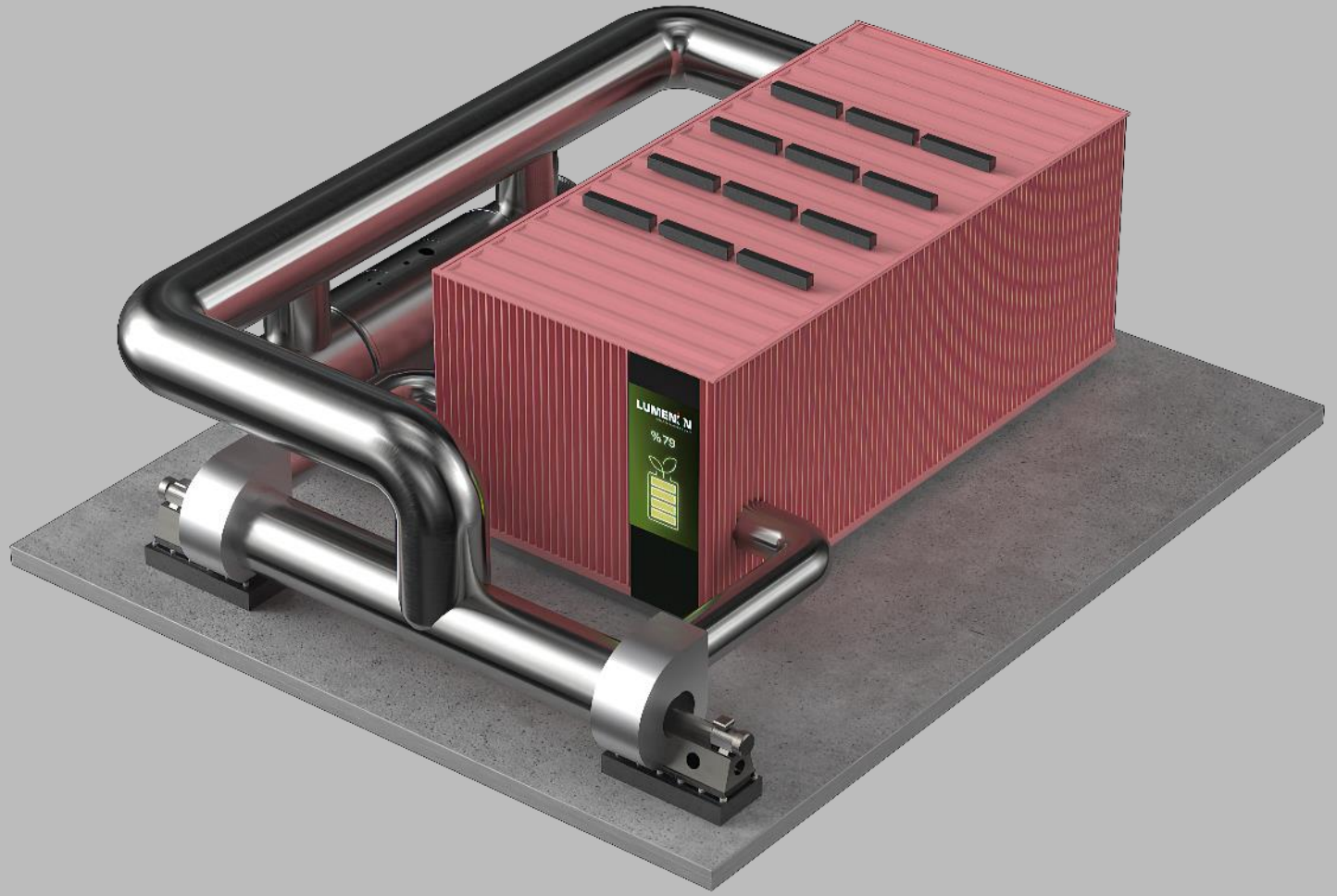
HIGH-TEMPERATURE STORAGE DELIVERING 24/7 CO_2-FREE ENERGY

General Information, October 2022



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About us

- Established in 2016 by entrepreneurs with a background in solar PV and battery industries.
- Renewable power as source for our smart Power-to-Heat system using steel to store thermal energy.
- Our innovative technology enables heat storage solutions for direct supply of CO_2-free thermal energy in various industries.
- LCOS typically between 2 – 5 €cts/$kWh_{thermal}$

“Our low-cost storage technology enables the transition to carbon-free energy supply worldwide.”

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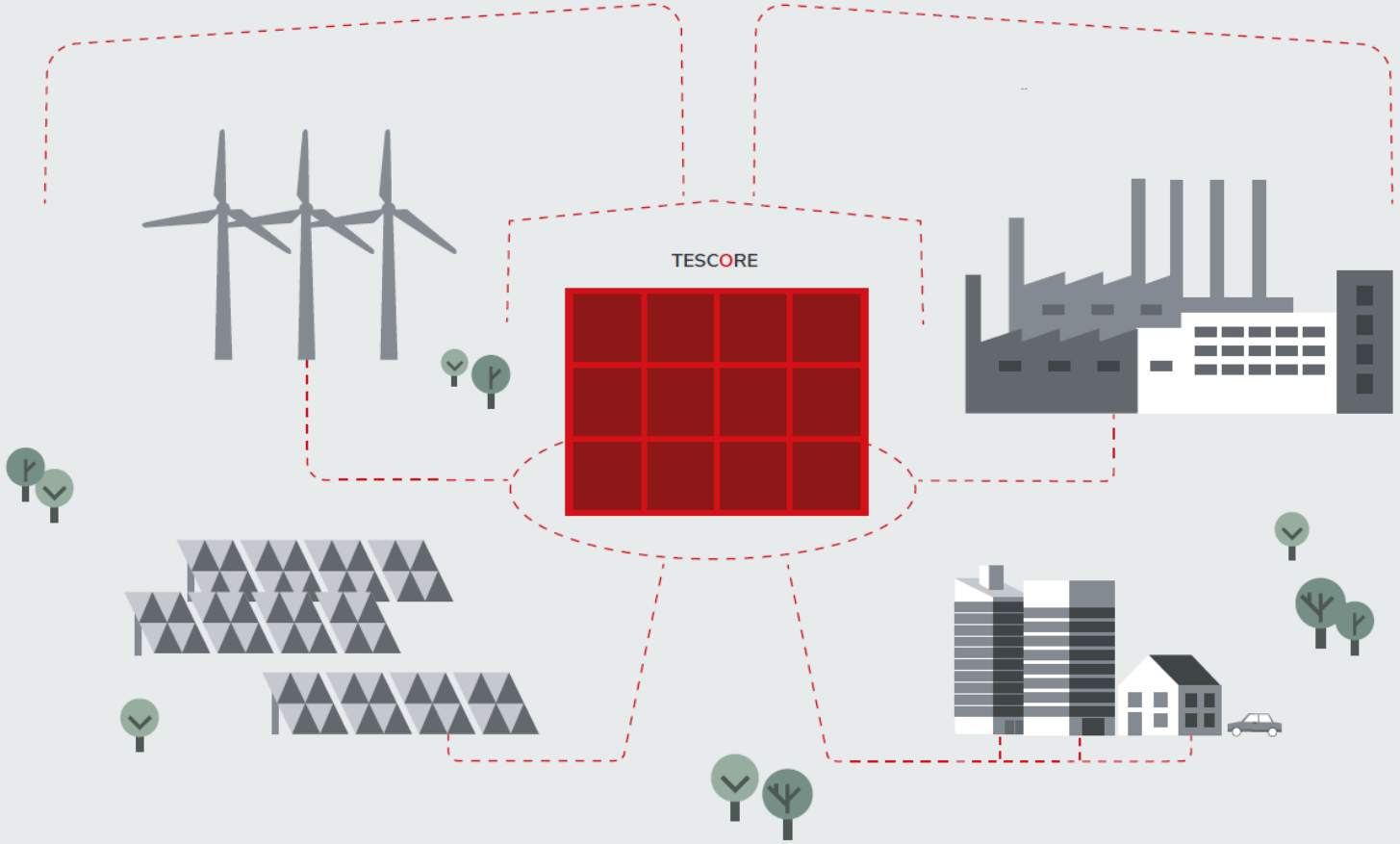
Why Thermal Storage?

AVAILABLE NOW - OUR SMART SYSTEM FOR A NET ZERO FUTURE



- **TESCORE** links green renewable power supply to thermal energy storage for industrial applications.
- **TESCORE** turns volatile and unpredictable renewable power supply into 24/7 reliable thermal energy for industrial applications.

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Our Role

LUMENION IS COMMITTED TO THE DECARBONISATION OF ELECTRICITY AND HEATING MARKETS

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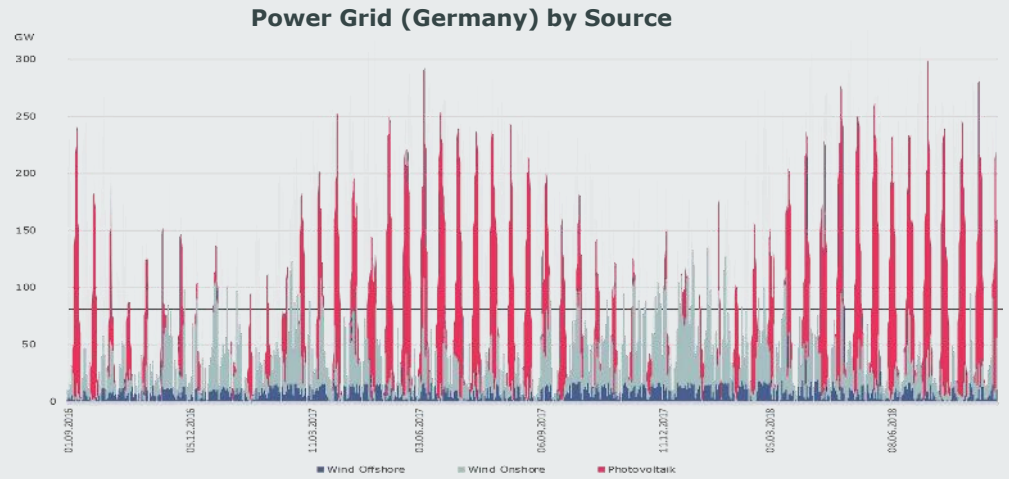
1 SOLUTION FOR INTERMITTENCY

- 24/7 and 100% renewable power and heat *(mismatch of energy supply and energy demand leads to curtailment)*
- Grid operators concerned about limited storage capacity; need to maintain balance and to avoid losses during transport of renewable power to load centers.



2 PROVIDES CO_2 FREE HEAT

- Our target: decarbonisation of industrial heat *(app. 50% of heat consumed in 2020 was used in industrial processes in Germany)*

- *Sector coupling as enabler for decarbonisation of thermal processes*
- *Volatile renewable power becomes predictable thermal energy for industrial applications*

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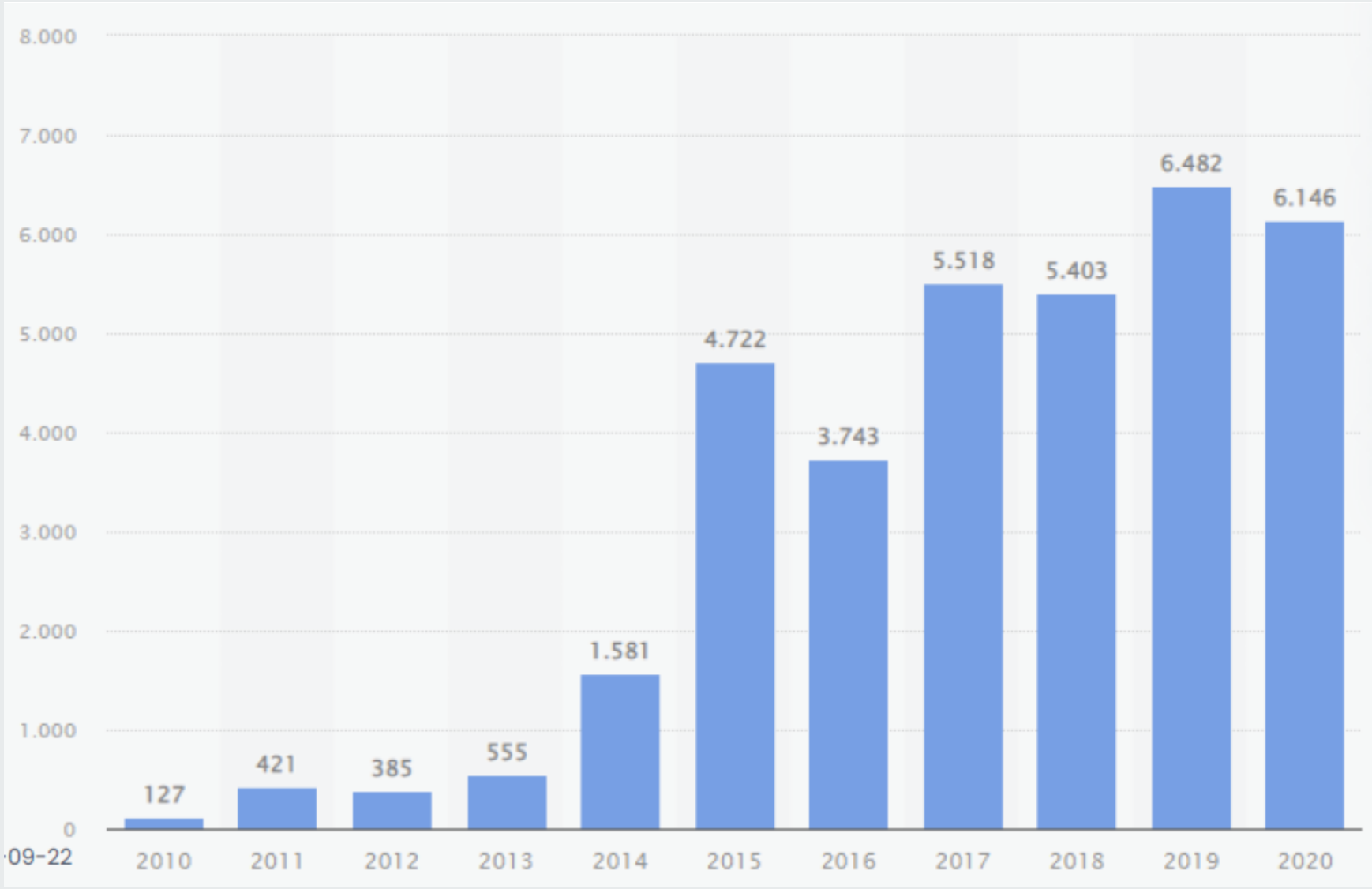
Curtailed Electricity in Germany 2010 – 2020 (GWh)



Source: Statista

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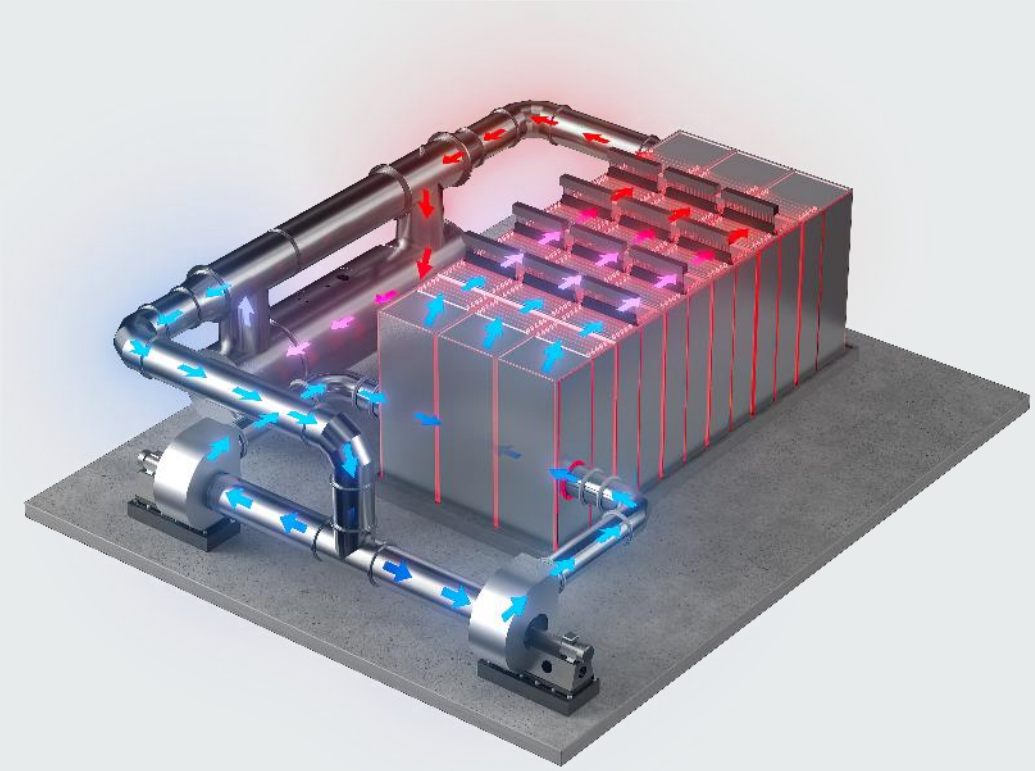
Our Solution

INGENIOUSLY SIMPLE: RENEWABLE POWER TO 24/7 HEAT TRANSITION

- **LUMENION's TESCORE** enables the immediate reduction of CO_2 emissions. Our system can be charged within 4 hours and easily discharged even while charging. It provides 24/7 energy and is therefore the missing link to reliable thermal energy provision from 100% renewable sources.
- All core materials are 100% recyclable, can be re-used and sourced locally.
- **TESCORE** lowers costs, reduces CO_2 footprint and is easy to run and maintain.



TECHNICAL SPECIFICATIONS

- Charge flexibly
- Charging time 4 to 6 times faster than discharging time (simultaneous)
- Up to 600°C steel core storage temperature
- Reliable and continuous provision of thermal energy (120-400°C)

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Milestones Achieved

2018

pilot tests undertaking

2019

successful rollout of storage system

first commercial project with VATTENFALL

2020

CO2-free steam system feasibility for Highland Park Distillery

Innovation Award Berlin/Brandenburg

2021

feasibility study **500 MWh** storage Stadtwerke Leipzig

2022

20 MWh system organic farm, D

WESTHOF BIO

2023+

60 MWh system, PT

35 MWh system brewery, D

100 MWh system PVC-mill, PT

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Selected Track Record

Successful Demonstration at the HTW grid simulation lab	Vattenfall Berlin District Heating station	Organic Frozen Vegetables Processing Plant
	 Gewobag LUMENION VATTENFALL	 BIO-Frost Westhof WESTHOF BIO
storage capacity: 0.45 MWh	**storage capacity: 2.4 MWh**	**storage capacity: 20 MWh**
• Testing our steel storage systems under real conditions in the grid simulation. • Laboratory of the University of Applied Sciences (HTW). • Installation: April 2019.	• Steel-based district heating storage system in a heating station of a large apartment block in Berlin, Tegel. • Installation May 2020.	• Processing plant for organic frozen vegetables with capacity of 10 t/h. • Wind turbines and onsite PV can be connected directly to the storage system.
integration into grid @ HTW	**in use** since September 2020	**construction** started

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Reference Application: BIO-Frost Westhof

TARGET:

Installation of a TES facility contributing to a sustainable, CO_2-free energy supply and thus to safe, reliable and high-quality food production.

WESTHOF BIO®

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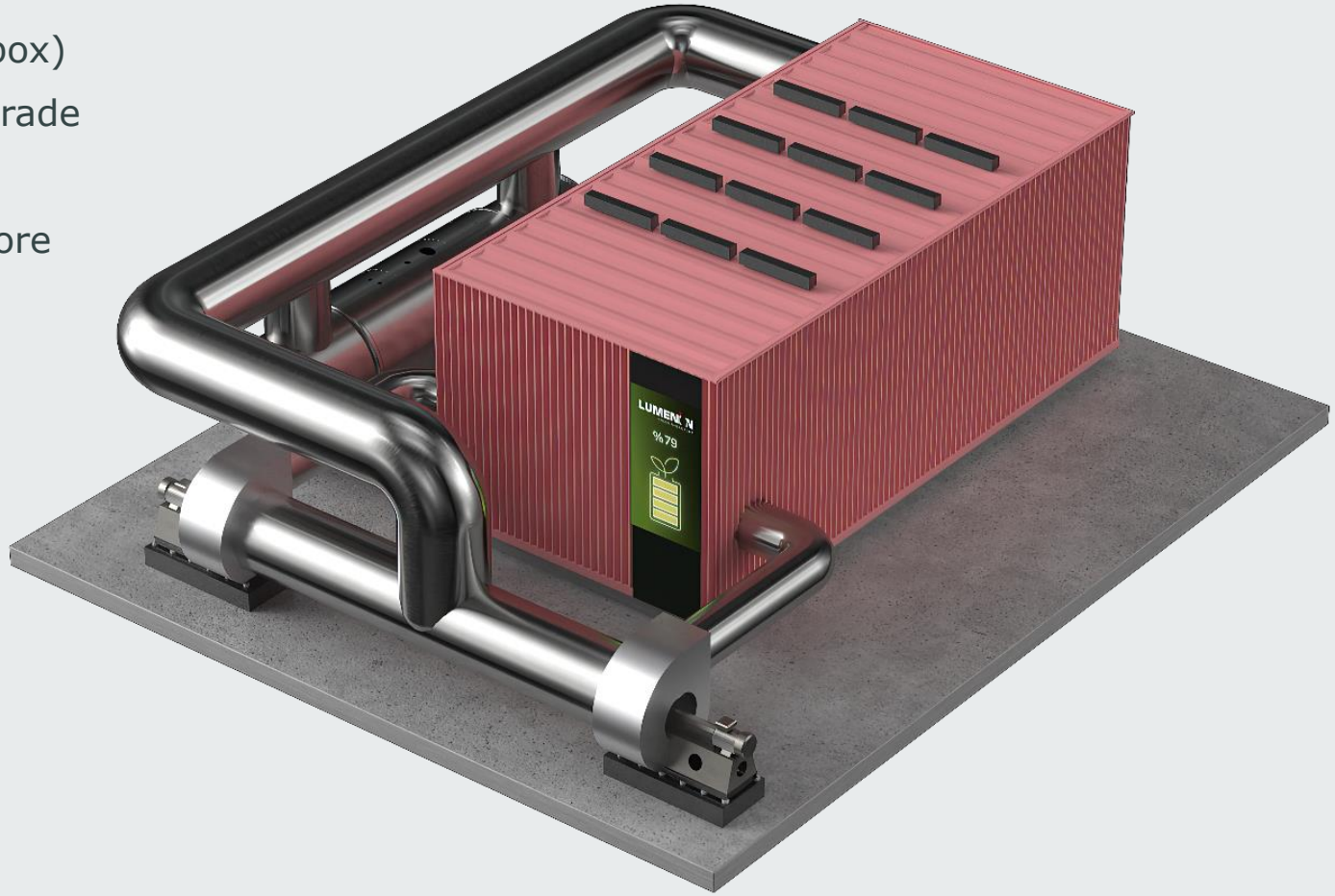
Reference Application: BIO-Frost Westhof

TECHNICAL SPECIFICATION OF OUR TURN–KEY SYSTEM:

- overall dimensions: 25 x 20 x 7 m
- storage dimensions: 15 x 7 x 7 m (red storage box)
- core material: 600 t of commercial steel grade
- primary energy cycle: hot air, pressure free
- heating technology: heating elements in steel core
- P-t-H conversion: convection & radiation
- output to customer: steam at 207 °C at 17 bar
- output via bypass: steam generator
- energy management: fan speed, flap position
- delta T charged: max. 5 K (in storage box)



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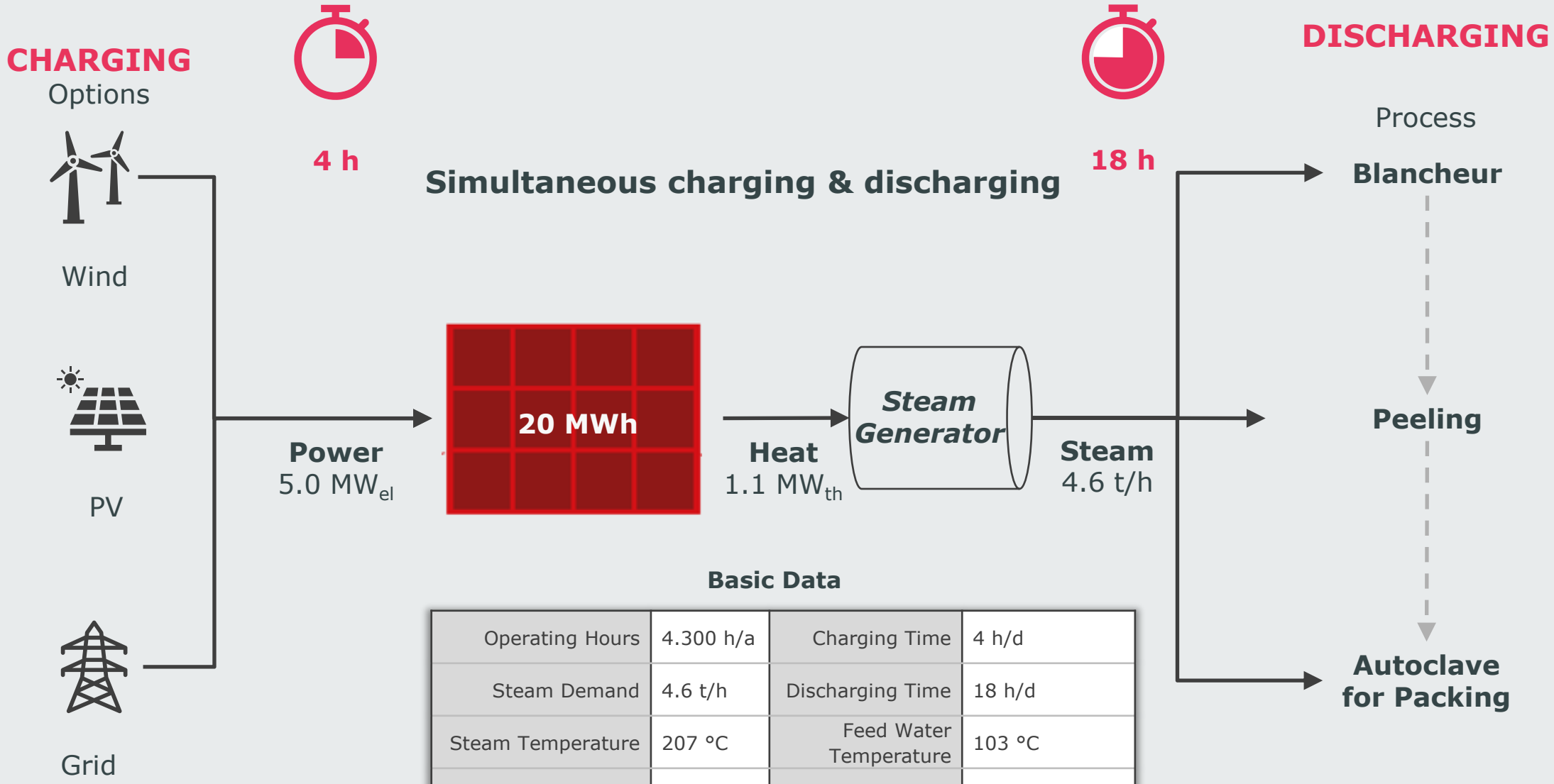

Basic Data

Operating Hours	4.300 h/a	Charging Time	4 h/d
Steam Demand	4.6 t/h	Discharging Time	18 h/d
Steam Temperature	207 °C	Feed Water Temperature	103 °C
Steam Pressure	17.0 bar	**CO_2-reduction**	**1,670 t/year**

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LUMENION TESCORE at a Glance

Key Benefits

1

Cost competitiveness
- Low LCOS compared to competitors
- Low maintenance costs
- System lifecycle currently well over 40 years

2

Recyclable / reusable product
- Application is recyclable, facilitating low investment risk (steel core can be fully reused)
- A substantial part of investment can be regained at end of lifetime due to steel core

3

Efficiency up to 95%
- Nearly loss-free conversion of power-to-heat
- Strong insulation and closed primary thermal loop reducing thermal losses
- Thermal energy is instantly available

4

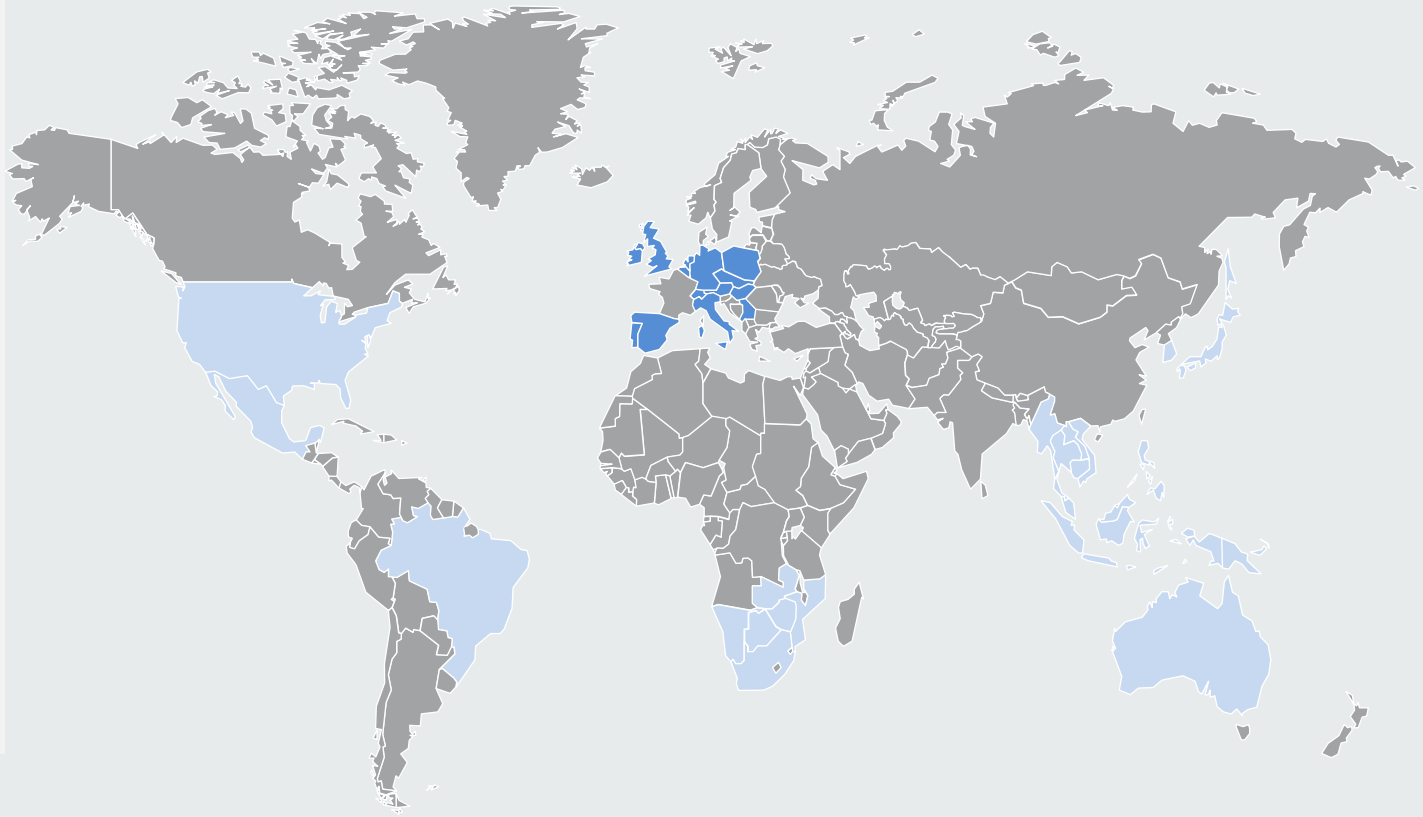
Flexibility and scalability
- Highly flexible dimensioning following heat requirements (e.g. temperature levels, pressure)
- Highly modular design
- Easy up- and downscaling

Focus Markets & Sectors (for thermal demand of 120° - 400°C)

Decarbonisation now – in combination with renewables!

Our **TESCORE** stands for:

- CO_2 free thermal energy
- proven and robust
- available short term
- customised modular storage
- simplicity of design



Target industry sectors:

- Energy Contractors
- Agriculture
- Automotive / Battery
- Chemical Industry
- Construction Materials
- Food & Beverages
- Pharmaceuticals
- Pulp & Paper
- District Heating

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