SO Fuel Cell AND SOLIDpower

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SOLIDpower GmbH

ENERGY IS OUR PACE
OF PROGRESS

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ABOUT US

History

Location

Production Plant

References

BlueGEN BG-15

OUR HISTORY

2000

EPFL (CH) Spin Off
HTceramix

SOFC POWER

2007

SOFCpower was founded,
acquisition of **HTceramix**

2008

Pilot Plant in Italy,
G8 stack technology

2014

Roll-out within European
Ene.field program

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OUR HISTORY

2015

Asset acquisition of Ceramic Fuel Cells GmbH

2016

Restart commercialization of **BlueGEN**

2018 + 2019

1300 units sold, 30 GWh produced, **BG-15 release, New plant Italy** (50 MW/y planned)

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OUR LOCATIONS

SOLIDpower GmbH
Heinsberg
Germany

SOLIDpower S.A.
Yverdon
Switzerland

SOLIDpower S.p.A.
Mezzolombardo
Italy

SOLIDpower AU
Melbourne
Australia

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OUR PRODUCTION PLANT 1 (ITALY)

- 3.600 square meters
- Around 100 employees
- Capacity in products/day: 300 cells/shift or 4 stacks/shift
- Research and development

SOLIDpower
Mezzolombardo, Italy

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OUR PRODUCTION PLANT 2 (GERMANY)

- 1.600 square meters
- Around 85 employees
- Capacity in products/day: up to 32 units/day
- Assembling

SOLIDpower
Heinsberg, Germany

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OUR NEW PRODUCTION PLANT 3 (ITALY)

OPENING SEPT. 2019

- 6.400 square meters
- 100 employees
- Capacity in products/day: 60 stacks/day
- Stack production

SOLIDpower
Trento, Italy

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OUR REFERENCES & INSTALLATIONS

- 1300+ units installed
- 12 countries
- 24 Mio. hours of operation
- 30 GWh produced (6k ton CO_2 saved)
- 1,5% reduction of efficiency per year
- Stack lifetime 7 years

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SELECTED References

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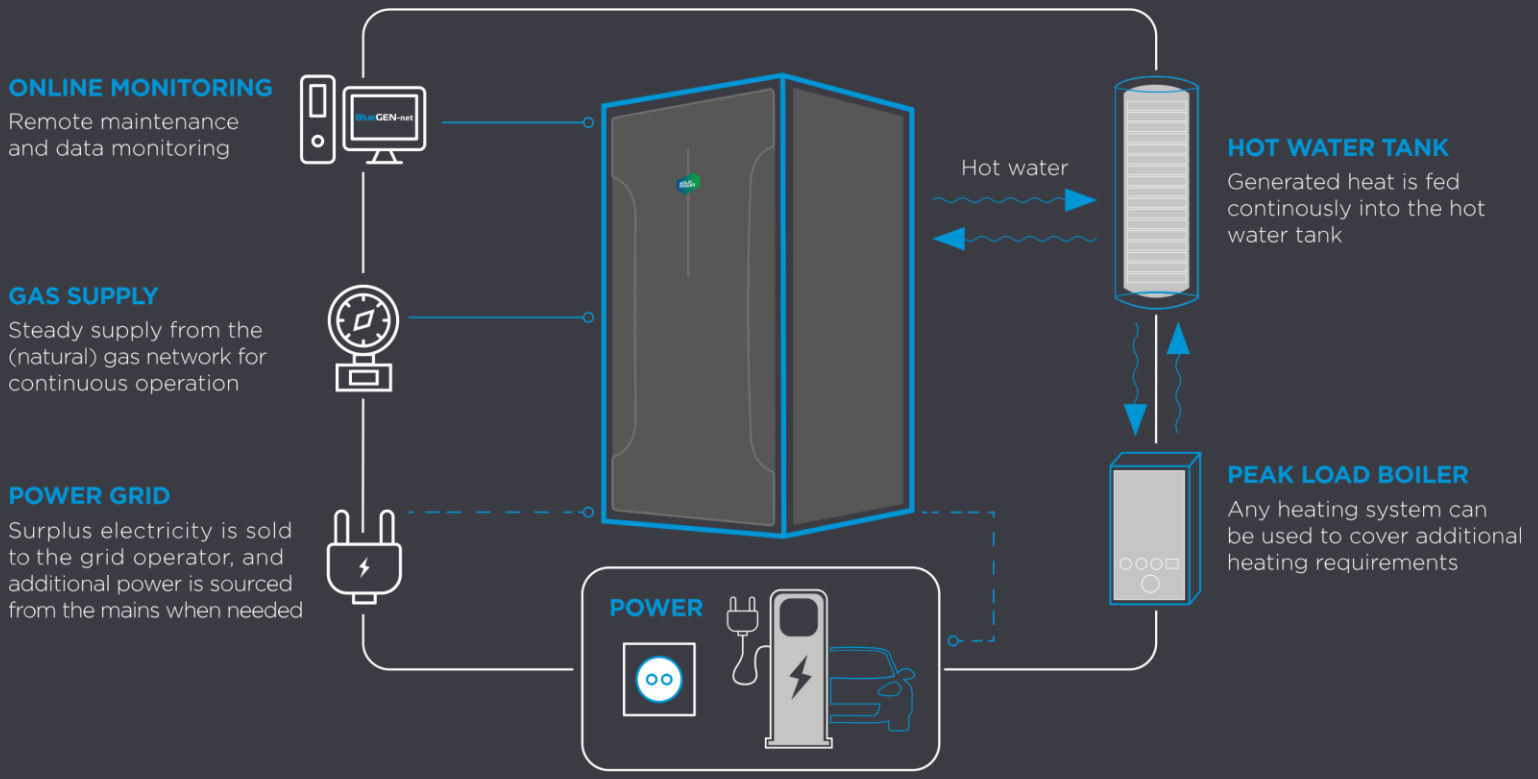
SOLID POWER
BlueGEN
BG15

OUR PRODUCTS

BlueGEN BG15

Generate power and heat for businesses and homes



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OUR PRODUCTS: BG-15

Key features

1.5 KW ELECTRIC POWER
UP TO 13,000 KWH OF ELECTRICITY PER YEAR

ADDITIONAL HEAT
E.G. FOR YOUR WARM WATER

CONTINUOUS OPERATION
RELIABLE ENERGY 24/7

EFFICIENT & AFFORDABLE
PROTECTS THE ENVIRONMENT AND YOUR WALLET

EASY INSTALLATION
COMPATIBLE WITH ALL HEATING SYSTEMS

IMPROVES THE ENERGY PERFORMANCE OF YOUR BUILDING NO EXPENSIVE ADDITIONAL MEASURES

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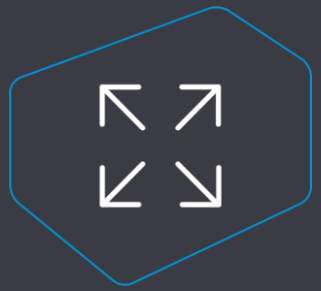
OUR PRODUCTS: BG-15

ENERGY 24 / 7 – SERVICE 24 / 7

LOW ENERGY COSTS
DUE TO THE SYSTEM'S OUTSTANDING EFFICIENCY

PROTECT THE ENVIRONMENT
REDUCES YOUR CARBON FOOTPRINT UP TO 50%

ALL-INCLUSIVE SERVICE & MAINTENANCE
THROUGH MANUFACTURER



LOW SPACE
REQUIREMENT FOR CASCADING MULTIPLE UNITS

APP
FOR MONITORING & POWER PROFILING

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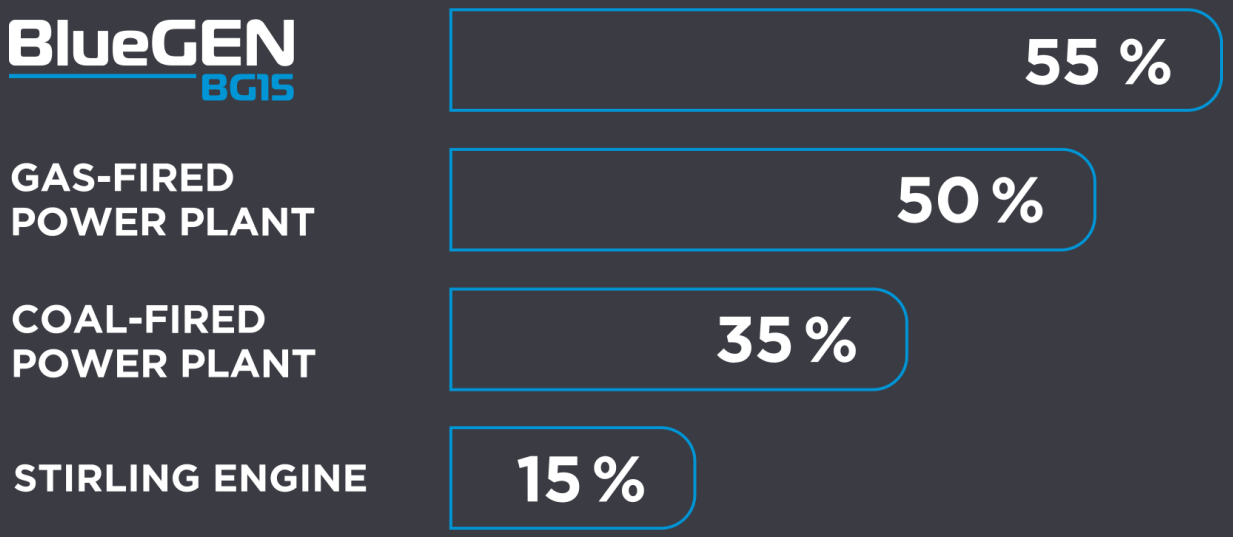
OUR PRODUCTS: BG-15

Electrical Efficiency



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OUR PRODUCTS: BG-15

Complete control

Control and full access to the extensive data:

- ✓ Electricity you are producing
- ✓ CO_2 emissions you have saved

- ✓ For iOS and Android
- ✓ $HTML_5$ responsive
- ✓ Security compliance (GDPR)
- ✓ Monitoring / power profiling

Download on the App Store

GET IT ON Google Play

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OUR PRODUCTS: BG-15

Increasing power demand ? More BG-15s!

Two or more BG-15 units can be combined easily to create a cascade.

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OUR PRODUCTS: BG-15

Technical Specification

Electrical power	Max. 1.5 kW Min. 0.5 kW	Default operation mode: Constant operation at maximum electrical efficiency, output 1.5 kW
Electrical efficiency*	Up to 55%	At 1.5 kW electrical output
Thermal power*	Up to 0,85 kW	At 30°C return temperature
Overall efficiency*	Up to 88%	At 1.5 kW electrical output and < 30°C return temperature
Ramp rate electrical power	Up: 50 W/min Down: 50 W/min	Depending on system conditions
Weight	230 kg	
Dimensions	1200 x 550 x 800 mm	Height x width x depth

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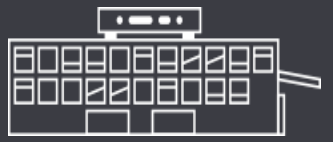
OUR PRODUCTS: BG-15

SPORT CENTERS

BIG SFH OR MFH



SME AND OFFICES

CONDOS

BlueGEN BG15

SWIMMING POOLS

TERRACES HOUSES

HOTELS

SCHOOLS

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SOFC

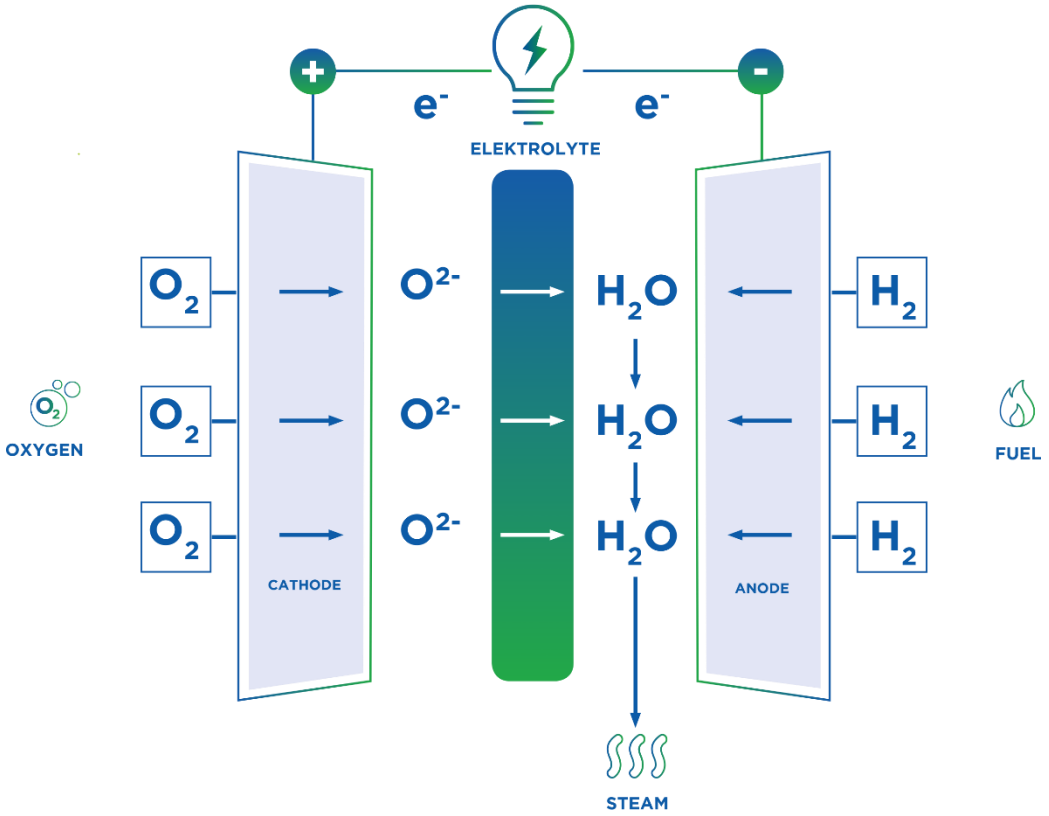
Principle

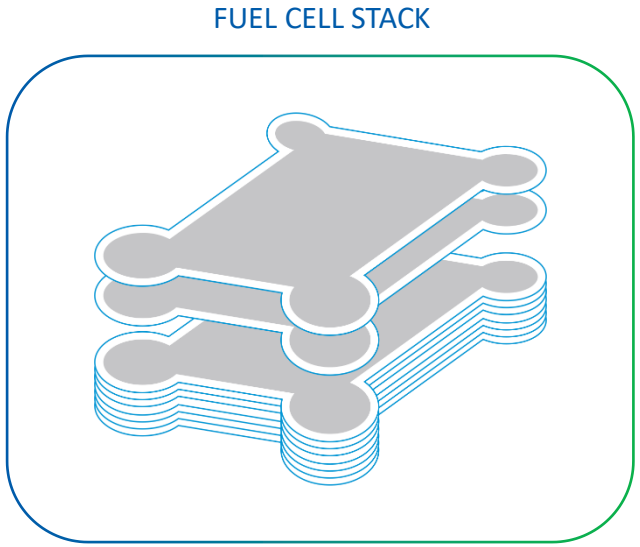
Advantages

Market Potential

SOFC PRINCIPLE

Principle of a Fuel Cell





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SOFC PRINCIPLE

NATURAL GAS
LIQUID FUELS
COAL (GASIFIED)
BIOFUELS
HYDROGEN
AMMONIA

AIR

WATER

SOFC

SOLID
OXIDE
FUEL
CELL

ELECTRICITY

HEATING

COOLING

WATER

NO CO_2

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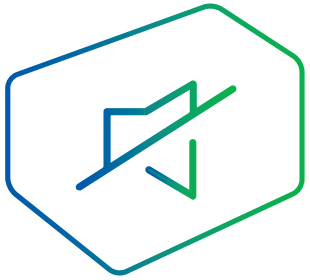
SOFC ADVANTAGES

Key Advantages:

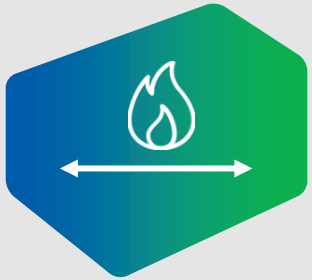


SILENT OPERATION
(NO MOVING PARTS)

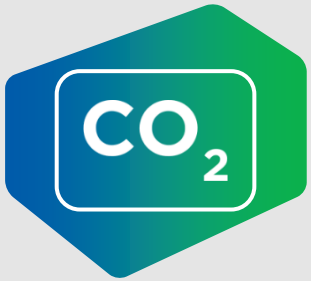
HIGHER EFFICIENCY
THAN COMBINED CYCLE
GAS TURBINES (> 60% AC DELIVERED)

CLEAN EMISSIONS
NO SO_X OR NO_X

Other unique features:



WIDE RANGE OF FUELS
(H_2, GAS, BIOGAS, ETC.)



CO_2 CAPTURE "BUILT-IN"
WITHOUT LARGE INVESTMENT
OR EFFICIENCY PENALTY

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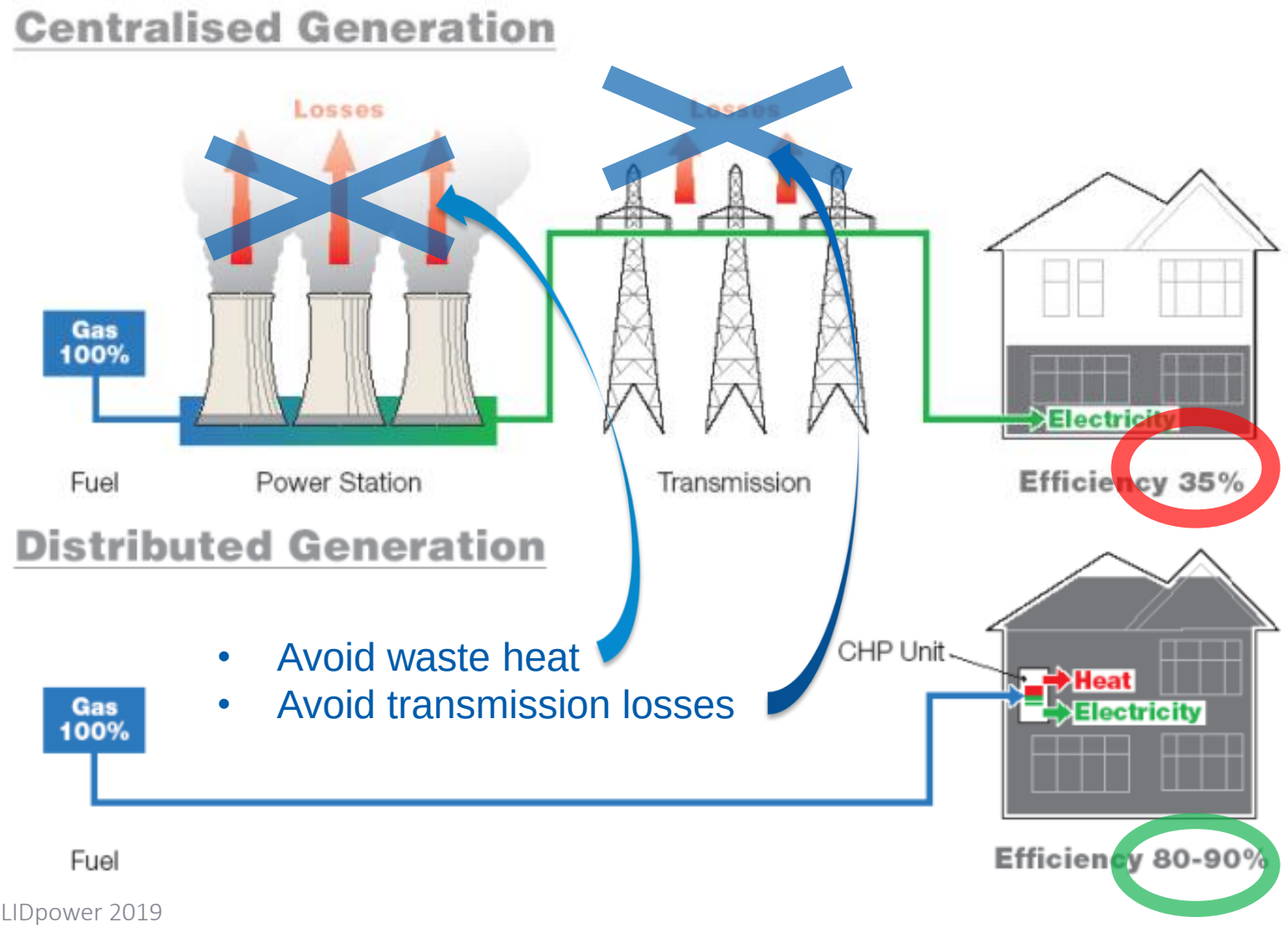
SOFC ADVANTAGES: DISTRIBUTED GENERATION



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SOFC ADVANTAGES

Clean Energy

ULTRA-CLEAN:

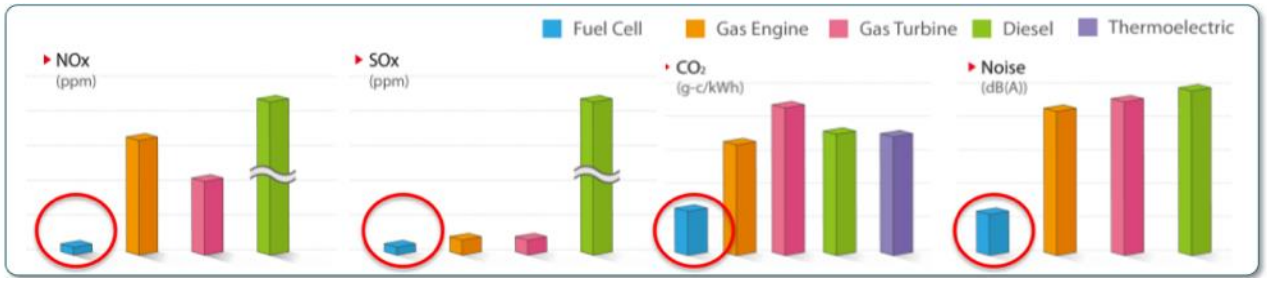
Fuel cell power promotes healthy living & helps preserve the environment

NEAR “0” POLLUTANTS:

Combustion-free fuel cell creates electricity without pollutants no NOx, SOx and particles.

LOW to zero CARBON FOOTPRINT:

Release less CO_2 than combustion-based generation due to high efficiency. Zero emission on Green gas or Green Hydrogen



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3

NEXT STEPS

Future Products

Future Projects

FUTURE PRODUCTS

BlueGEN BG-60: Key elements specifications

- Nominal Power: 6 kW
- Net electrical efficiency: 60%
- Net cogeneration efficiency: 90%
- Thermal Cycles: 12/y
- Operation without any tap water, incl. Start-up and cool-down
- Operation mode: load following, heat capped or DC-control loop
- Installation indoor
- Floor standing
- Plastic chimney
- Annual service by front panel only
- On-board display: LED
- Stackable units

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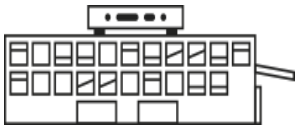
FUTURE PRODUCTS

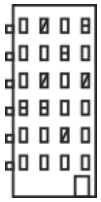
BG-60: Applications (mCHP)

SPORT CENTERS

BIG SFH OR MFH

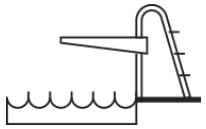


SME AND OFFICES



CONDOS

BG-60



SWIMMING POOLS

TERRACES HOUSES

HOTELS

SCHOOLS

MIN BASE-LOAD OF 6 KW

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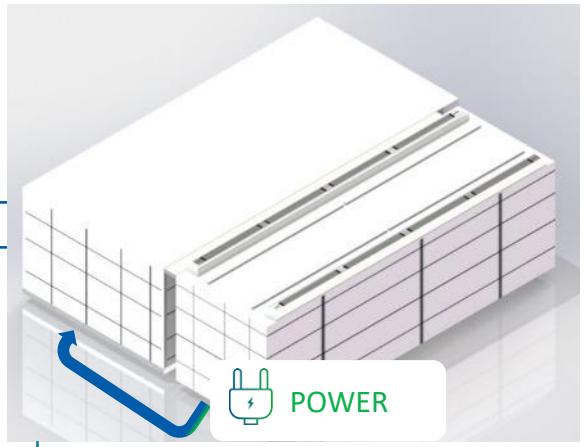
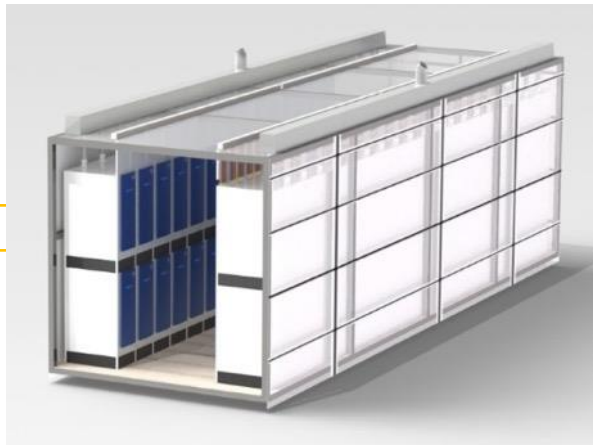
FUTURE PRODUCTS

BlueGEN BG-60: Applications (Datacenter)





MODULE UP TO 480 KW

- Input = low pressure gas
- Individual power generator
- DC (or AC)
- Load following

BG-60 MODULE

6kW, 2 levels to power

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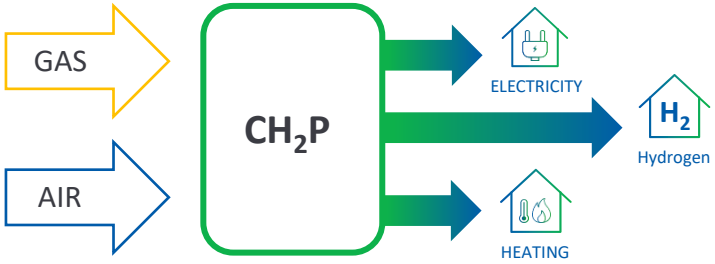
FUTURE PROJECTS

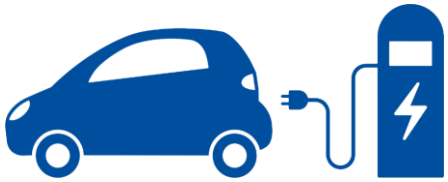
Development Project CH2P with Shell

PROJECT GOALS

CH_2P – Combined H_2, Heat&Power



APPLICATION



HRF with 100-200 kg H_2/h

PARTNERS

FUNDING

1. EU cofounded project CH_2P
2. Shell contributuion

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

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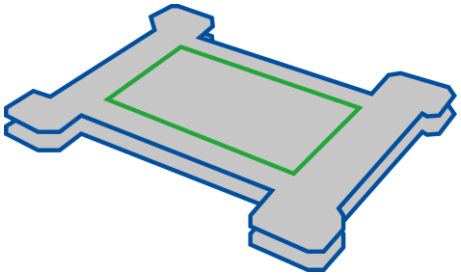
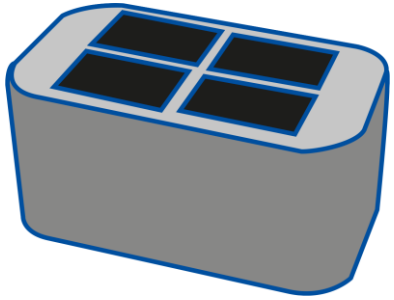
FUTURE PROJECTS

Similar design principles secure scale up with high performance and minimum risks.

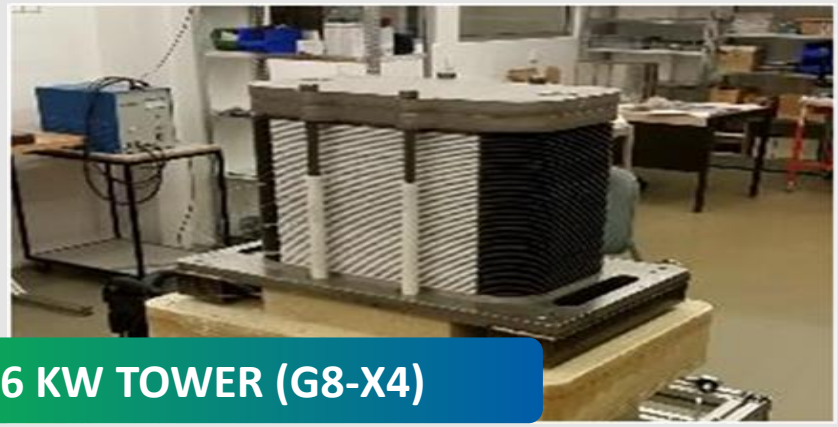
G8



G8-X4



Successful test with 6,7 kW and 62% electrical efficiency.



6 KW TOWER (G8-X4)

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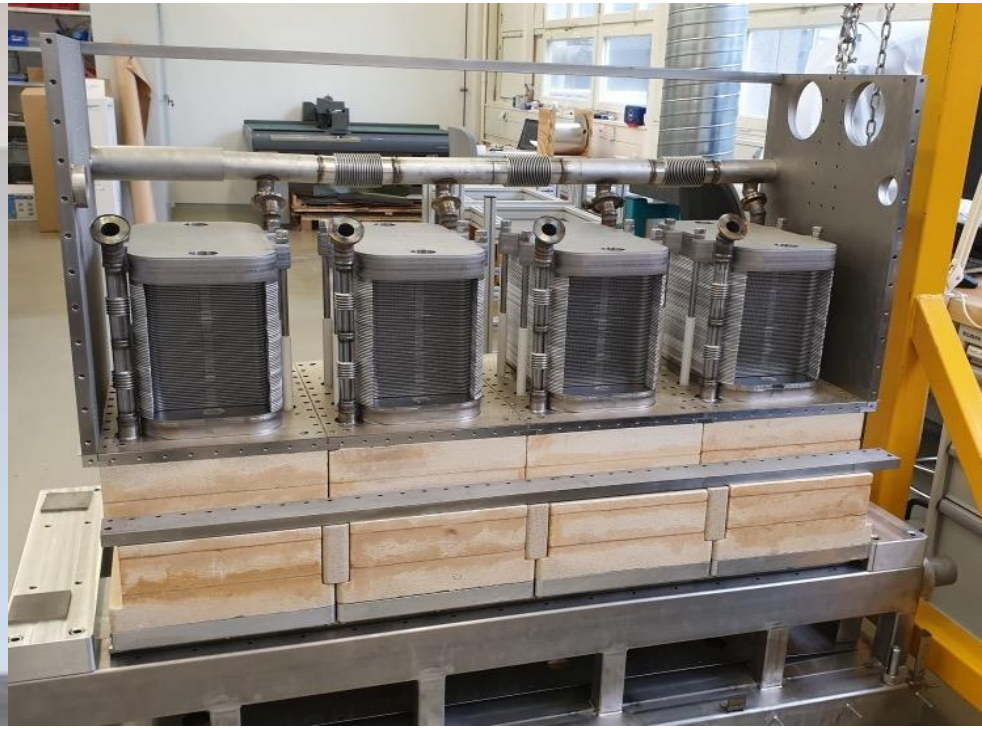
FUTURE PROJECTS



25 kW module (4 towers)

- Larger Stack Module with 4 stack towers
- Produces 25 kW electrical power in Solid Oxide Fuel Operation
- 75 kW power of chemical energy (H2, synthetic fuel) in Solid Oxide Electrolyser Operation

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SOLID POWER

MAY THE POWER BE WITH YOU!

BACKUP

SOFC MARKET POTENTIAL

Global Solid Oxide Fuel Cells Market Analysis*

$2.6 BILLION BY 2025:

The global market for Solid Oxide Fuel Cells (SOFCs) is projected to reach $2.6 billion by 2025, driven by the ever increasing global demand for electricity and rising focus on clean and renewable energy production.

INCREASE ELECTRICITY PRODUCTION:

With per-capita consumption of electricity on the rise worldwide, the need to increase electricity production has become a top priority for governments across the globe.

ASIA-PACIFIC IS THE LARGEST MARKET:

Asia-Pacific represents the largest and the fastest growing market worldwide.

*Merkle & Sears, Global Solid Oxide Fuel Cells Market Analysis, April 2019. Strategic assessment of a high growth market.

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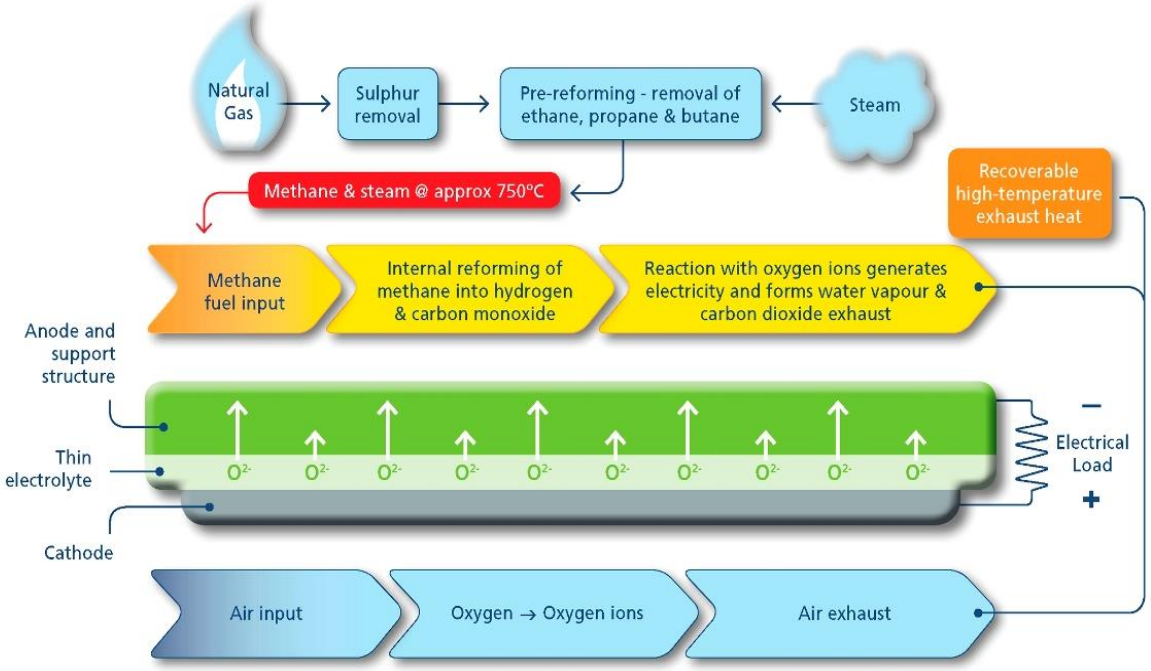
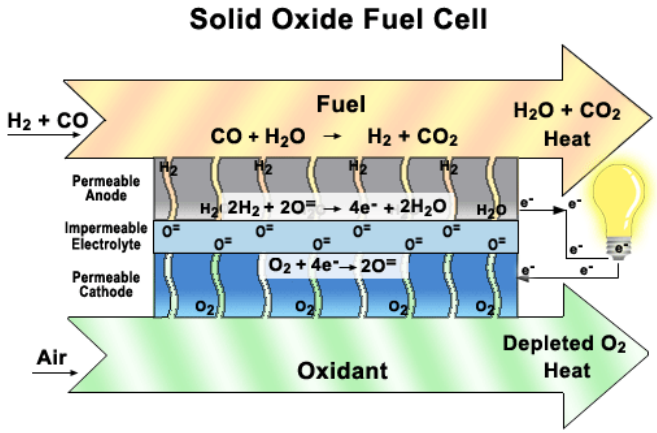
How does SOFC work?

The SOLIDpower SOFC-technology





Different types of Fuel Cells

Low temperature *(60 to 80° Celsius)*

Need 99.999999 pure hydrogen

Most suitable for **start/stop applications** or short periods of use (**automotive**)

Lower electrical efficiency (30-45%) & more waste-heat: 60%

Example:

Polymer Electrolyte Fuel Cell (PEFC) (or **PEM**FC)

High temperature *(600 to 800° Celsius)*

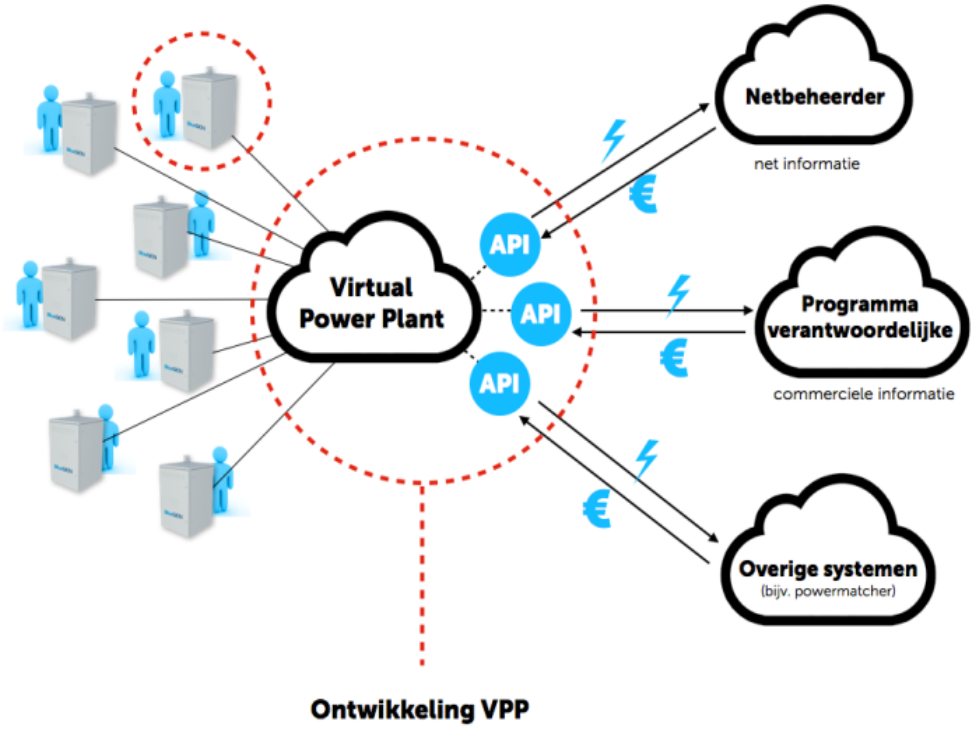
Many different fuel-sources: Hydrogen, natural gas, biogas, LPG, etc.

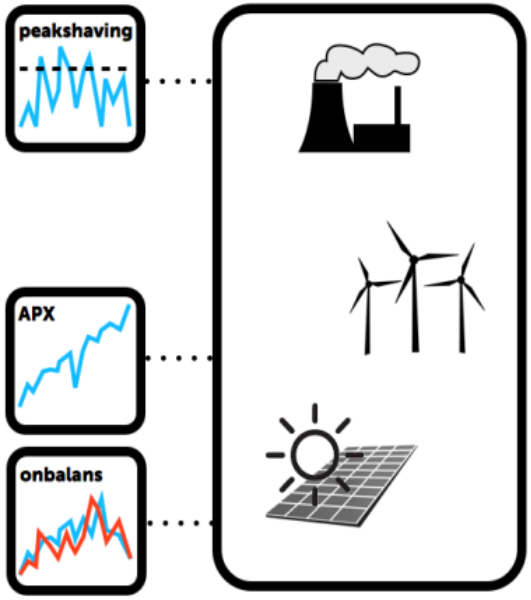
Most suitable for **Base load productions** (buildings)

Higher electrical efficiency (60%) & less waste heat 40%:

Example: *Solid Oxide Fuel Cells* (**SOFC**)

Example of BlueGEN in Virtual Power Plant
Project Ameland





Projects: Data centers Microsoft

"Essentially what we want to do is get out of R&D as soon as possible and actually use them to power the data center, we hope to do that as soon as possible," he said. "Unfortunately we have a supply chain issue. I need hundreds of megawatts of these things."

Microsoft Is Getting Hungry for Fuel Cells

By **Anna Hirtenstein**
31 October 2017 06:00
From **Climate Changed**

Bloomberg