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FUEL CELL
SYSTEMS

Convion Fuel Cell Systems

“The Role of Fuel Cell and Hydrogen Technology in Delivering Energy Security for Europe”, Tallinn 2017



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Convion Oy

BACKGROUND

- Corporate R&D of Wärtsilä through 2000-2012
- Convion started in 2013 by 9 founding members

CURRENT STATUS

- Unique IPR portfolio including 38 patented inventions
- Focus on mid-range SOFC co-generation solutions
- First customer delivery in Q2/2017

C50 PRODUCT

- Power 58kW, heat 30kW
- >53% (net-AC), >80% total
- Biogas or natural gas
- Power security during grid outages



References

- Several validated 20 – 50 kW systems



WFC20 20kWe
α-Prototype
NG
 η_e 41%

WFC50 50kWe
Laboratory units
NG, Biogas
 η_e ~47 %



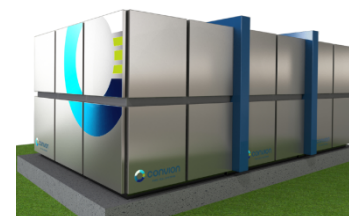
WFC20
NewEnergy
Land fill gas
 η_e > 49 %

Convion C50
50kW, NG, Biogas
Validation 2015



WFC20
Methapu
Methanol
 η_e > 43 %

X00 concept
175 kWe, Biogas
 η_e > 55 %
2016





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Transformation of the energy sector

DRIVERS

Electrification

Need to reduce CO₂

New needs

ACCELERATORS

New technologies

Regulatory
framework

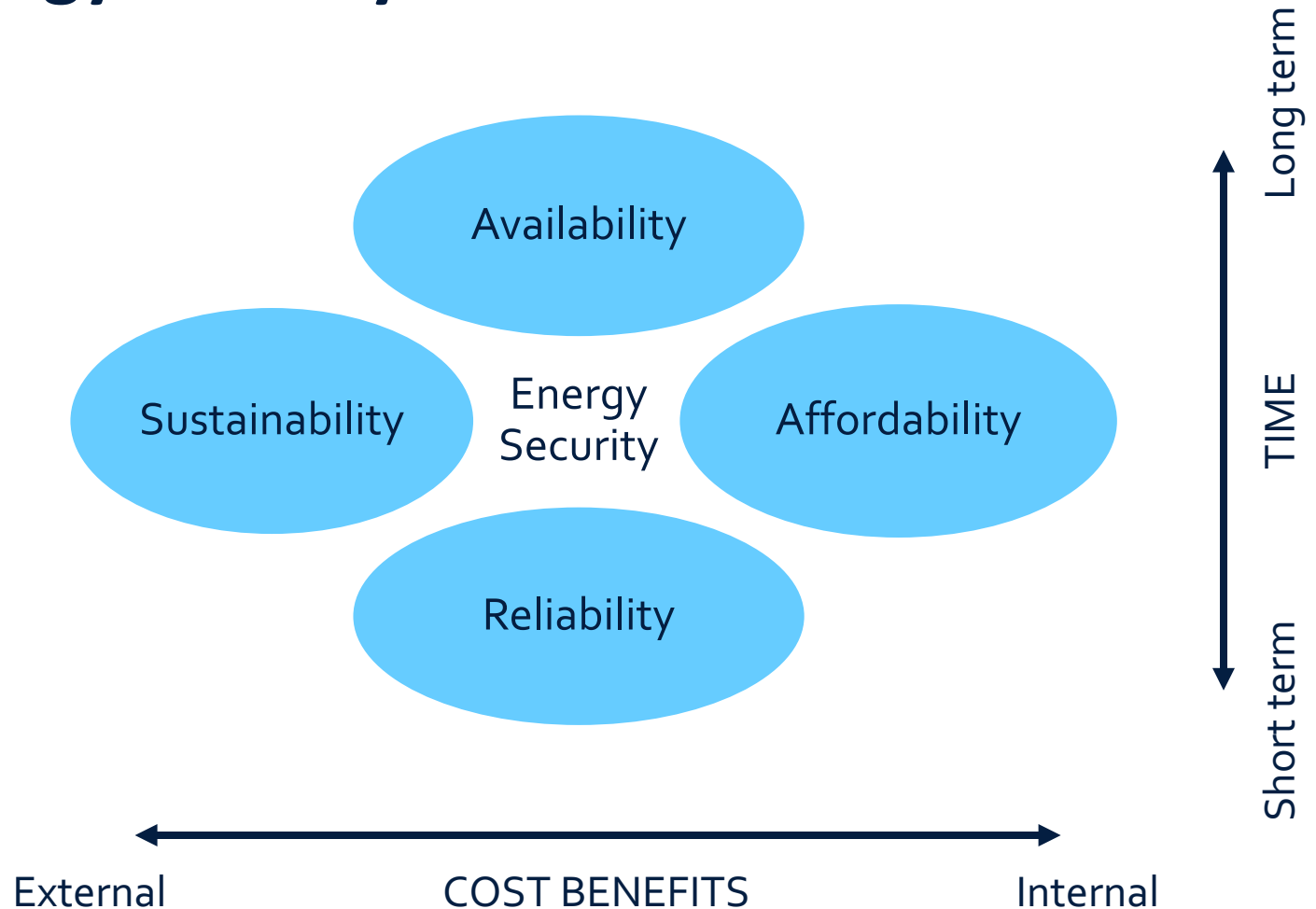
Active end-users



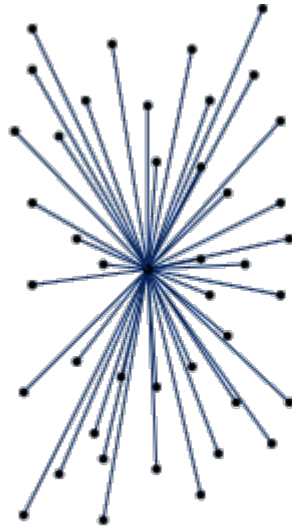
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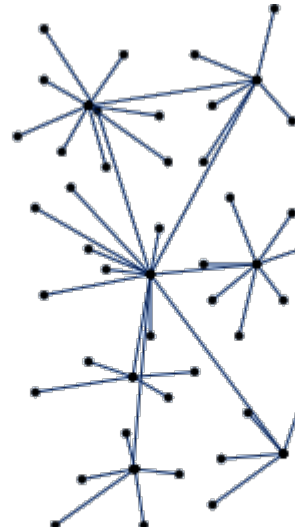
Energy Security – Different dimensions



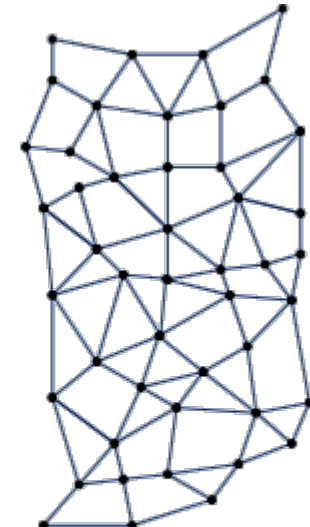
Structural evolution of energy systems



CENTRALIZED



DECENTRALIZED

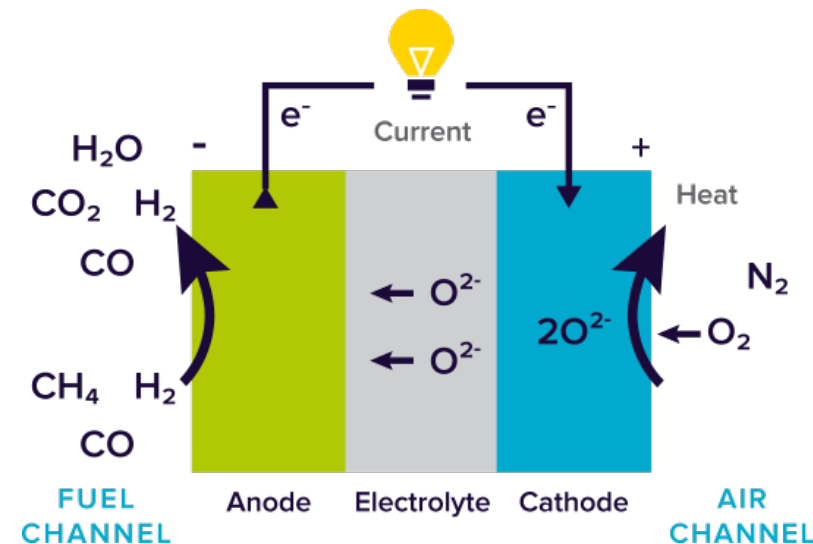


DISTRIBUTED



What is an SOFC fuel cell ?

- A fuel cell is an electrochemical device that directly converts chemical energy of a fuel into electricity and heat
- Produces low-voltage DC directly from natural gas or biogas – works with H_2 but does not require it.
- Key properties
 - High electrical efficiency
 - Low emissions
 - Fuel flexible
 - Scalable from mW to MW

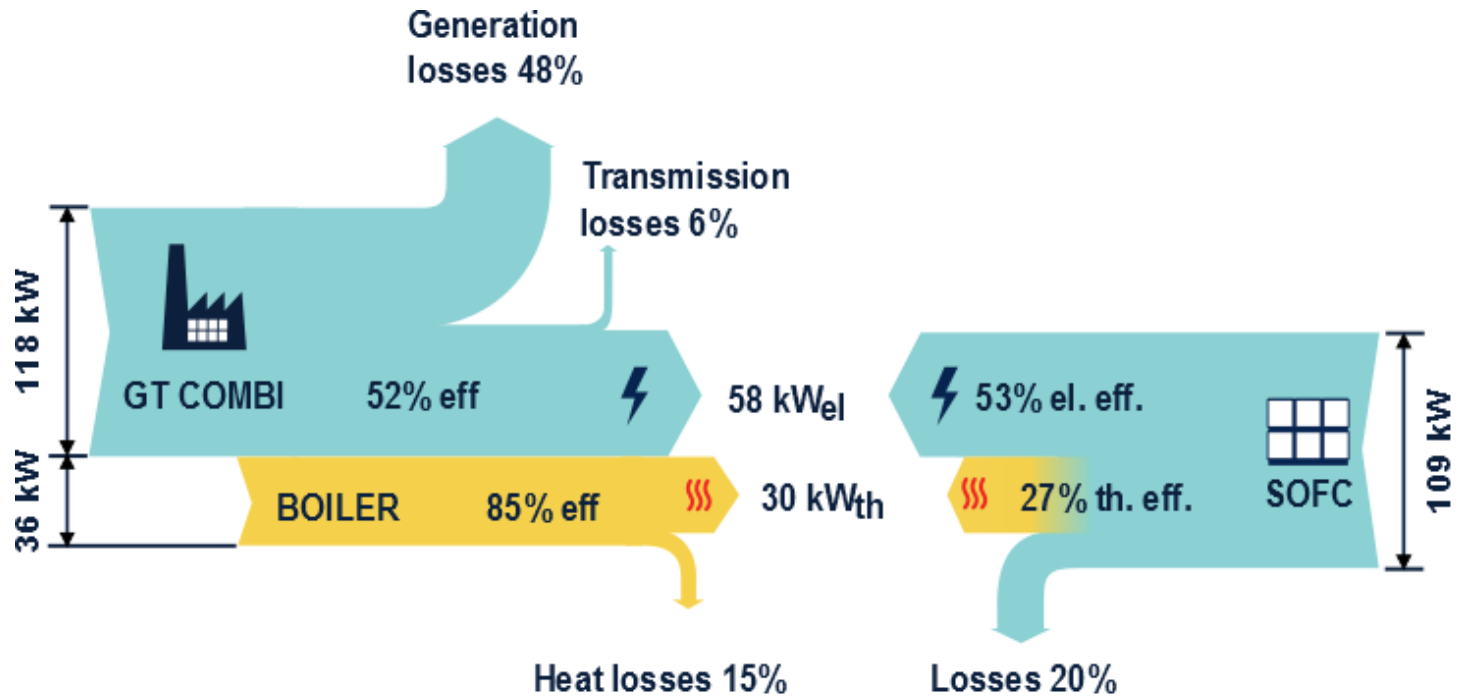




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More with less



>29% reduction in primary fuel consumption for the same output as compared to the state-of-the-art, central generation.

Potential fuel cell applications

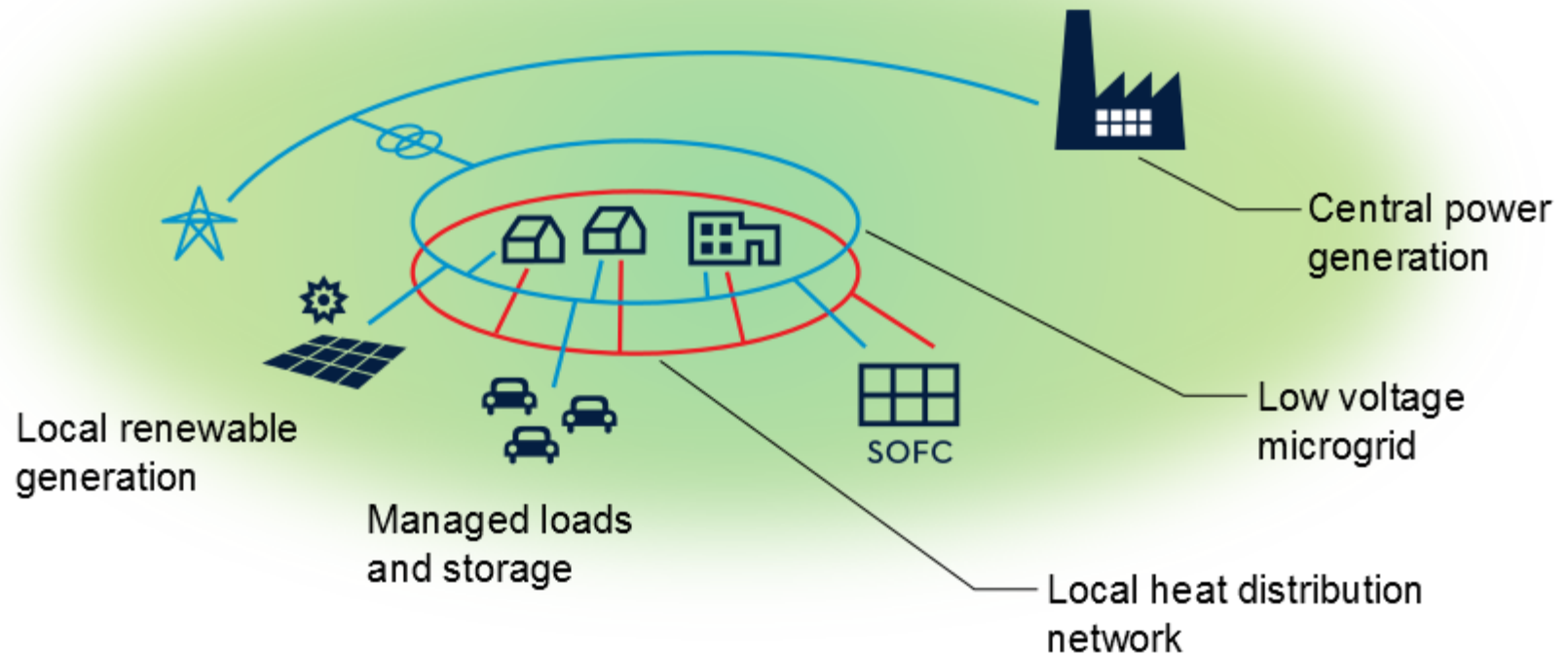
- Energy efficiency with distributed CHP
 - Commercial buildings, small industries
 - Continuous onsite power generation
- Power security and energy independence
 - Grid parallel, islanding capable micro grids
 - Smart grids and virtual power plant concepts
- Direct biogas utilization
 - Sustainable biogas from waste



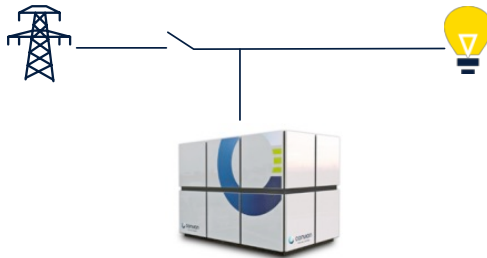
Photo courtesy of
Photographic Archives SMAT

Integrated CHP generation

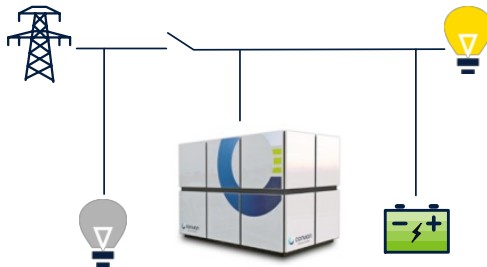
– an enabler for smart micro grids



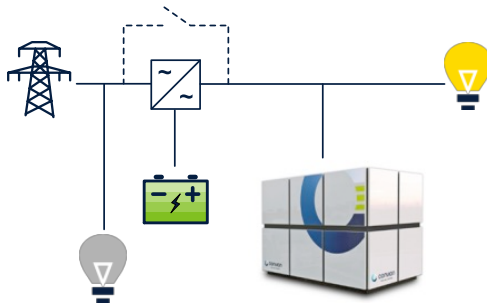
Grid parallel but islanding capable – with or without storage



Grid-parallel on-site CHP for high eff & simple islanding capability



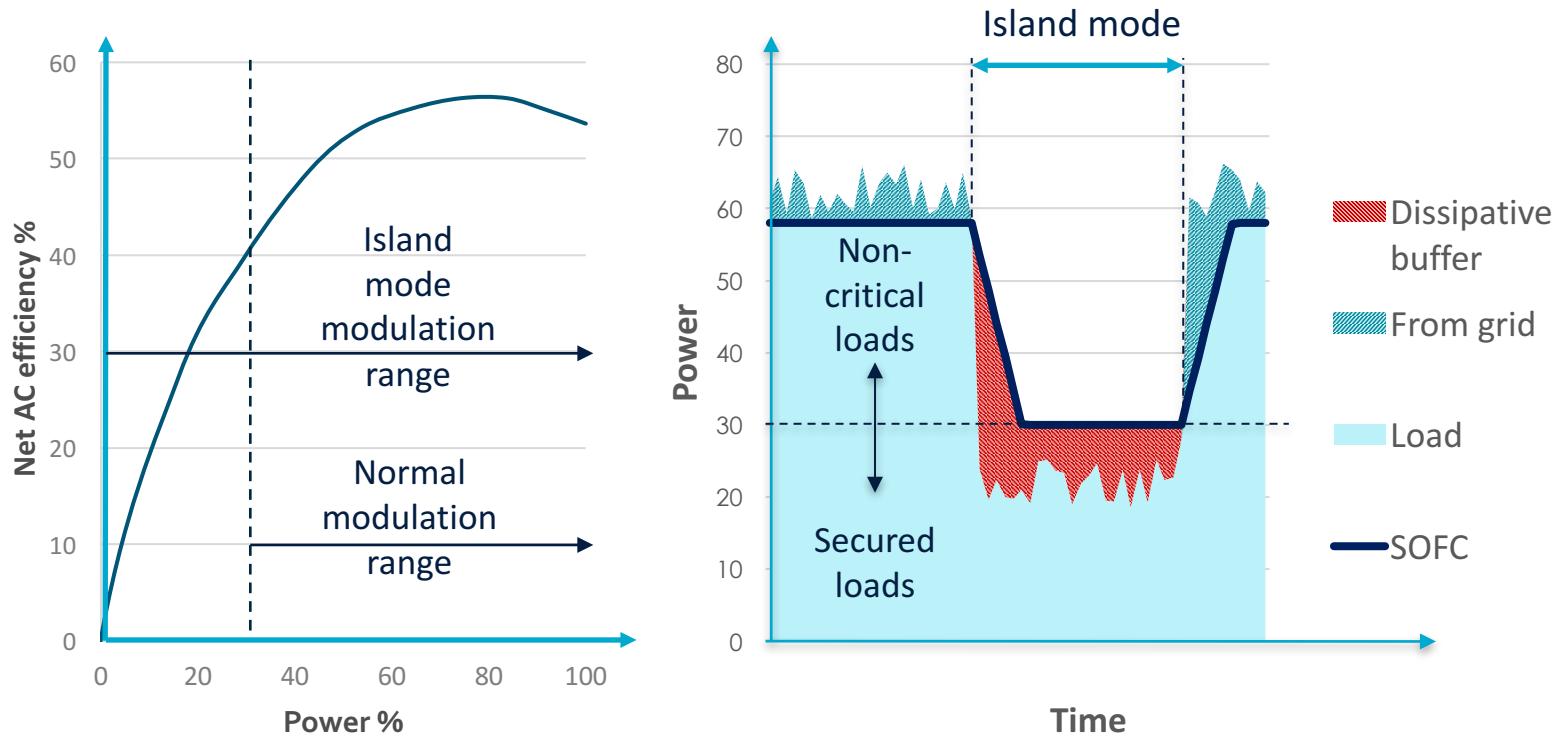
Grid-tied micro grid with storage, capable of instant load following

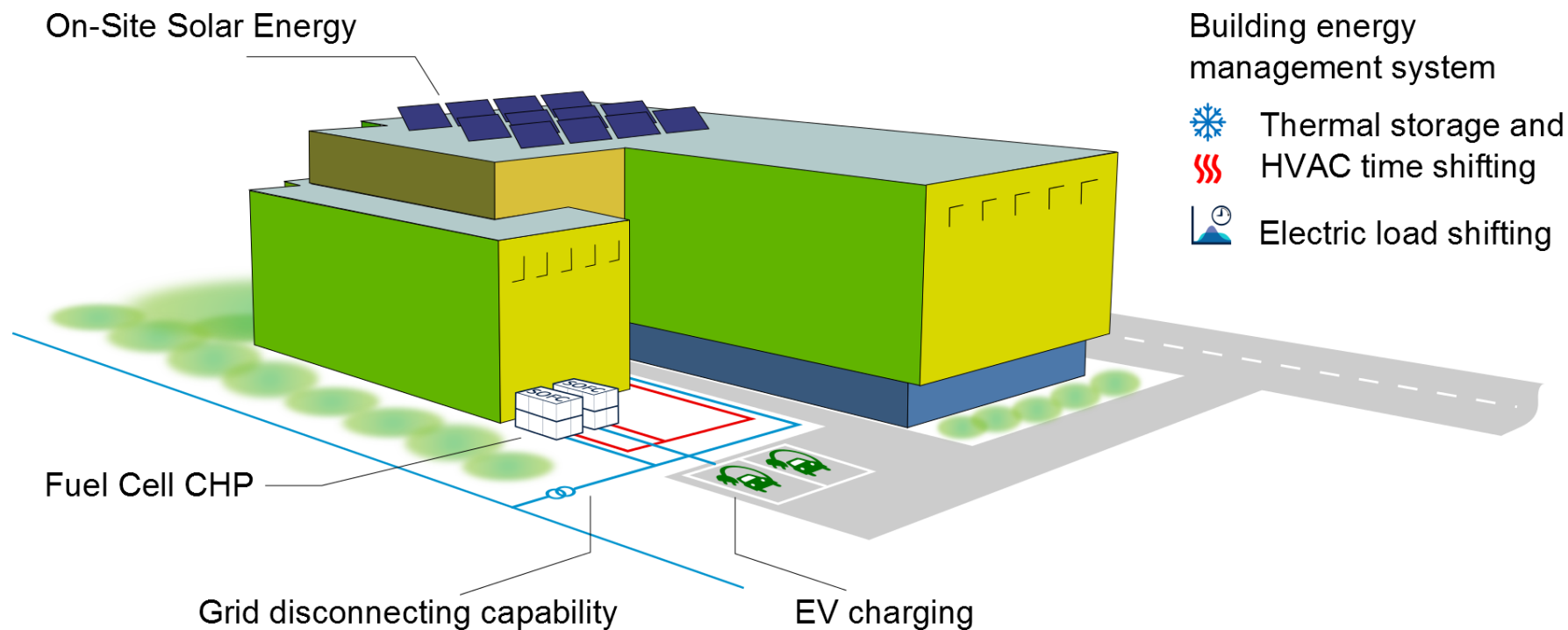


Power quality & availability through an UPS-configuration

SOFC systems are not just for baseload

- In grid-tied mode, SOFC can be modulated from 100% to 50% with little compromise in efficiency.
- During a grid outage, SOFC system with built-in dissipative means can form an intentionally islanding grid and supply dynamic loads with power.

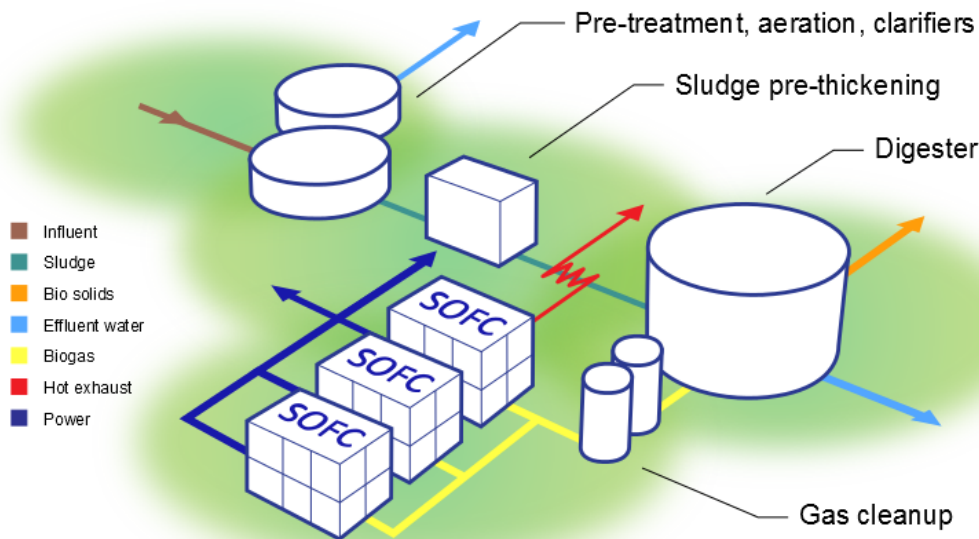




- Commercial buildings, campuses or institutions
- Grid-tied microgrids have redundancy built in their power supply
- Aggregated CHP, storage and demand response assets facilitate participation in capacity and grid support markets.

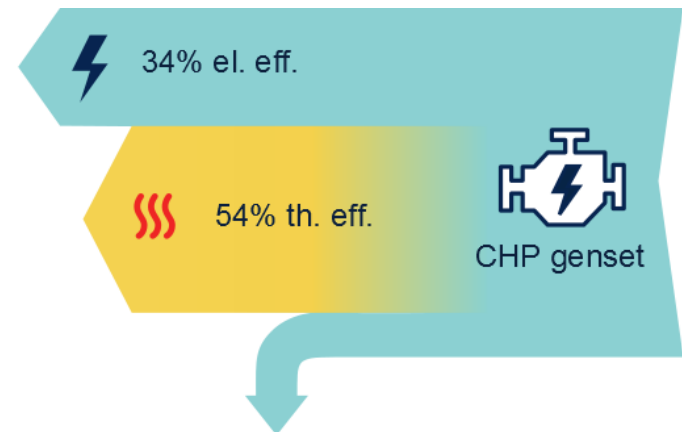
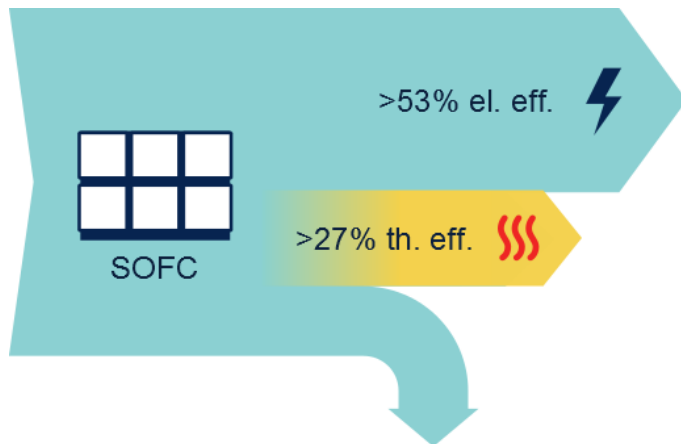


Photo courtesy of Photographic Archives SMAT



Energy autonomy of critical municipal functions

- Waste water
- Potable water
- Organic solid waste



DEMOSOFC Project: FACTS

AIMS

The DEMOSOFC project will demonstrate technical and economic feasibility of operating an industrial scale biogas SOFC installation.

WHERE

The DEMO plant will be installed at a medium sized wastewater treatment plant (WWTP) located in the Torino area (IT).

HOW

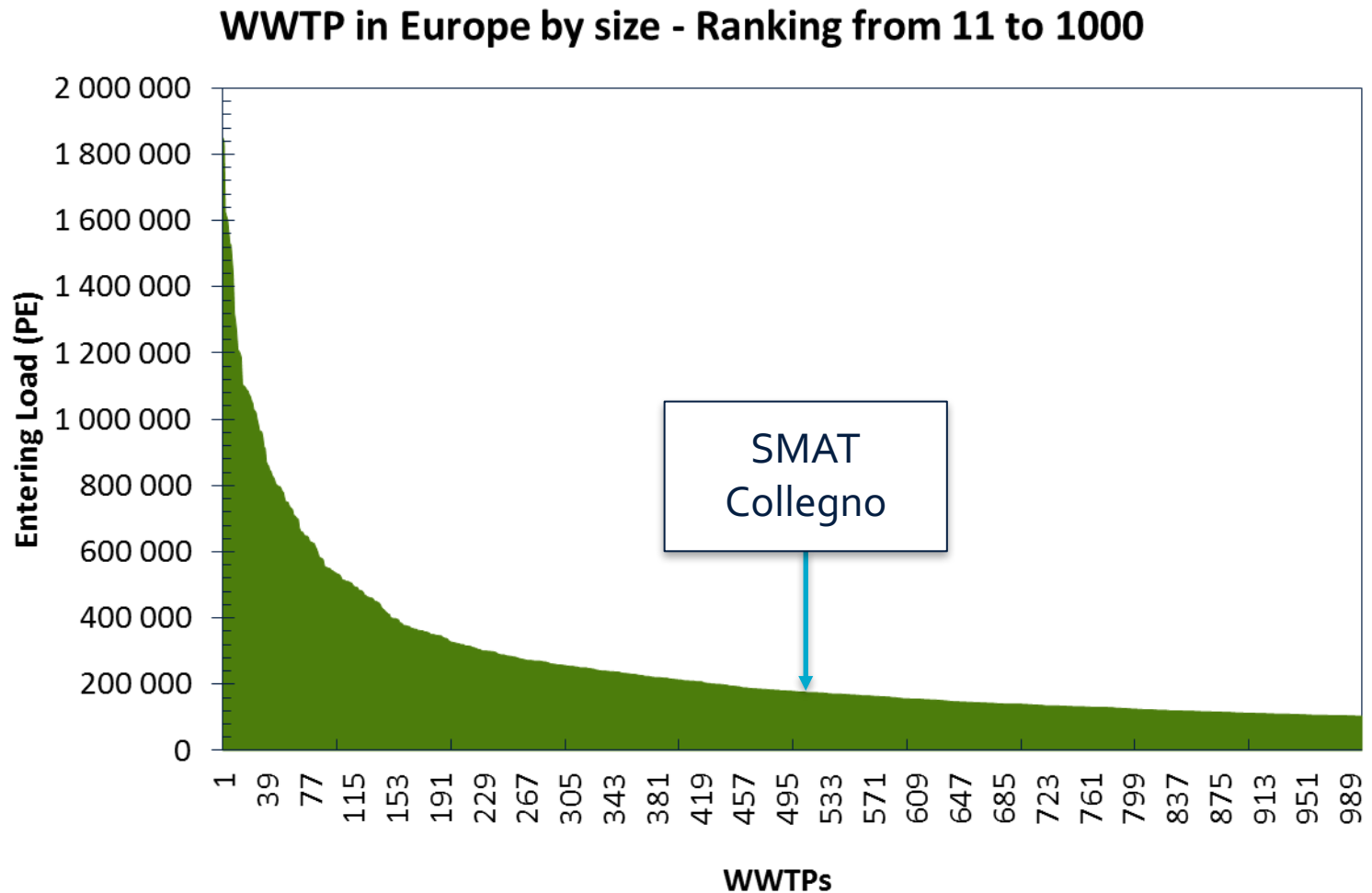
Biogas produced by anaerobic digestion of wastewater sludge is used in a SOFC installation to cover ~30% of the plants electrical and 100% of the processes thermal energy needs.



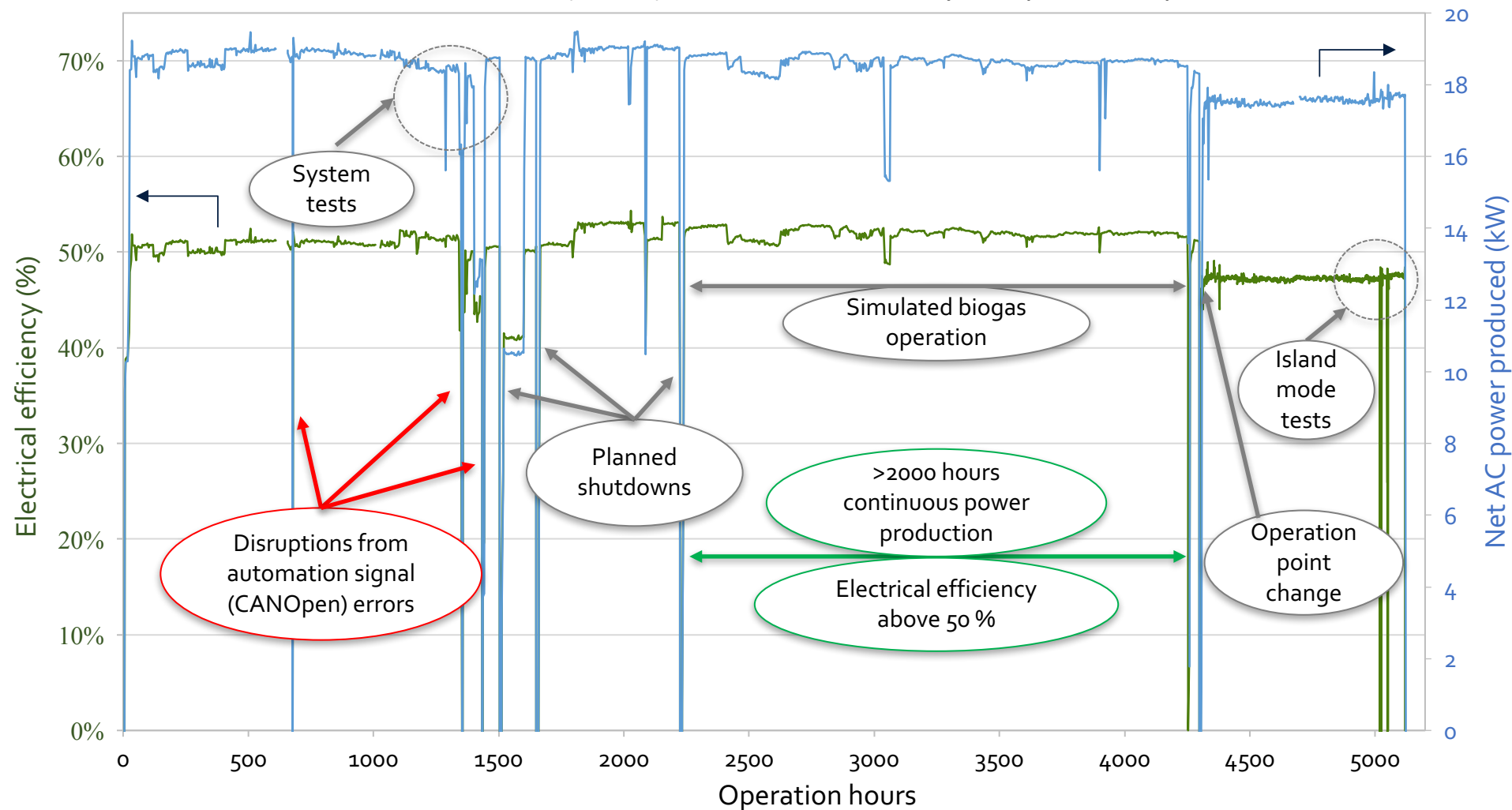
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DEMOSOFC site in Europe



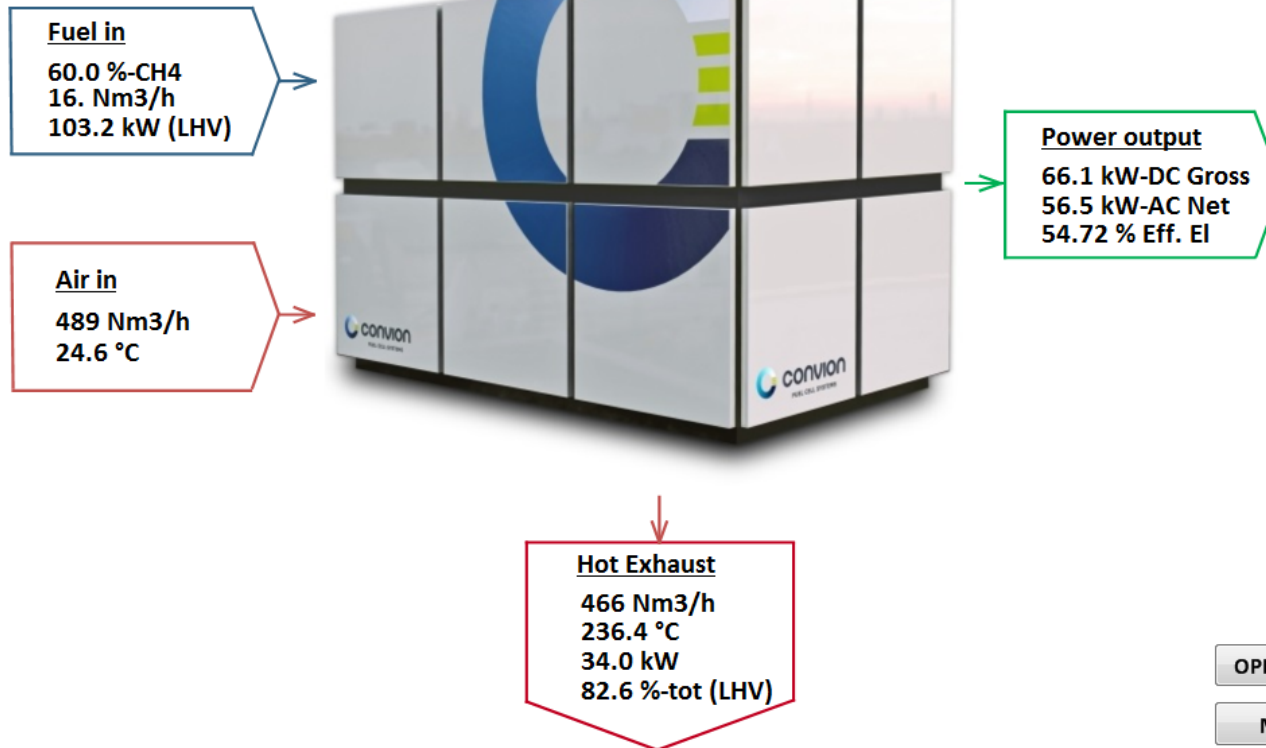
Convion C50 v 1.0 validation (20kW) – electrical efficiency and produced power



- Autonomous operation validated for different conditions
- Multiple special conditions test, gas composition change etc.

Loading : 500.00 hours
AC electricity produced : 26978.04 kWh
DC electricity produced : 31453.50 kWh
Heat produced : 15629.57 kWh

Biogas operation



OPERATOR

MAIN

DIAGRAM

Status now



Conclusions

- Dependable, continuously operating fuel cells are an enabling part of the future, decarbonizing generating mix.
- SOFC provides the highest generation efficiency and a broad modulating range, regardless of scale.
- Fuel flexibility and superb performance in small scale extends sustainable biomass resource base for flexible, CO₂ neutral power generation.
- Convion will start the first customer demonstration in Q3/2017



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Thank You!

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