



# CO<sub>2</sub>-FREE PROCESS HEAT FOR OUR INDUSTRIES

March 2024

**LUMENIX**  
GREEN ENERGY 24/7

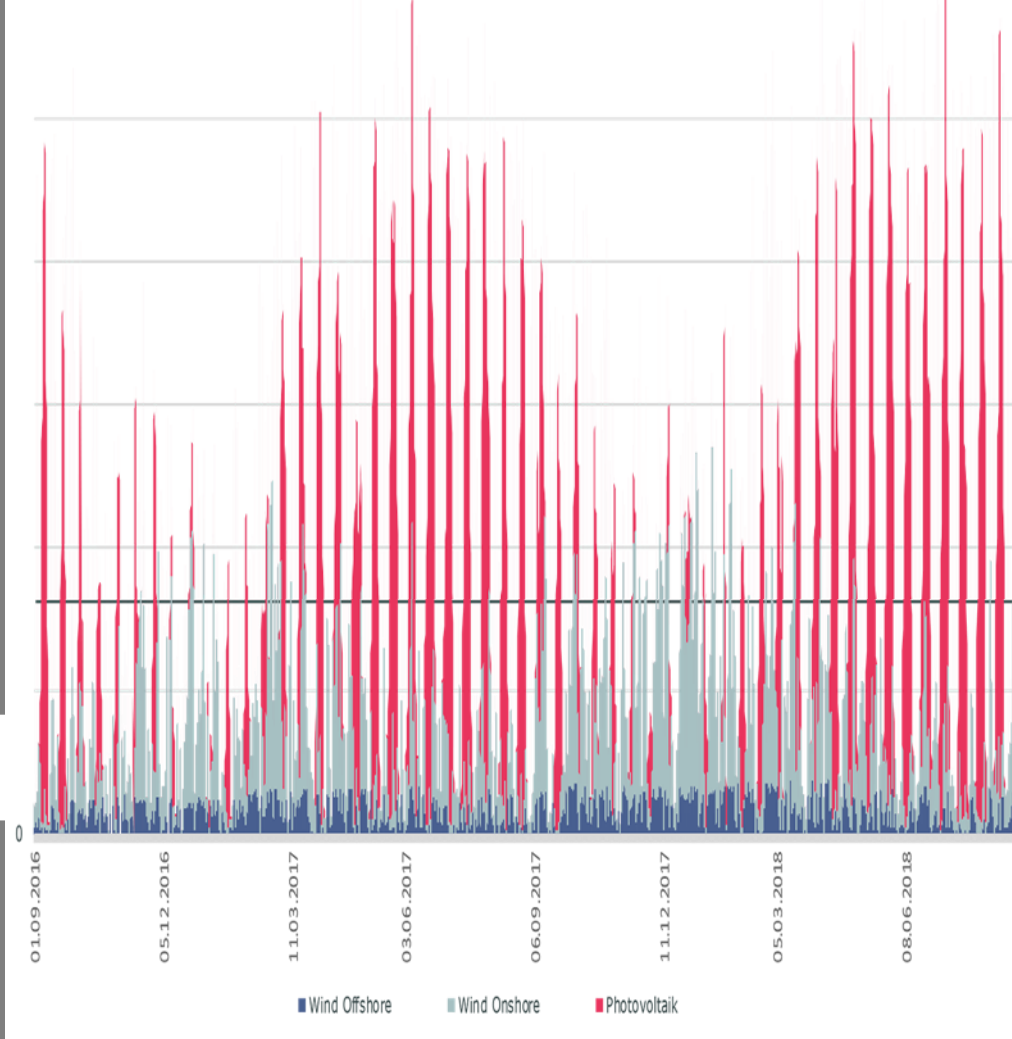
# P2H - SECTOR COUPLING AT SOURCE

## Affordable Renewables

- ↓ Network investment
- ↓ Network charges
- ↑ Connections per network capacity
- ↓ Connection cost
- ↓ Curtailment

**ELECTRICITY  
SECTOR**

Renewables generation



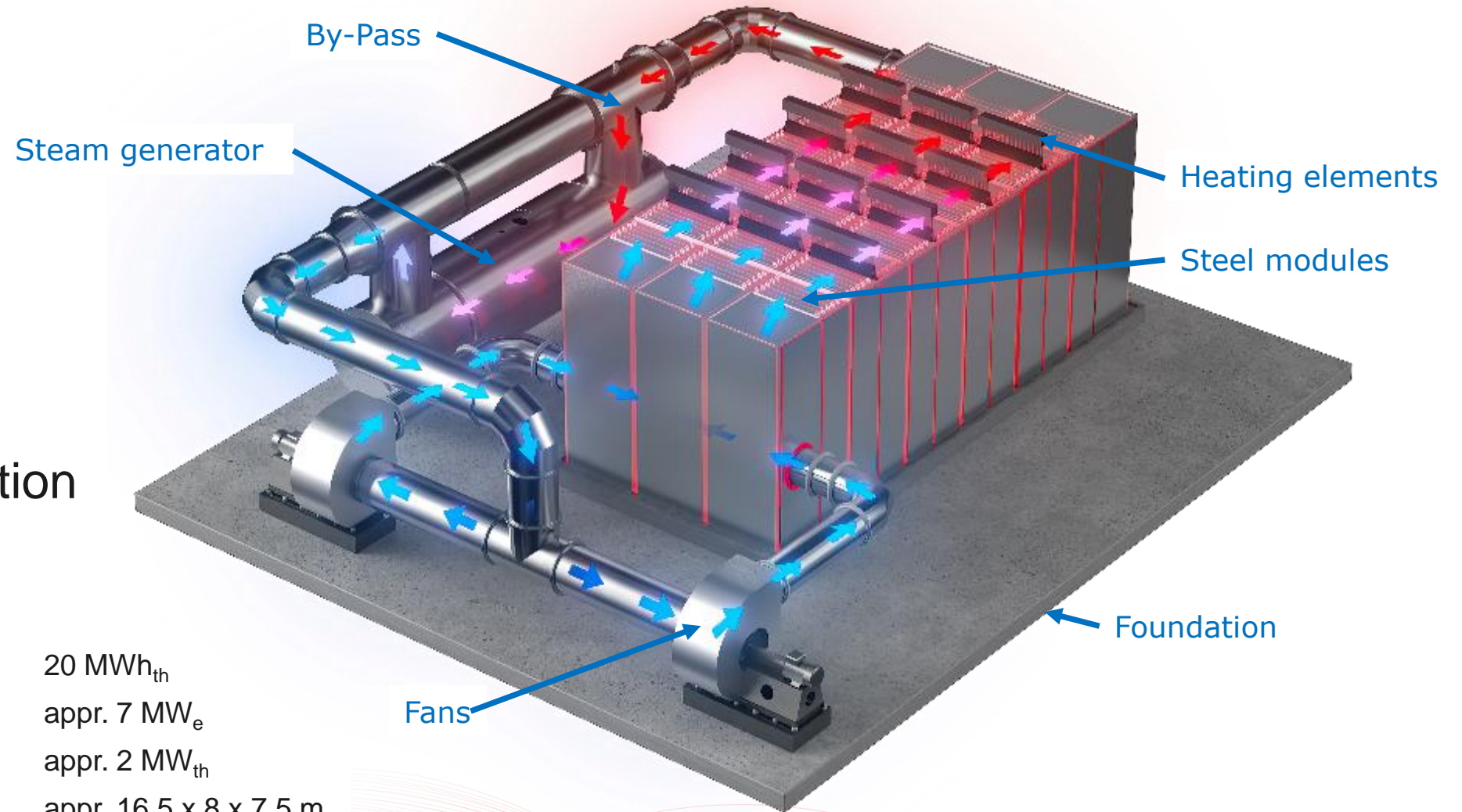
## Replace gas - NOW



**HEAT  
SECTOR**

- CO<sub>2</sub>-free process heat
- On demand
- At attractive tariffs

# WORKING PRINCIPLE AND MAJOR COMPONENTS



## Example specification

Capacity	20 MWh <sub>th</sub>
Max charging power	appr. 7 MW <sub>e</sub>
Max discharging power	appr. 2 MW <sub>th</sub>
Size (core only)	appr. 16.5 x 8 x 7.5 m
Weight	appr. 600 t

See Youtube video at  
<https://lumenion.com/technologie/>

# BUSINESS CASE



Food processing, northern Germany



Thermal demand: 66 GWh/a  
Saturated steam @204°C<sup>2</sup>



Electricity demand: 64 GWh/a



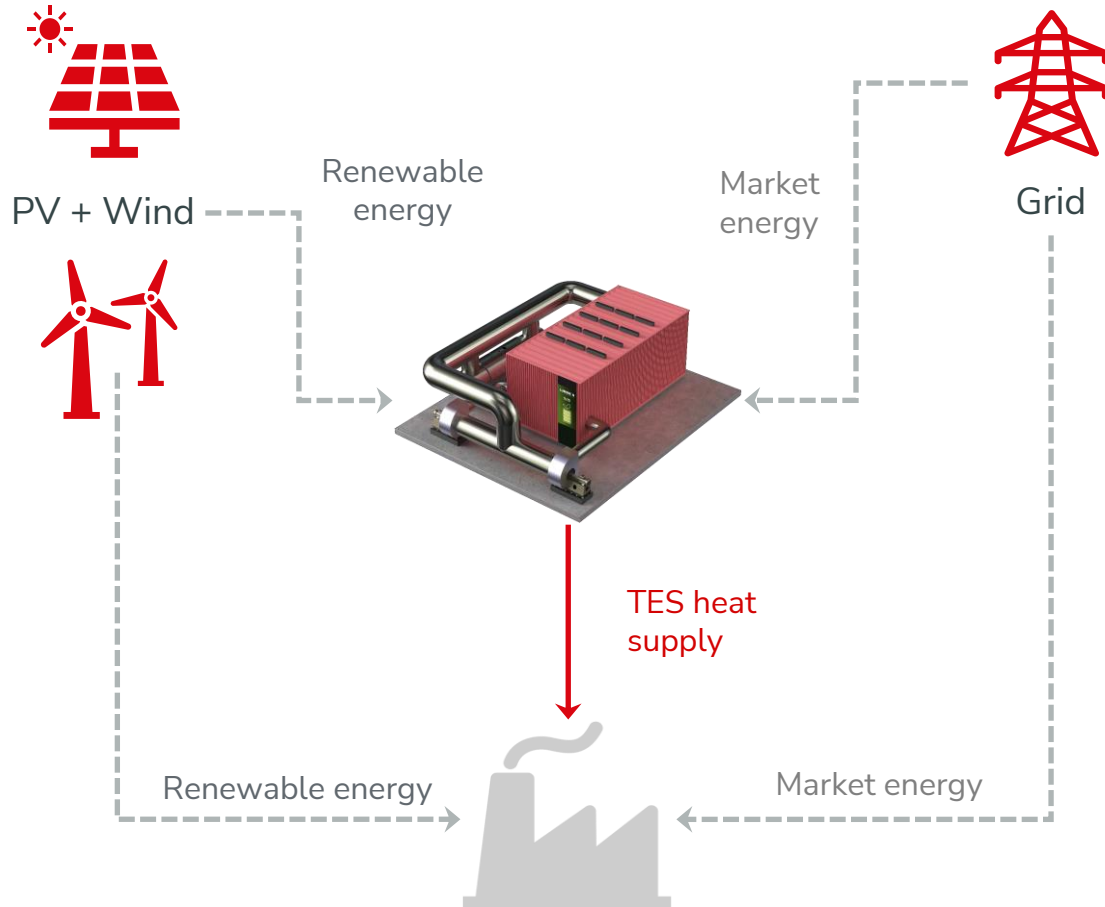
Existing RES: PV 1 MWp / Wind 2,4 MW

New RES: unrestricted

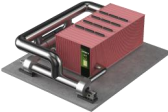




# PV + WIND SCENARIO

## Structure Chart



## Sensitivity analysis

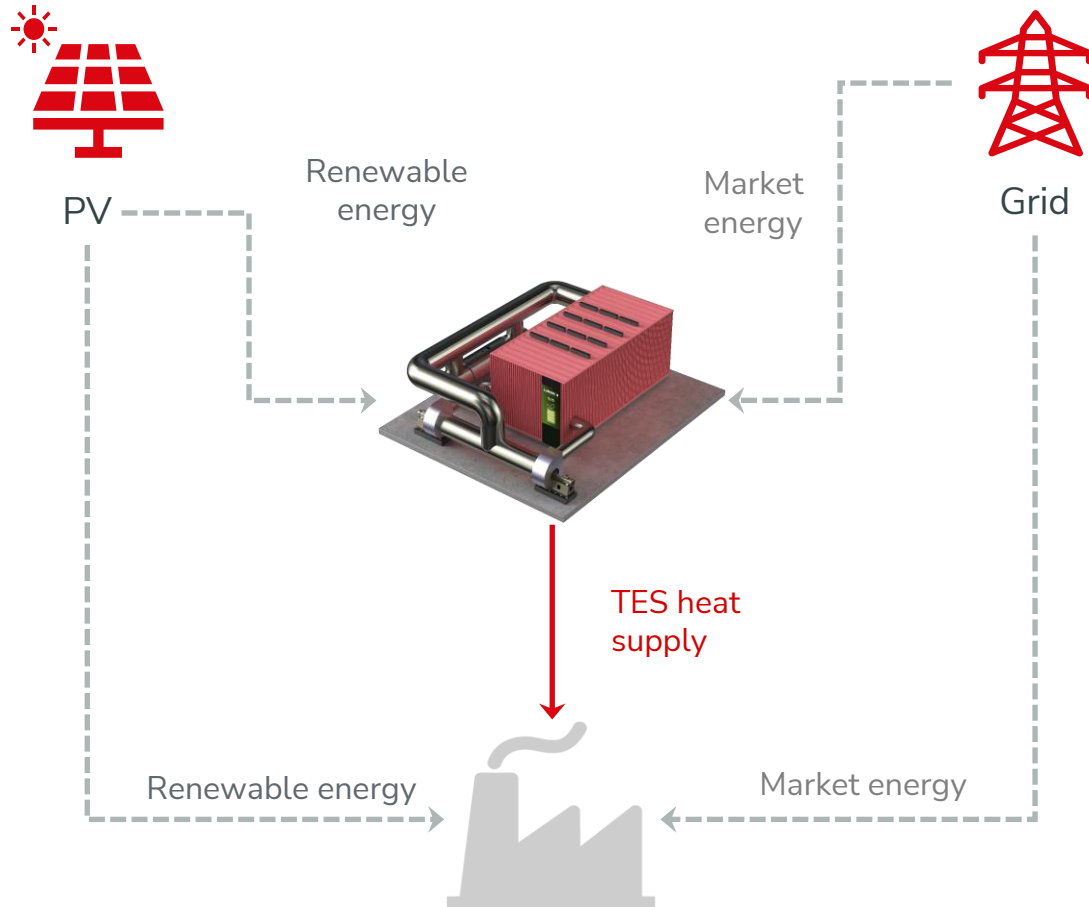
			
Size	90 MWh	45 MW <sub>p</sub> <sup>1</sup>	23 MW <sub>p</sub> <sup>1</sup>
RES coverage ratio of total annual demand	~60%		
Thermal demand coverage	~ 60% RES, 40% grid		
RES annual surplus	~ 30%		
Emissions avoidance	~ 15000 tCO <sub>2</sub> e/a <sup>2</sup>		

<sup>1</sup> Additional to existing renewable assets

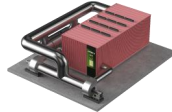

<sup>2</sup> Based on 2030 estimated EU energy mix CO<sub>2</sub>e intensity of 0.118 tCO<sub>2</sub>e/MWh and Natural Gas CO<sub>2</sub>e intensity of 0.201 tCO<sub>2</sub>e/MWh

# PV SCENARIO

## Structure Chart



## Sensitivity analysis

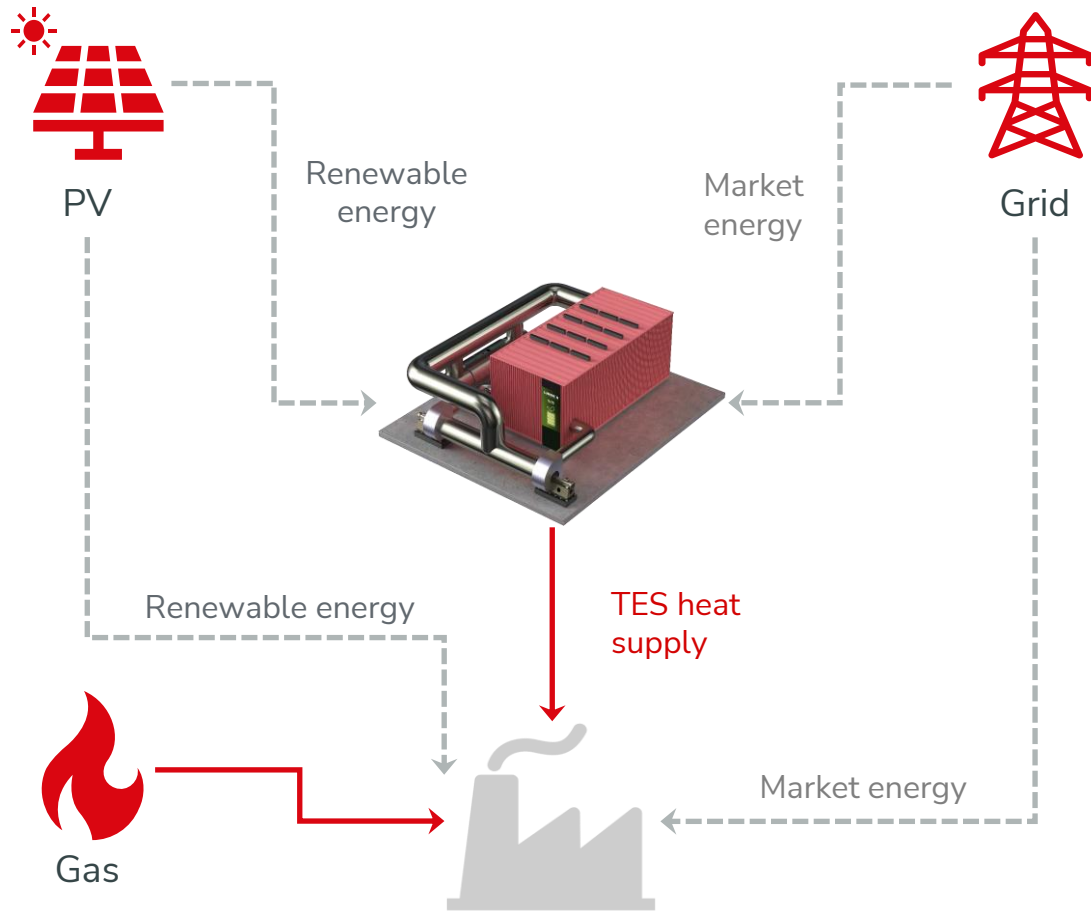
	 110 MWh	 60 MW <sub>p</sub> <sup>1</sup>
Size	110 MWh	60 MW <sub>p</sub> <sup>1</sup>
RES coverage ratio of total annual demand	~ 40%	
Thermal demand coverage	~ 40% RES, 60% grid	
RES annual surplus	~ 20%	
Emmissions avoidance	~ 11500 tCO <sub>2</sub> e/a <sup>2</sup>	

<sup>1</sup> Additional to existing renewable assets

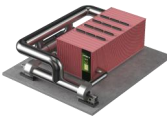

<sup>2</sup> Based on 2030 estimated EU energy mix CO<sub>2</sub>e intensity of 0.118 tCO<sub>2</sub>e/MWh and Natural Gas CO<sub>2</sub>e intensity of 0.201 tCO<sub>2</sub>e/MWh

# PV + GAS SCENARIO

## Structure Chart



## Sensitivity analysis

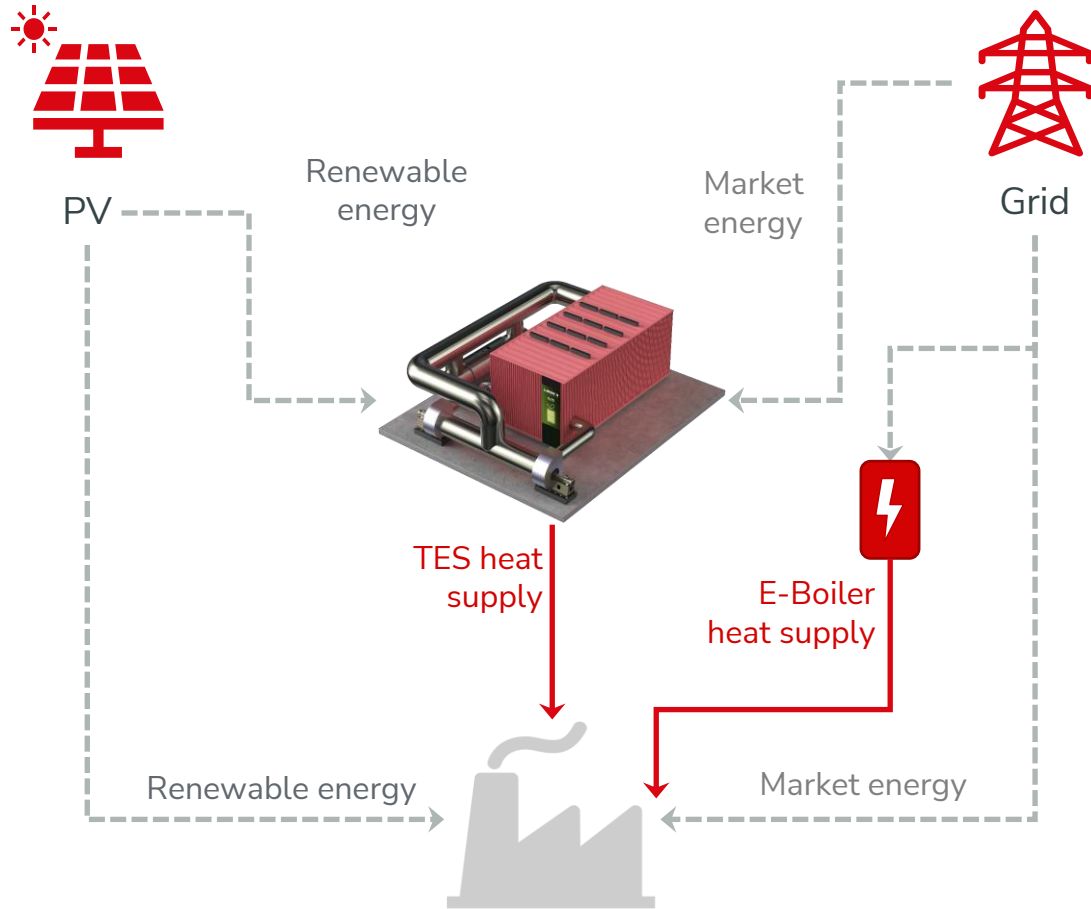
		
Size	86 MWh	50 MW <sub>p</sub> <sup>1</sup>
RES coverage ratio of total annual demand	~ 35%	
Thermal demand coverage	~ 30% RES, 70% gas	
RES surplus	~ 20%	
Emmissions avoidance	~ 4800 tCO <sub>2</sub> e/a <sup>2</sup>	

<sup>1</sup> Additional to existing renewable assets

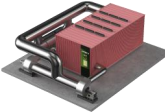


<sup>2</sup> Based on 2030 estimated EU energy mix CO<sub>2</sub>e intensity of 0.118 tCO<sub>2</sub>e/MWh and Natural Gas CO<sub>2</sub>e intensity of 0.201 tCO<sub>2</sub>e/MWh

# PV + E-BOILER SCENARIO

## Structure Chart



## Sensitivity analysis

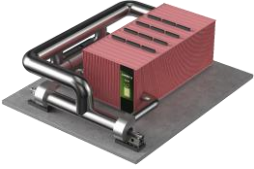



	 85 MWh	 60 MW <sub>p</sub> <sup>1</sup>	 7 MW
Size	85 MWh	60 MW <sub>p</sub> <sup>1</sup>	7 MW
RES coverage ratio of total annual demand	~ 40%		
Thermal demand coverage	~ 40% RES, 60% grid		
RES surplus	~ 25%		
Emmissions avoidance	~ 11000 tCO <sub>2</sub> e/a <sup>2</sup>		

<sup>1</sup> Additional to existing renewable assets

<sup>2</sup> Based on 2030 estimated EU energy mix CO<sub>2</sub>e intensity of 0.118 tCO<sub>2</sub>e/MWh and Natural Gas CO<sub>2</sub>e intensity of 0.201 tCO<sub>2</sub>e/MWh



# SUMMARY

			 / 	Renewables total demand coverage	Renewables surplus	Emission avoidance
<b>PV + Wind Scenario</b>	90 MWh	45 MW <sub>p</sub> <sup>1</sup>	23 MW <sub>p</sub> <sup>1</sup>	~ 60%	~ 30%	~ 15000 tCO <sub>2</sub> e/a <sup>2</sup>
<b>PV Scenario</b>	110 MWh	60 MW <sub>p</sub> <sup>1</sup>	-	~ 40%	~ 20%	~ 11500 tCO <sub>2</sub> e/a <sup>2</sup>
<b>PV + Gas Scenario</b>	86 MWh	50 MW <sub>p</sub> <sup>1</sup>	-	~ 35%	~ 20%	~ 4800 tCO <sub>2</sub> e/a <sup>2</sup>
<b>PV + E-Boiler</b>	85 MWh	60 MW <sub>p</sub> <sup>1</sup>	7 MW	~ 40%	~ 25%	~ 11000 tCO <sub>2</sub> e/a <sup>2</sup>

## Main takeaways:

- ▶ The combination of both PV and Wind as energy sources results in a higher decarbonization level (and emissions avoidance) than any other scenario
- ▶ TES size decreases considerably by a combination of energy assets instead of considering only PV as the only source

<sup>1</sup> Additional to existing renewable assets

<sup>2</sup> Based on 2030 estimated EU energy mix CO<sub>2</sub>e intensity of 0.118 tCO<sub>2</sub>e/MWh and Natural Gas CO<sub>2</sub>e intensity of 0.201 tCO<sub>2</sub>e/MWh

# KEY FEATURES

- ✓ Up to 95% round trip energy efficiency
- ✓ Output temperature up to 350°C
- ✓ Rapid charging switch on and off times
- ✓ Purely resistive load
- ✓ Simultaneous charging and discharging
- ✓ Industry standard components and service
- ✓ Available NOW – Gas replacement
- ✓ No hazardous materials
- ✓ Superior system durability unaffected by cycling
- ✓ High residual value of steel modules
- ✓ Simple operations & maintenance
- ✓ Low life cycle costs
- ✓ Local value added



# THANK YOU!

**LUMENION**  
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