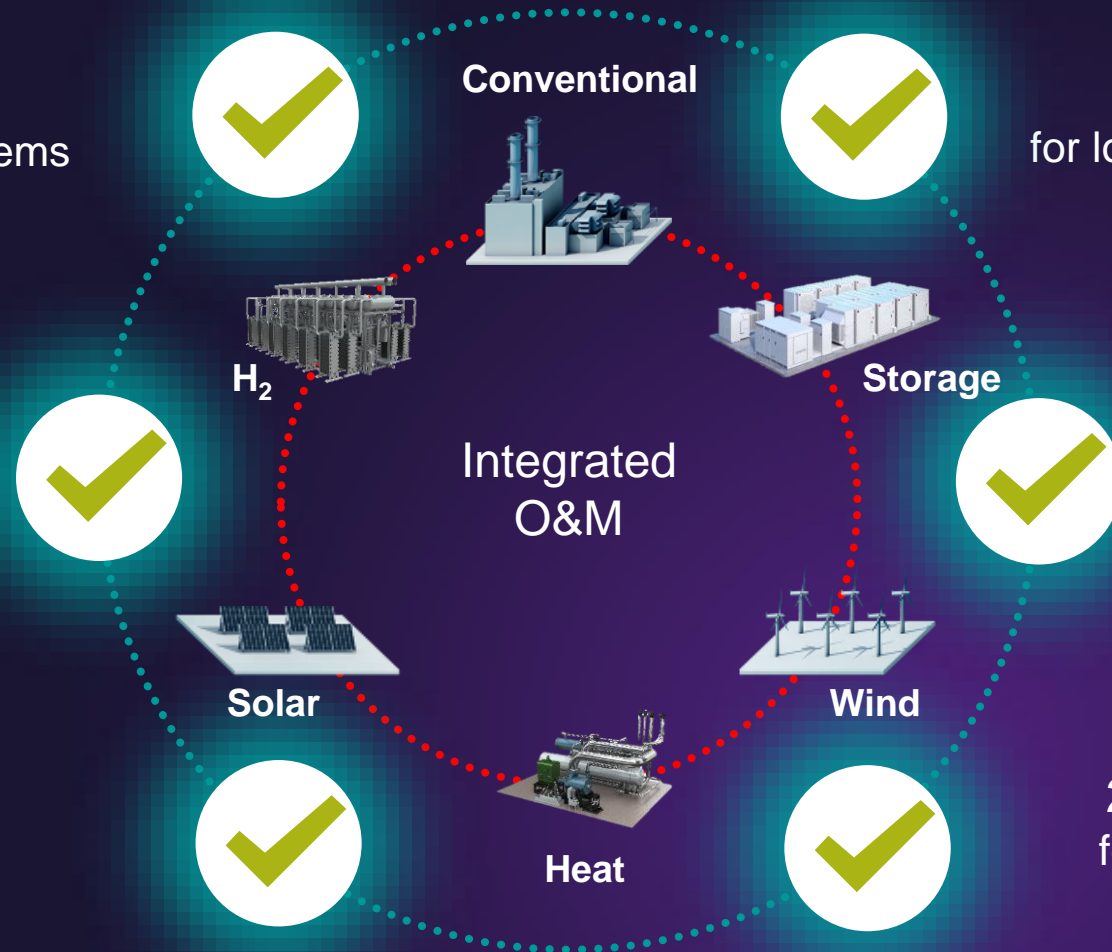
Synergies in Operation

Lean operations team for all systems

Synergies in Maintenance

Multi skilled personnel for highest service efficiency

Synergies in Spare Parts Management and warehousing



Remote Operation
for low manned / unmanned operation

Harmonized Maintenance Management System
incl. CMMS software

24/7 Remote Expert Support
for trouble shooting, operation and maintenance



Remote Services

- Trouble Shooting
- Problem Solving
- Remote Operator



Automation

- Better automation
- Better sensorics
- Less Black box
- Trip circuits upgrade



Digitalization

- APM & Asset Health Management
- Advances in AI
- Cloud Computing

Combining the developments in Remote Services, Automation and Digitalization by the changes in workforce and the energy transition enables...



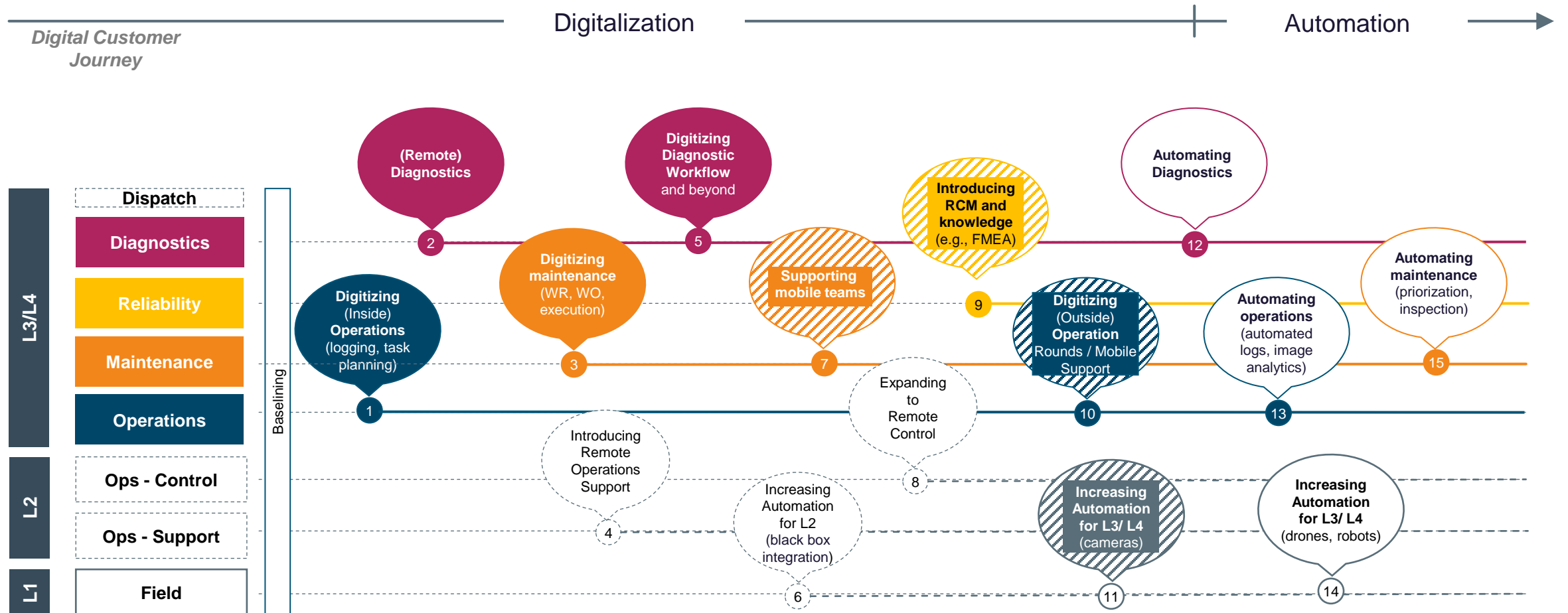
Autonomous Operation

The step further of remote operation

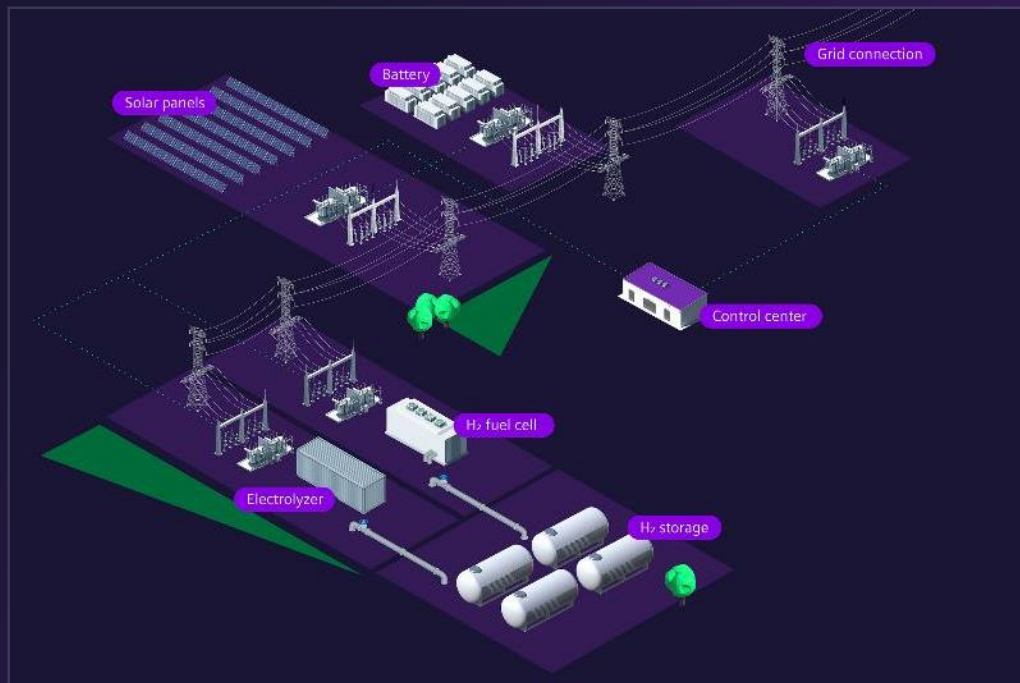
- ✓ **Lower CAPEX**
Centralized manning
- ✓ **Business Continuity**
Keep the lights on
- ✓ **Safety**
Achieving Zero Harm
- ✓ **Higher Availability**
Less unplanned downtimes

Omnivise Asset Management (OAM)

enabling your journey to autonomous operation



Zero Carbon Hybrid Power Plant saving 39,000 t/a CO2



Project Type

Hybrid solution



Customer Challenge/Driver

Developing zero carbon hybrid power plant for decarbonization of current energy generation and becoming independent from fossil fuel supply.



Portfolio Elements

- Solar
- Fuel Cell
- Battery Storage
- Electrolyzer



Scope

- Joined project development
- Establishing of best energy generation scenario including daily forecast
- EPC turnkey with LTSA

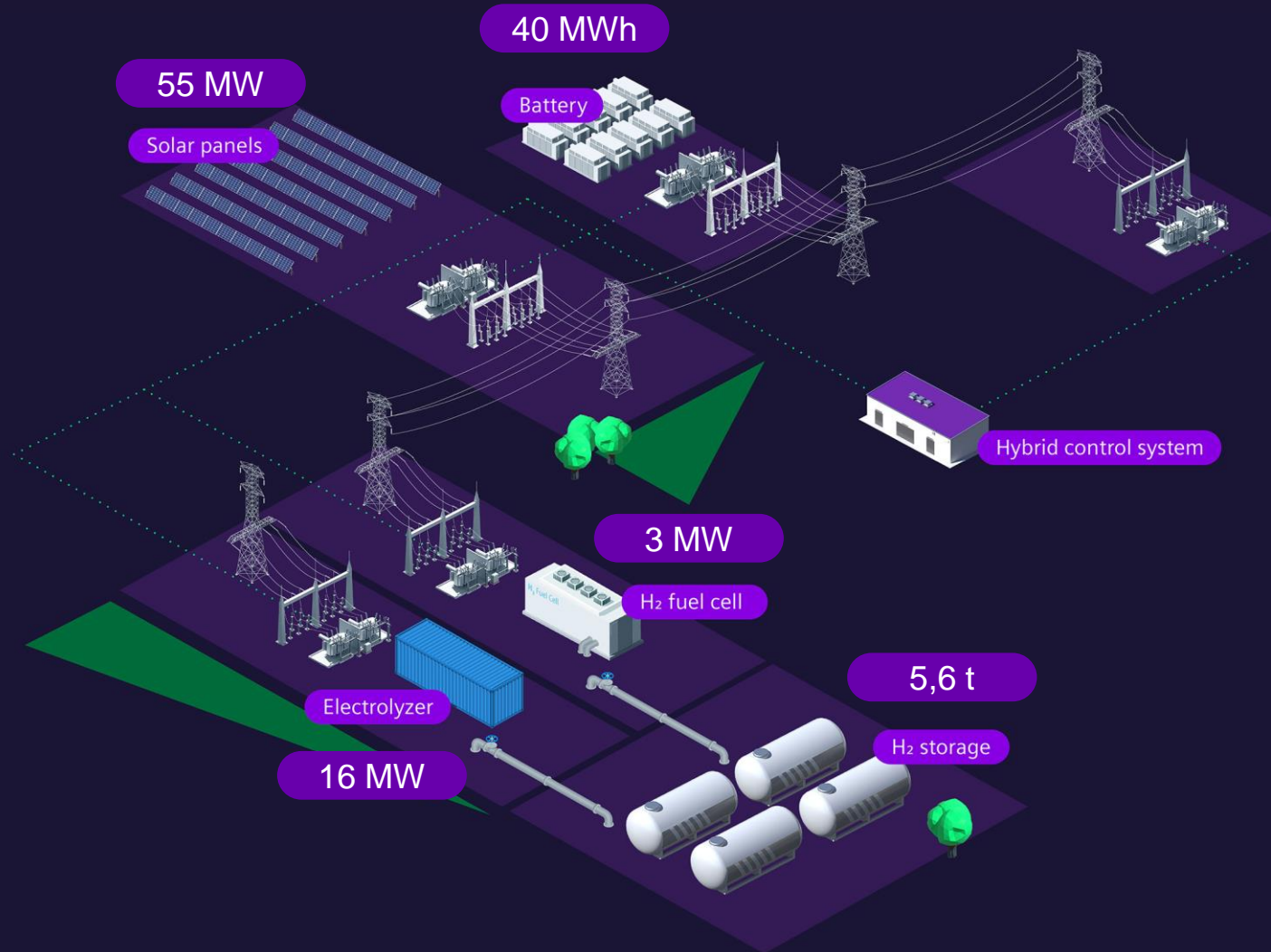


Customer Benefit

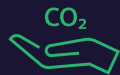
- Decarbonization of existing energy supply
- Achieve low electricity costs by sustainable power generation
- Develop partnership for further decarbonization projects
- High Quality on execution concept and integration capabilities
- Gaining independency for fossil fuel supply



Zero Carbon Hybrid Power Plant EPC Scope



supplies 10,000 households around the clock with green energy

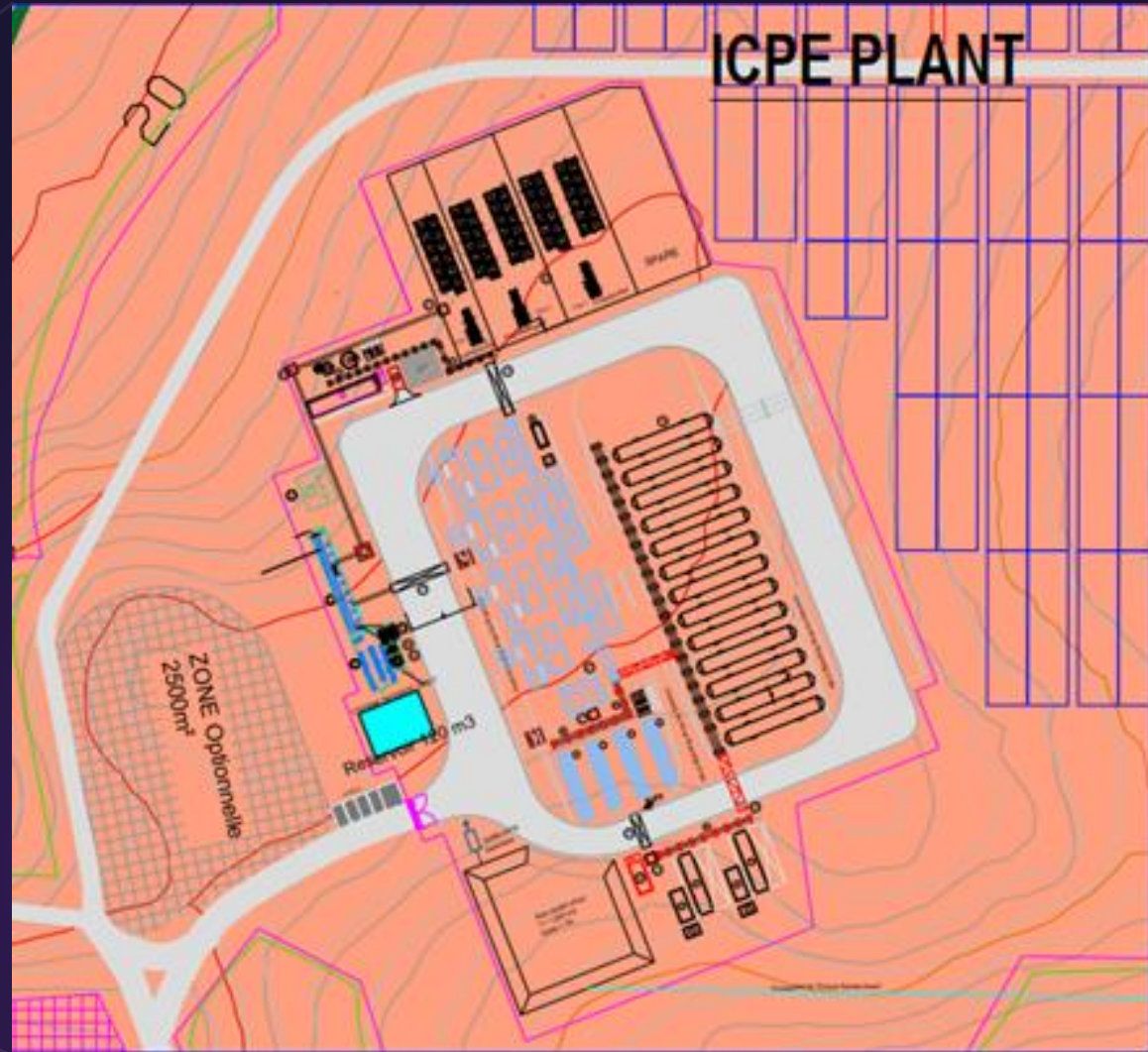
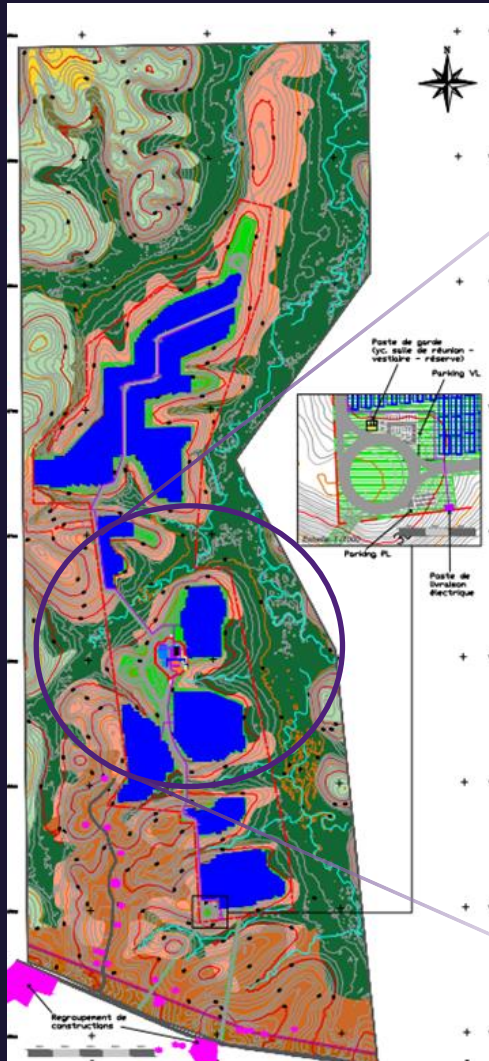


saves 39,000 tons of CO₂ yearly

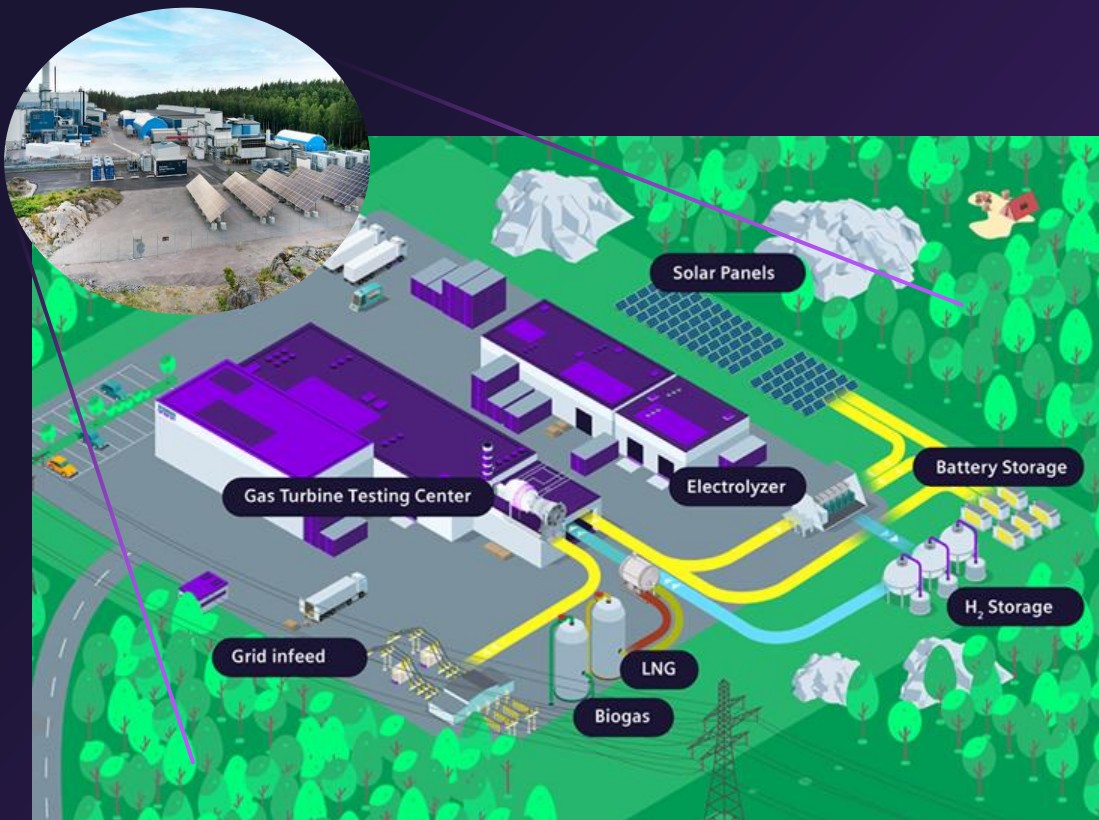


128 MWh storage in Battery and H₂

Zero Carbon Hybrid Power Plant Layout

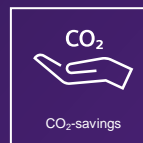
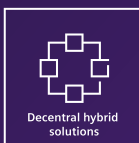
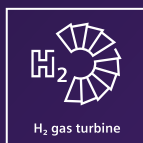


Zero Emission Hydrogen Turbine Center (ZEHTC)



PROJECT TYPE

Hybrid solution



Challenge / Driver

Showcasing a solution for future energy system and the integration of gas turbine technology by decarbonization of gas turbine test facility.

Setting up a demonstration plant with a flexible and sustainable energy system connecting gas turbines with hydrogen, renewable energy and energy storage.



Portfolio Elements

- Solar panels and battery storage
- Electrolyzer
- Hydrogen Storage
- Integration with gas turbine testing center



Scope

- Joined project development within a consortium of six partners from the private and public sectors including two international universities. Funding is supported by EU via Era Net SES.



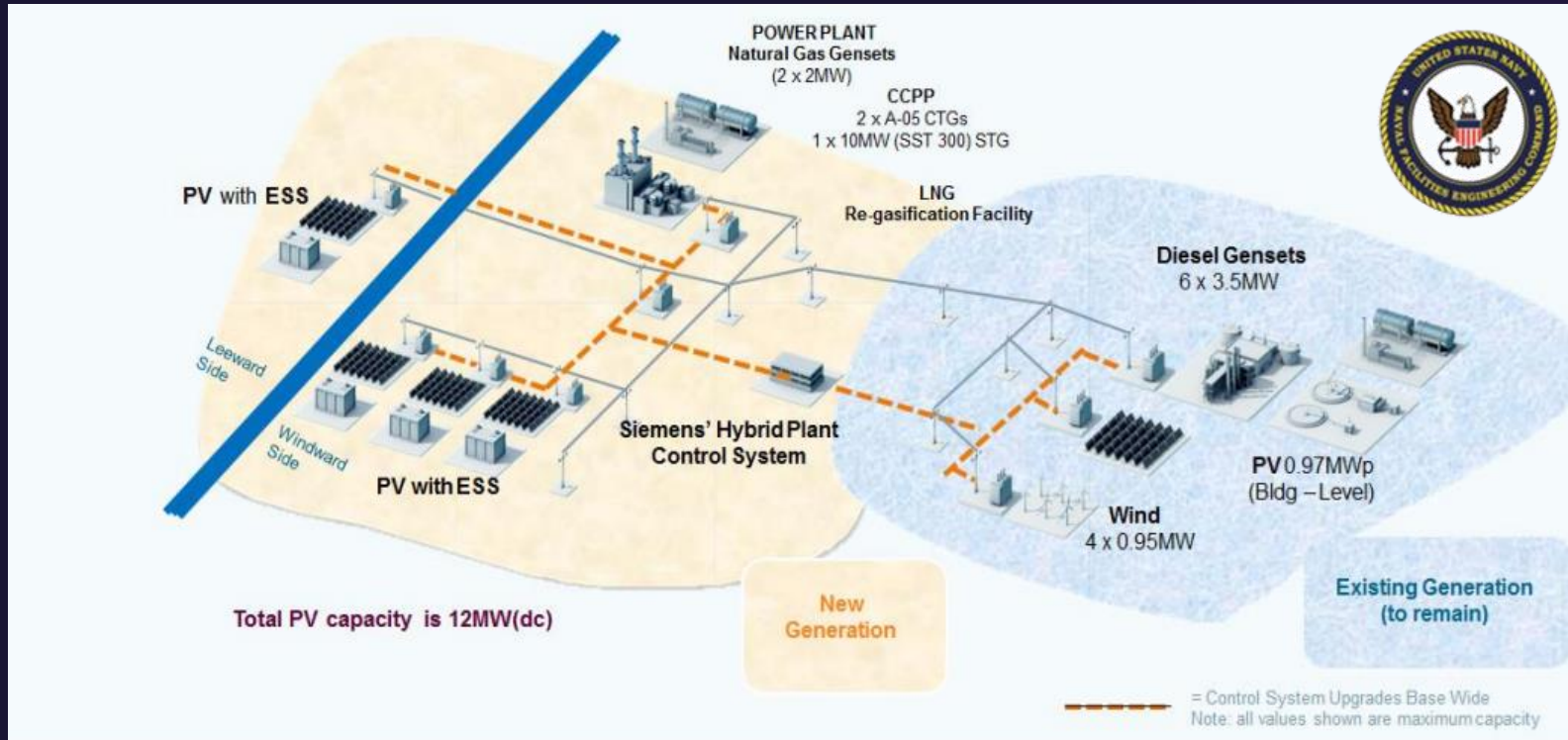
Benefit

- H₂ production from excess power from gas turbines test and renewables
- Decreased CO₂ emission from the testing facility
- Building expertise about sustainable energy systems and hybrid solutions
- Optimized use of power during test run
- Reduction of liquified natural gas (LNG) use and transportation thanks to local production of hydrogen
- Support hydrogen combustor development



ZEHTC

American Naval Station: Largest Energy Savings Performance Contract in Department of Defense



- Whole base solution providing energy resiliency, reliability and efficiency
- Liquefied natural gas (LNG) as primary fuel source
- LNG procured through Defense Logistics Agency (DLA)
- Cyber secure architecture
- Renewable energy – Photovoltaics, battery storage, and monitoring of the existing wind turbines
- Dual fuel capability providing resilience of supply
- Microgrid management system connecting together the installation’s power generation
- Enhanced maintenance, repair and replacement paid for through guaranteed savings

Hybrid Microgrid Control Reference - Galapagos Island

Within the objective of Ecuador's "Zero Fossil Fuel Initiative for the Galapagos Islands" a new hybrid power generation system was installed in Isabela island located in the Galapagos Archipelago. It is successfully in operation since October 2018



Siemens Energy implemented a 952 kWp photovoltaic system, a battery storage system with an output of up to 660 kW and a power generation plant with a total output of 1625 kW.



of diesel saved
monthly



availability

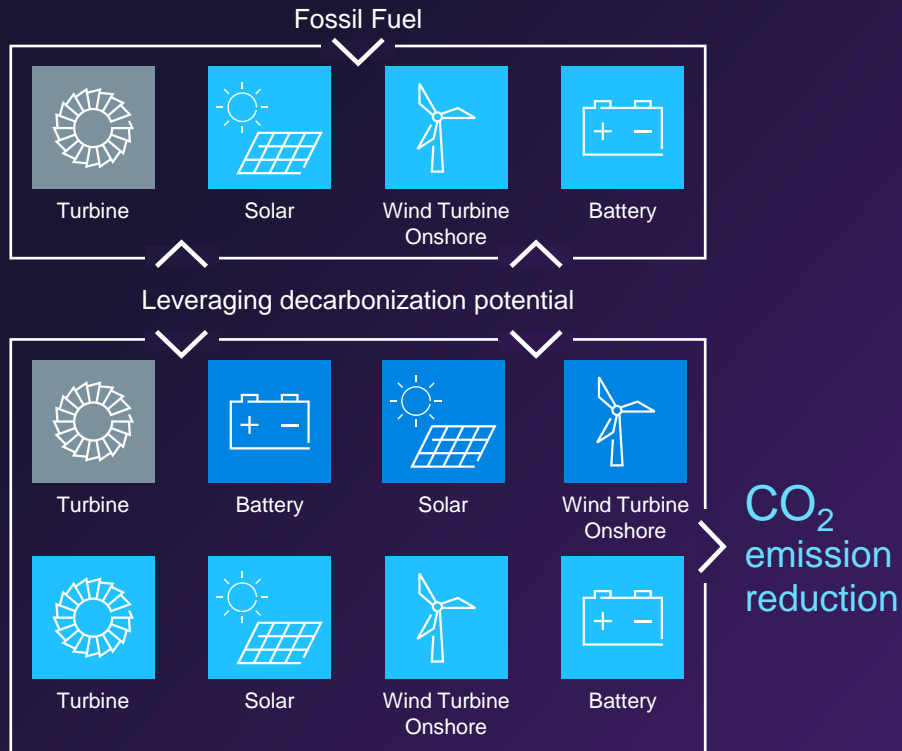


of CO₂ emissions
saved monthly



average energy from
PV per month

Mining Application



Project Type

Hybrid solution



■ Existing ■ Planned ■ Option

Customer Challenge/Driver

Decarbonization of mining operations by integration of renewable technology with 24/7/365 reliable power supply.



Portfolio Elements

- Solar
- Wind
- Battery Storage
- Gas turbine (new built/existing assets)



Scope

- Joined project development
- Supply of portfolio elements
- Integration of new technologies and existing assets
- Construction and Commissioning



Customer Benefit

- Decarbonization of existing power supply
- Achieve low electricity costs by sustainable power generation
- Develop partnership for further decarbonization
- Integration of gas turbines as reliable power supply
- High Quality on execution concept and integration capabilities



Sugar factory

an example for industrial application

Current situation

- ❖ Customer builds sugar factory and sugar beet farm with electricity demand >100 MWeI
- ❖ Process steam demand >100 MWth currently planned to be covered by gas fired boilers

Development goal

- ❖ Develop hybrid power plant to reduce the costs of electricity – currently the grid tariff

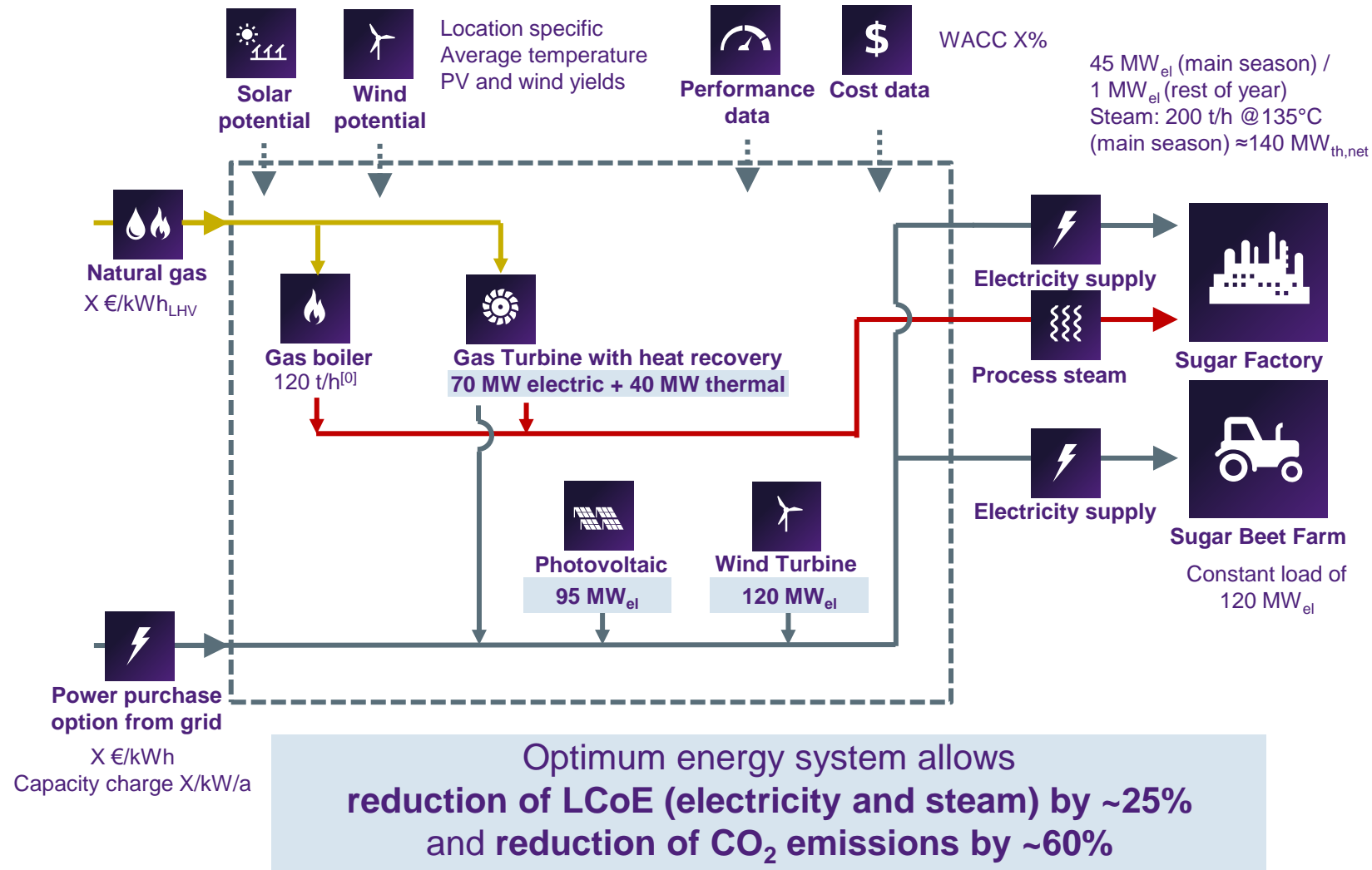
Boundary conditions

- ❖ Wide land use for PV and wind turbines
- ❖ Natural gas grid connection available

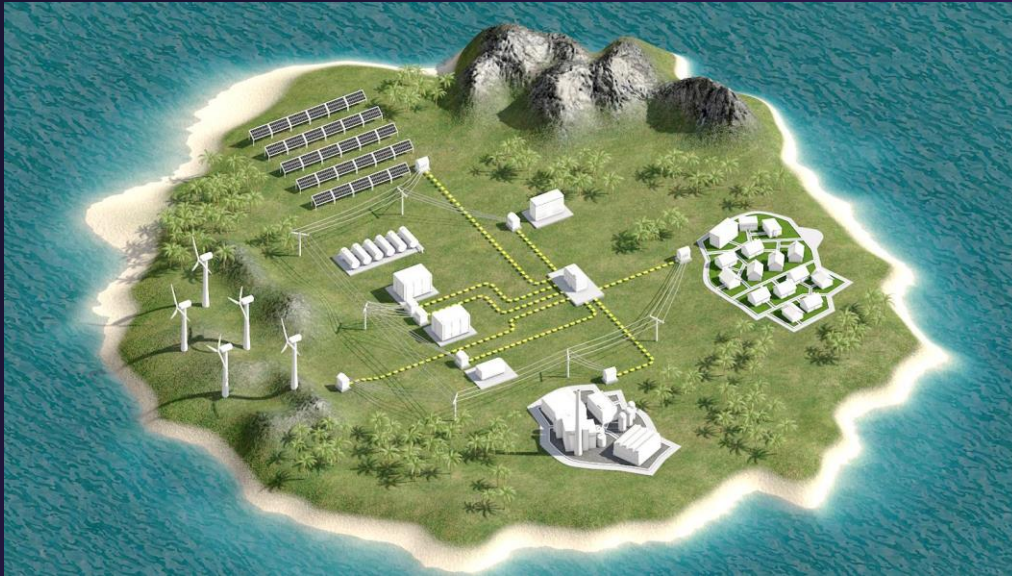
Idea

- ❖ Develop an optimized hybrid energy system consisting of renewables (PV & wind turbines) and fossil backup (e.g. gas turbine or combined cycle power plant)
- ❖ Demonstrate synergies to provide the required process steam as side product from fossil backup
- ❖ Perform analysis by Energy System Design to consider a wide range of energy systems including storage solutions

LCoE shown here are illustrative figures based on typical EPC prices for subsystems only.

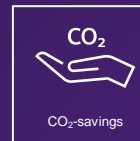


Island energy generation



PROJECT TYPE

Hybrid solution



Customer Challenge/Driver

Utilization of renewable power generation for decarbonization of energy landscape by ensuring grid availability and integration of various technologies.



Portfolio Elements

- Solar
- Wind
- Battery Storage
- Recips
- Electrolyzer



Scope

- Joined project development including setting best fitting technologies sizes
- Establishing of best energy generation scenario including daily forecast
- Integration of new technologies and existing assets
- Construction and Commissioning



Customer Benefit

- Cost efficient power generation of sustainable and green energy
- Stable power supply due to storage solutions
- Less fuel dependency
- Use existing thermal assets as back-up for microgrid stability

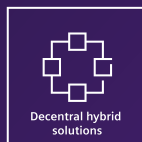


Leveraging possibility for coupling with existing and developing energy sectors



PROJECT TYPE

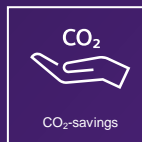
Hybrid solution



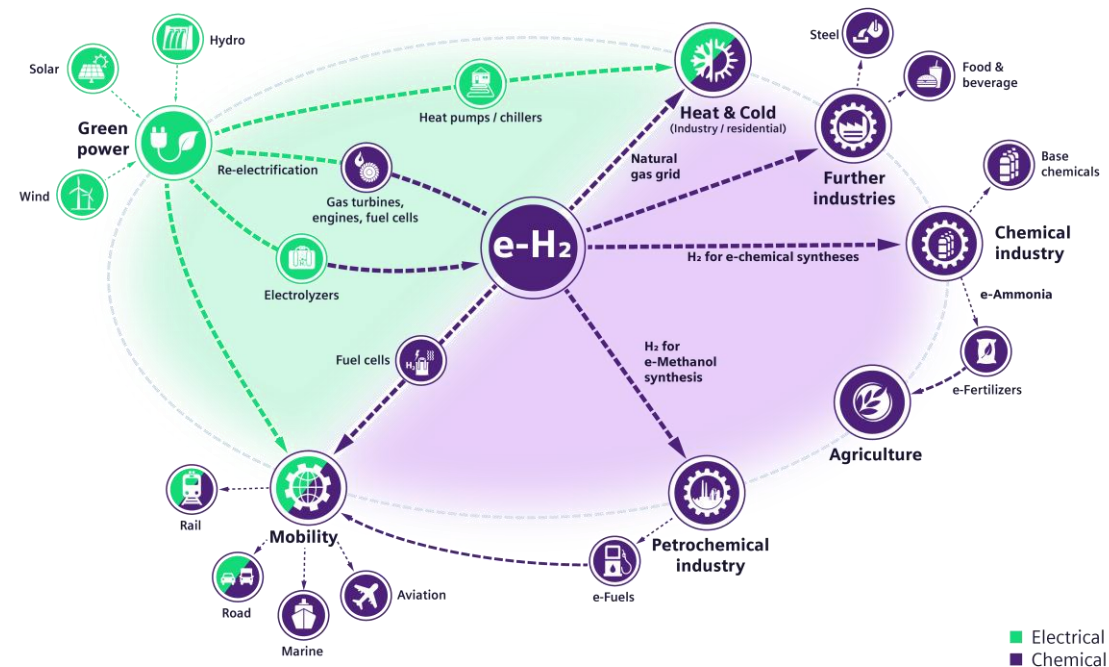
Decentral hybrid solutions



Partnership

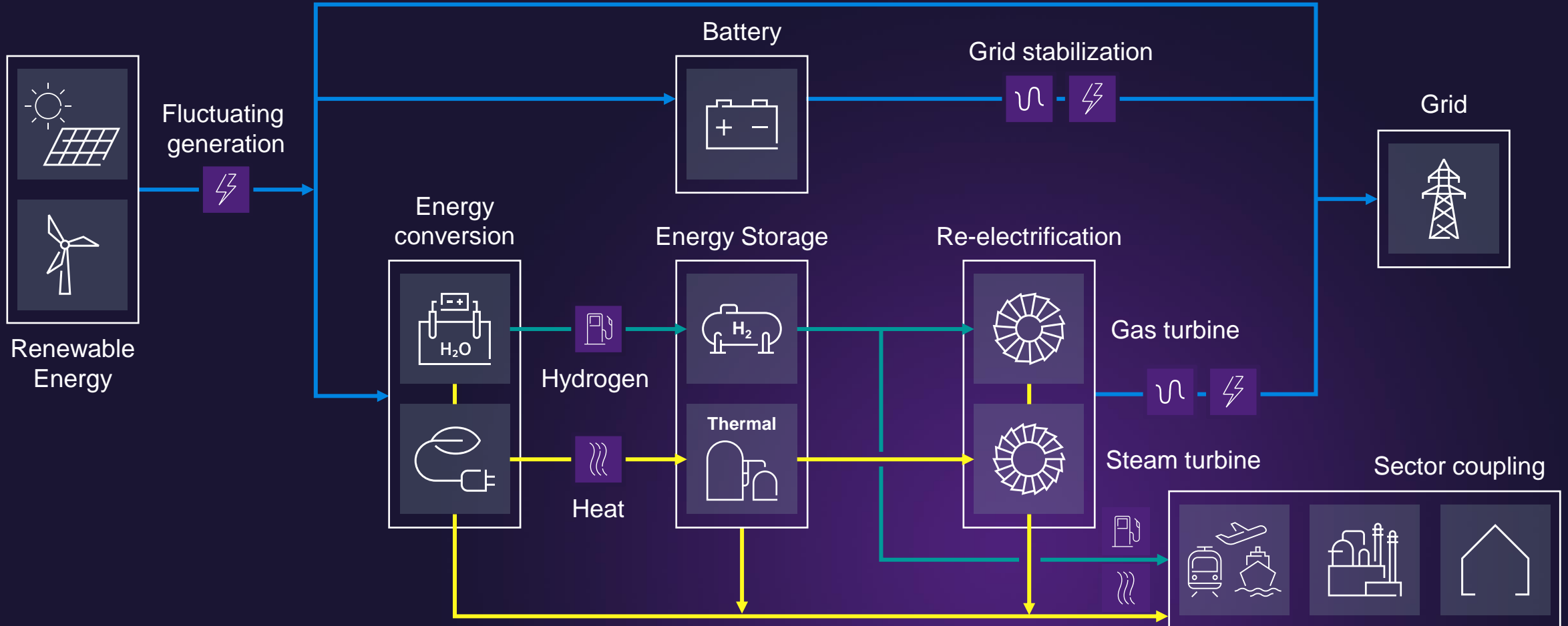


CO₂-savings



Possible scenarios for sector coupling

Low Carbon Hybrid Power Plant for CO₂-free city



Keeping in mind Hybrid Power Solutions

Powerfully decarbonize

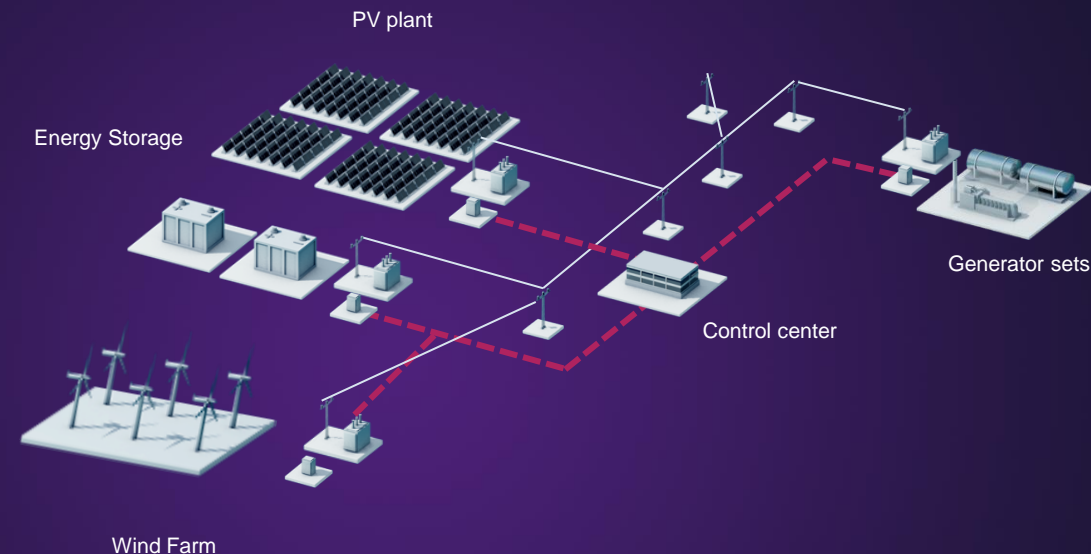
Utilization of renewable energy generation for lower CO₂ emission

with a Holistic project approach

Developing, designing and executing your idea to co-create the best energy system

Powerfully intelligent

Implementation of various technologies to one energy system



Lets get in touch

SIEMENS
ENERGY



Hans Koopman
Business Development
Hybrid Power Solution

SE GP G SO DSC DS HS

Mobile +49 173 6939692

E-mail hans.koopman@siemens-energy.com



Mario Hueffer
Business Development
Hybrid Power Solutions

SE GP G S DES CI

Mobile +49 152 01808708

E-mail mario.hueffer@siemens-energy.com

or visit us on our webpage: [Hybrid Power Solutions](#)

Disclaimer



© Siemens Energy 2022

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

All product designations may be trademarks or other rights of Siemens AG and Siemens Energy, its affiliated companies or other companies whose use by third parties for their own purposes could violate the rights of the respective owner.