



# Calor-e

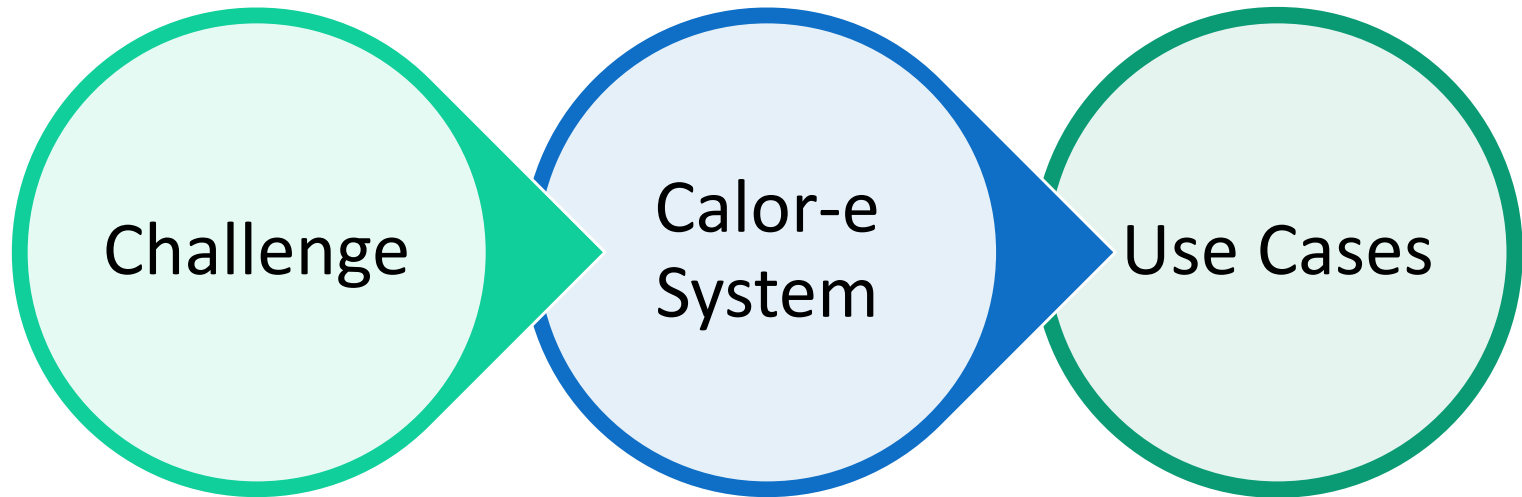
Versatile, Durable, Smart

**Unda Engineering Inc.**

*Unda Mühendislik San. ve Tic. A.Ş.*

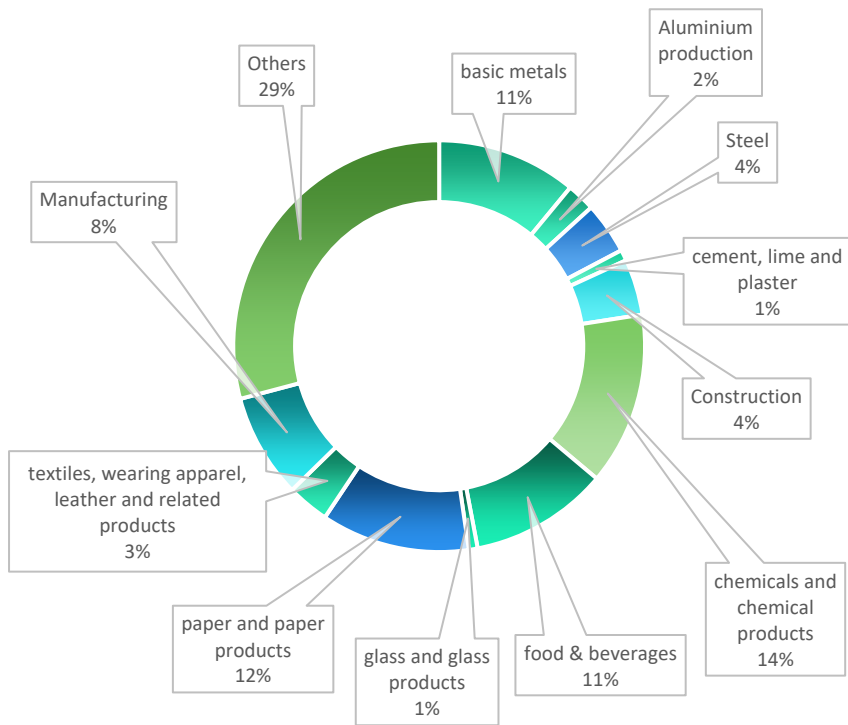
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# Content

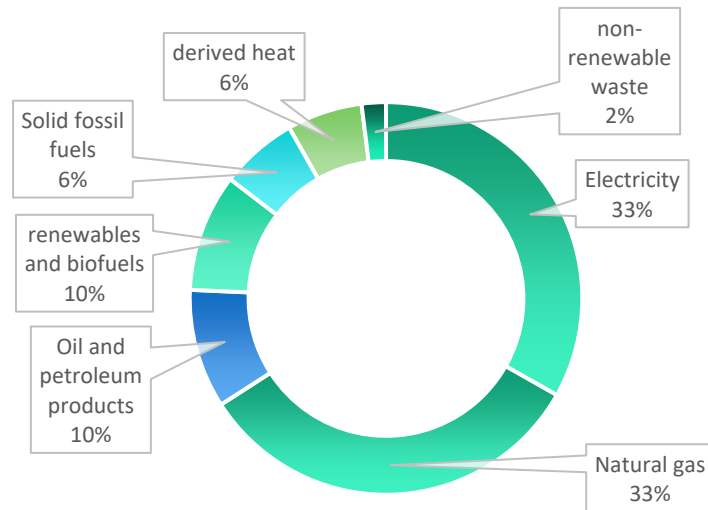


# Challenge - Industry

## Share of energy use for industries



## Energy products used in the industry sector

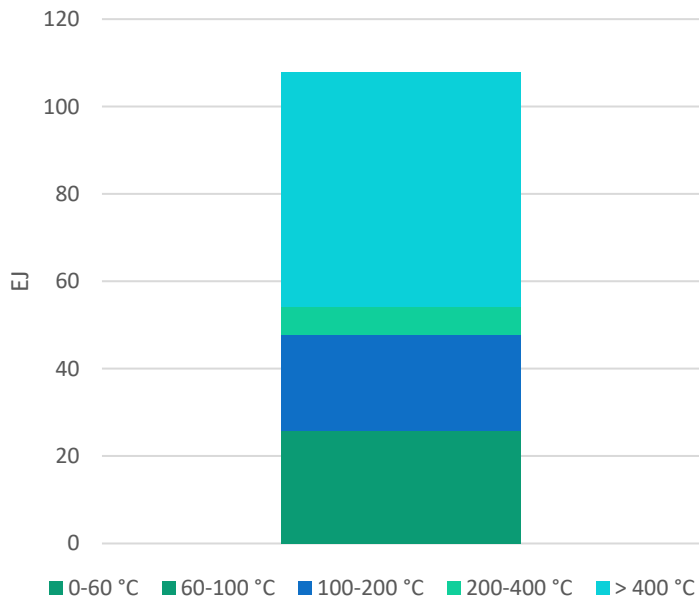


**Half of this demand occurs for thermal energy for temperature <math><400\text{ }^\circ\text{C}</math>.**

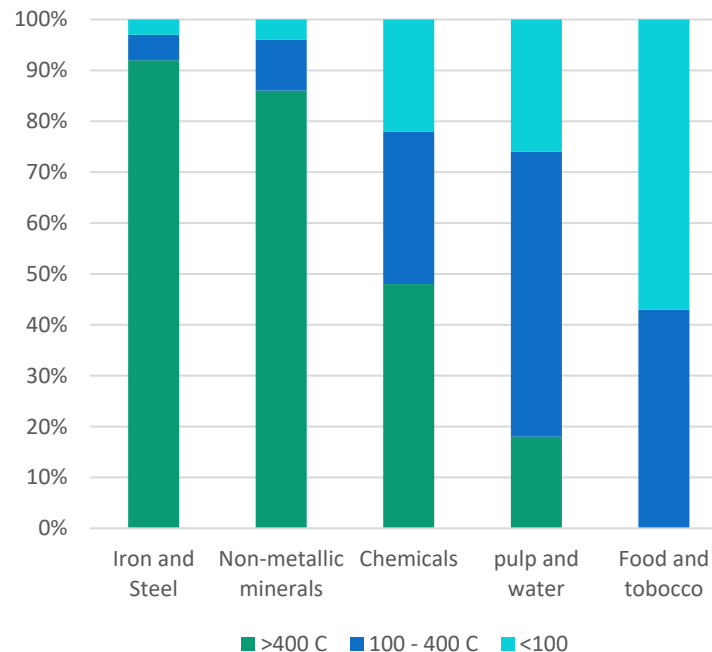


# Challenge Industry

Industrial heat demand by temperature range



Heat requirements by temperature range in different industry sectors

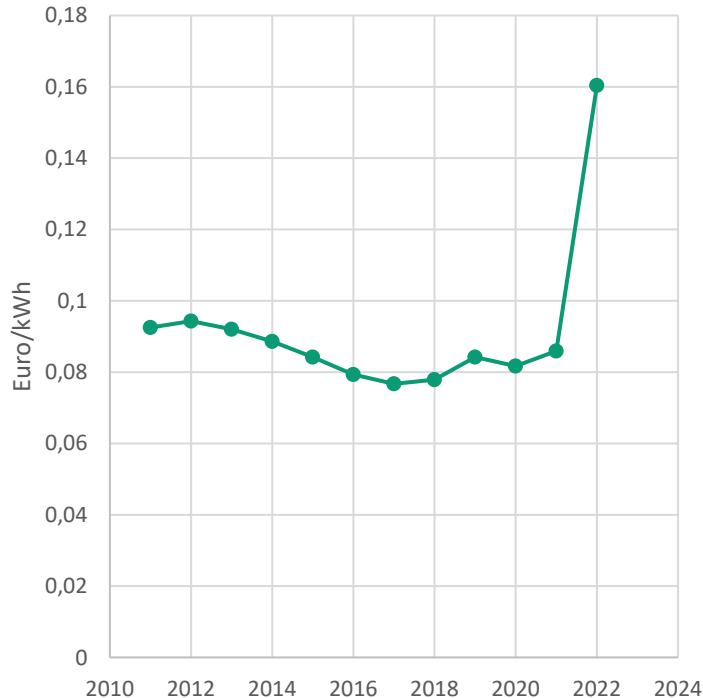


(2019a), World Energy Outlook 2019.

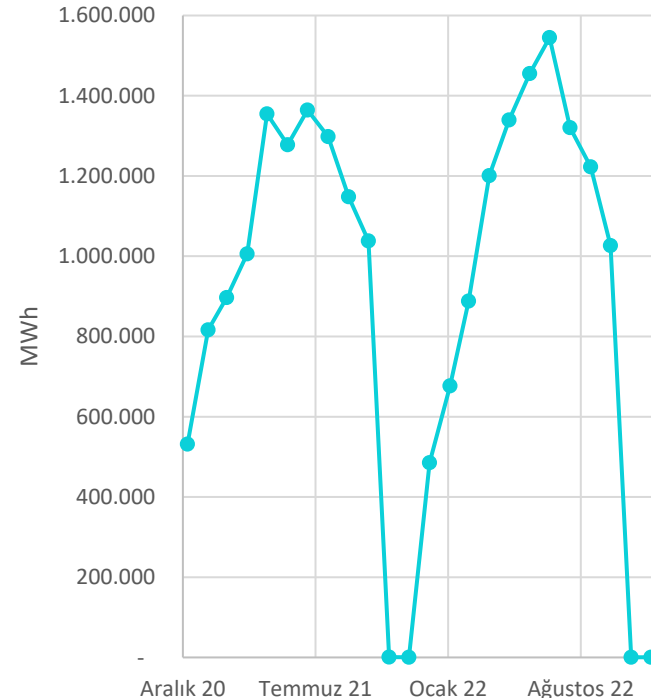


# Challenge – Electrical grid

EU – Average non-household electricity prices



Monthly un-licensed and off-demand renewable power generation (Turkey)



# 2 sectors - 2 problems

## Industrial heat

- Emissions
- Energy security (fossil fuel availability)
- Variable and increasing prices

## Electrical grid

- Increased renewables increase grid stability problems
- Overloading of existing transmission lines
- Demand and supply mismatch



# How to solve both problems?

Electricity

- Low cost / of demand renewables
- Renewable energy on site

Intraday storage

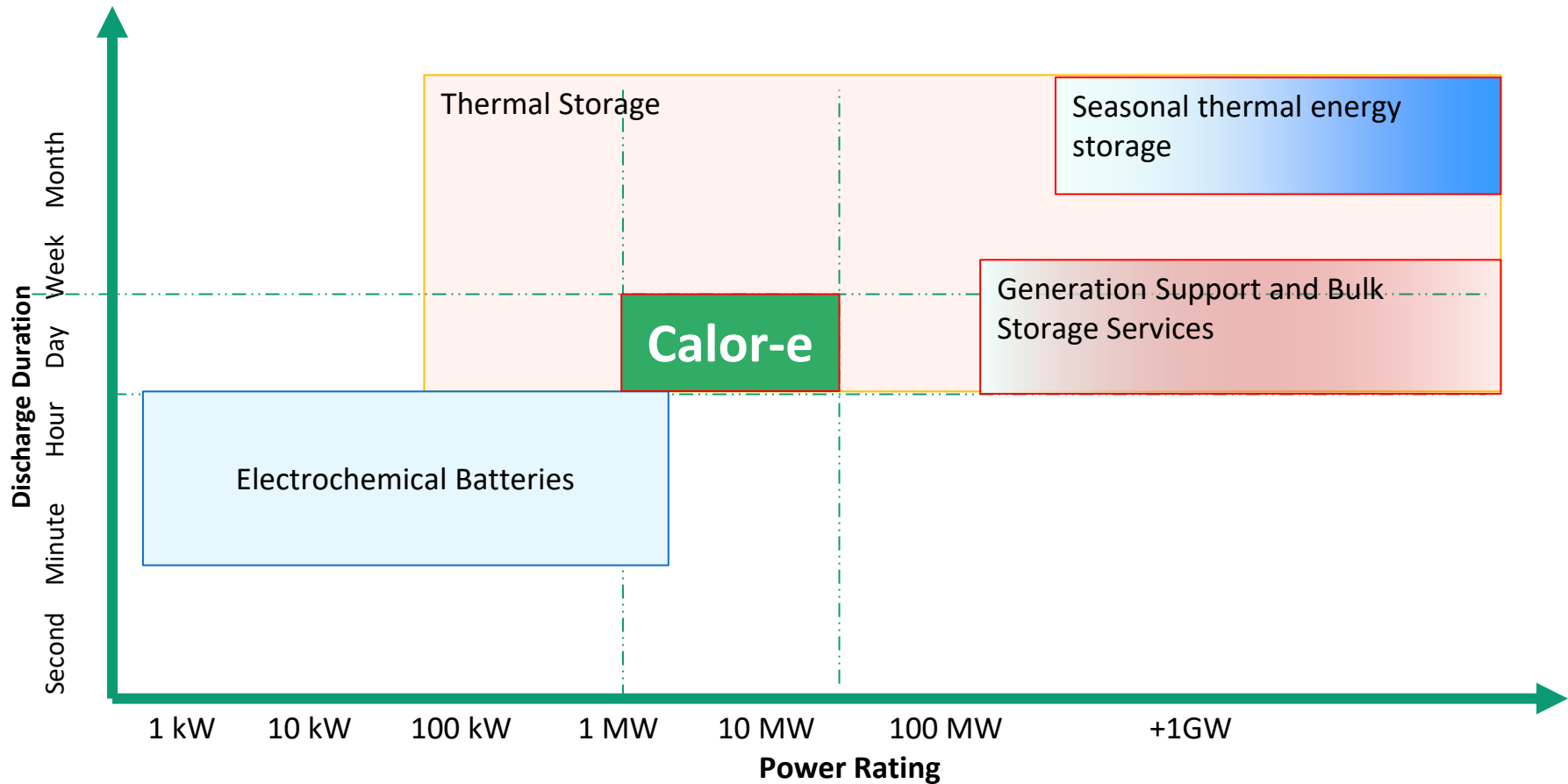
- Charge when its cheap
- Heat when you need

Heat

- Heat on demand
- High temperatures up to +400 °C



# Target applications





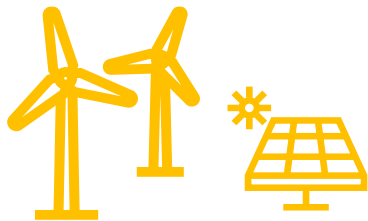
# Calor-e; durable and fully recyclable

## Technology

- Storing heat in Steel (0.6 – 1 MWe / unit)
- Fast response and charge (50-500 kW)
- Variable discharge (10-1000 kW)
- Transfer with **conventional heat transfer fluids**

## Merits

- Made from conventional materials
- Does not lose capacity with discharge
- Fully recyclable
- Modular and scalable
- 98% electricity to heat efficiency

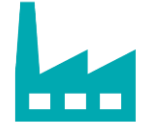


Off-demand / low-cost  
renewable power



High temperatures up to +400 °C

## Low-Medium Industrial Heat



### Sectors:

- Food and beverages
- Chemical
- Agriculture
- Textile
- Paper
- Metals

### Operations:

- Pasteurizing (60 – 80 °C)
- Drying (70 – 200 °C)
- Tempering (150 – 200 °C)
- Boiling / Steam (100 – 250 °C)
- Distillation (140 – 150 °C)
- Bleaching (130 – 150 °C)

## Office Heating



# Calor-e Units

### Calor-e Gen1

- Upto 400 °C Storage temperature

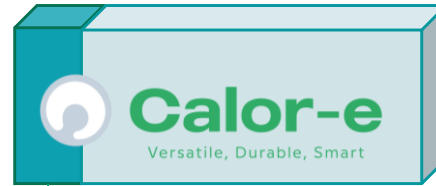
### Calor-e Gen2

- +700 °C storage temperature
- Up to 400 °C discharge temperature

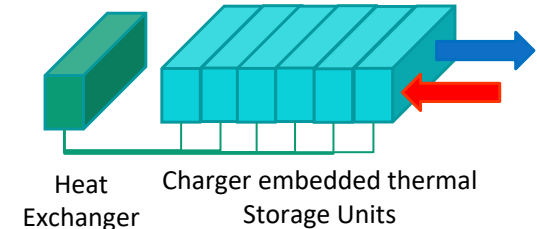
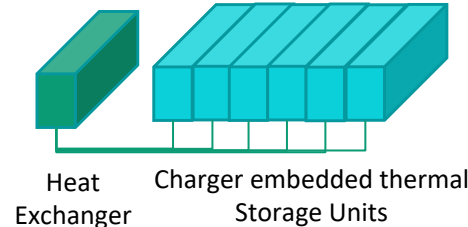
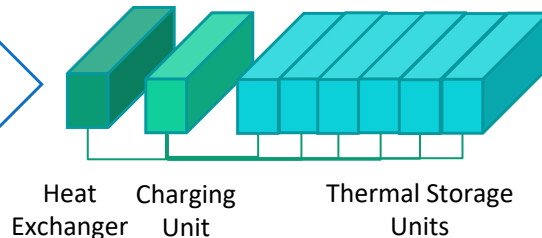
### Calor-e Hybrid

- Charged by both electricity and excess heat

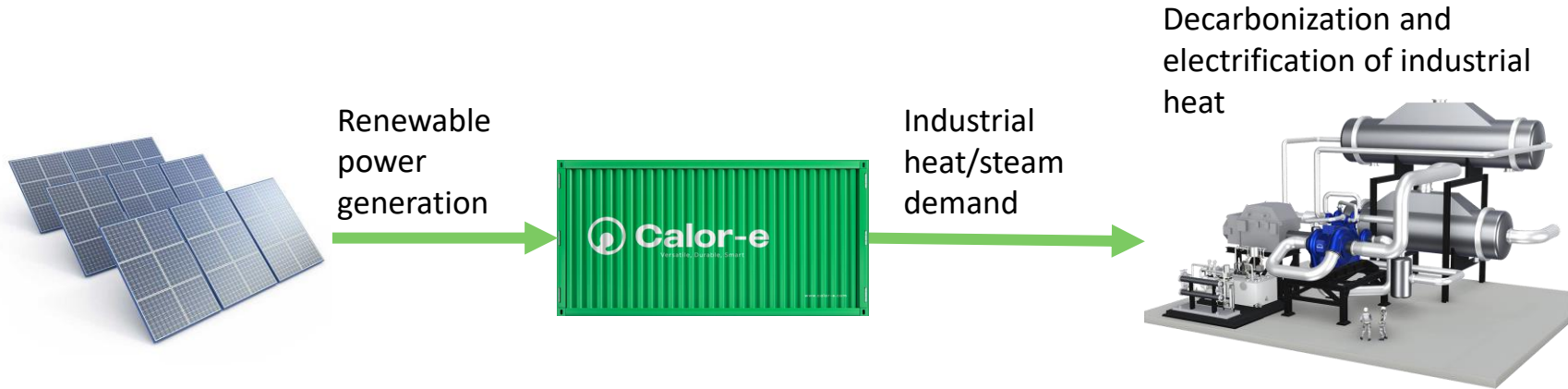
Single Unit use



Multi Unit use



# Low temperature low demand case: Calor-e + PVs

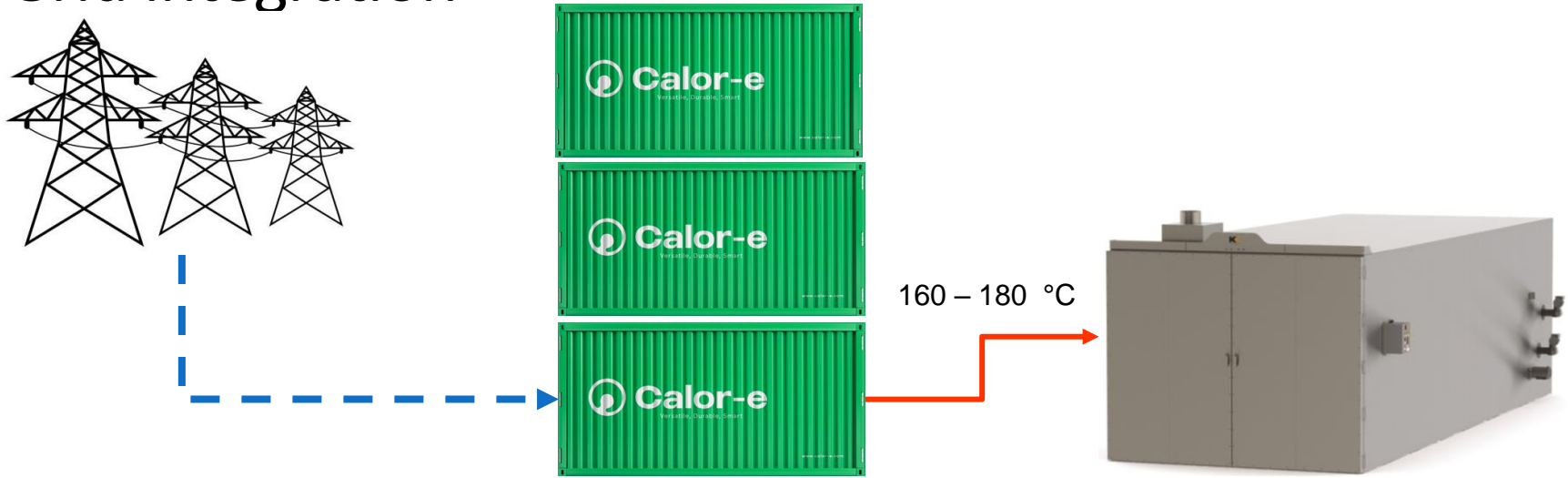


30 ton/day capacity Pasteurization plant (milk) currently uses burner to generate steam

- The plant consumes 42 tons of coal or 23.5 tons natural gas annually
- After coal burner is replaced by 1MWh(e) Calor-e unit:
- Prevents up to 113 tons of CO<sub>2</sub> emissions, 1.4 tons of SO<sub>2</sub> emissions, 0.65 tons of NO<sub>x</sub> emissions annually



# Medium temperature low demand case: Calor-e + Grid integration

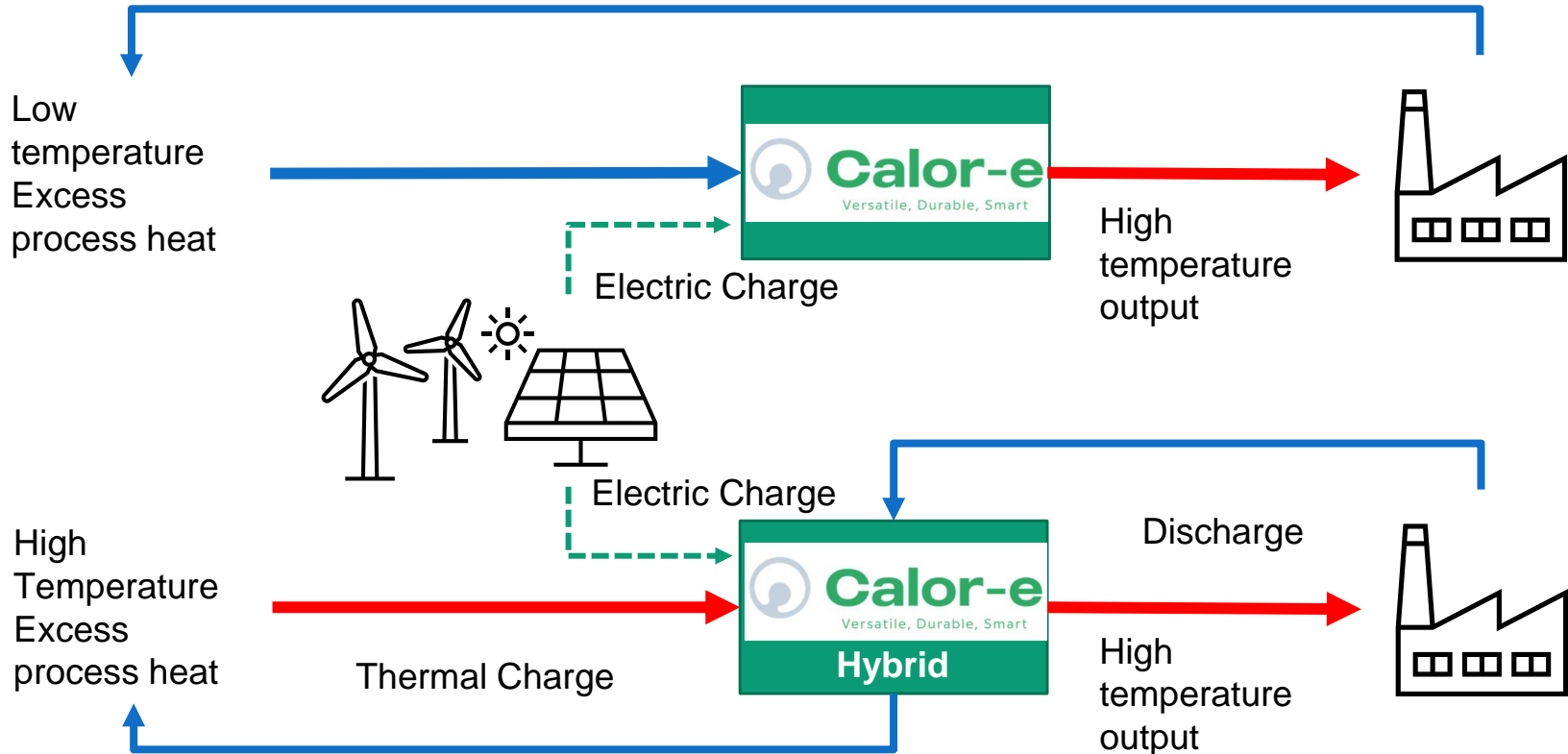


Electrostatic Powder Coating Oven burner to heat up the system to 160 – 180 °C

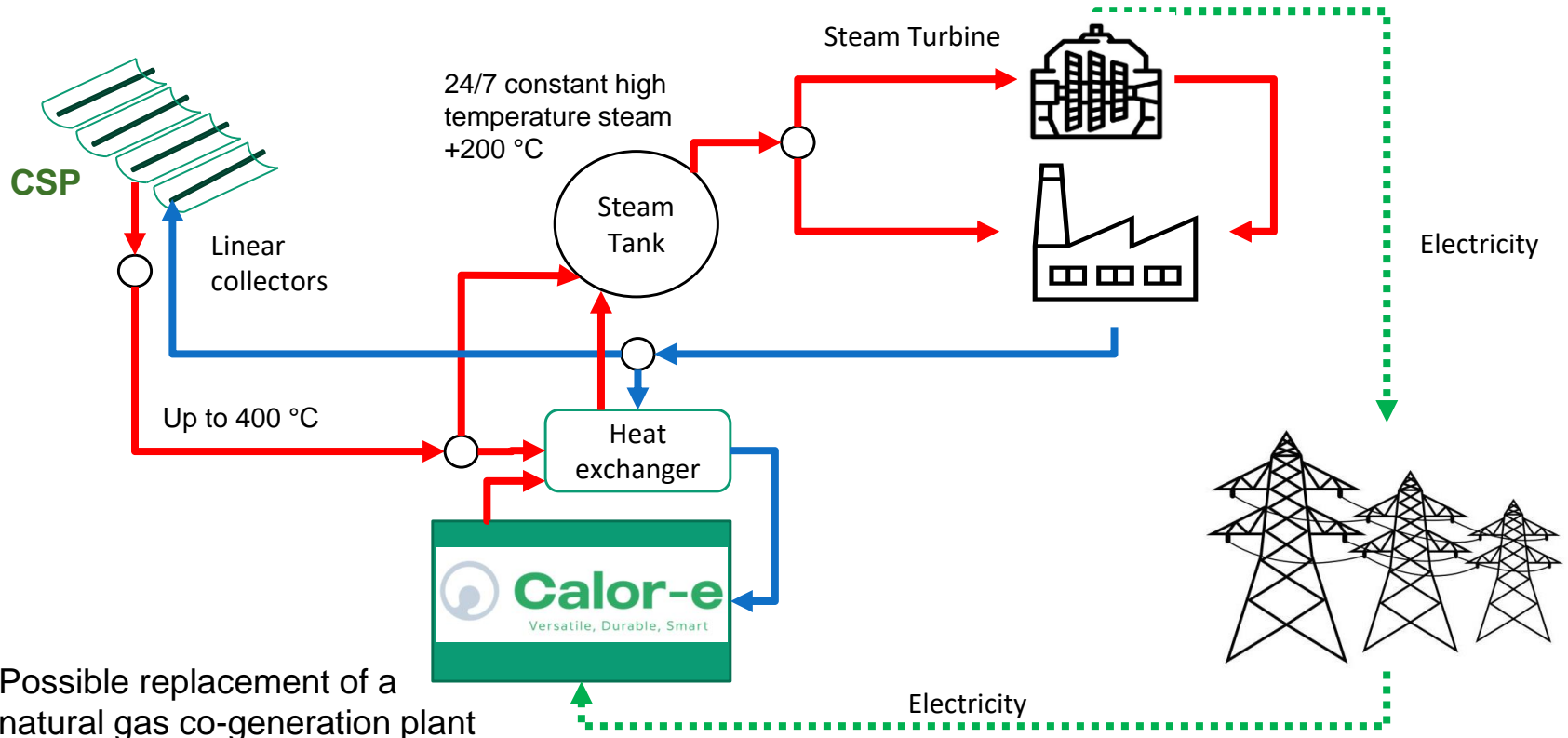
- 3 operations daily, 260 days work annually
- Natural gas burner is replaced by 3 x 1MWh(e) Calor-e unit
- Prevents up to 638 tons CO<sub>2</sub> emissions /year



# Medium Temperature Case: Calor-e + Heat recovery



# Medium Temperature Case: Calor-e + CSP (Direct Steam Generation) - Sectoral integration & Grid Flexibility



# System Impact

## Calor-e thermal batteries

- Fast response capacity for multiple charge/discharge through the day
- Low parasitic loads
- Low energy loss
- lifetime of 25 years
- low environmental footprint
- 100% recyclable with conventional methods

## Each 1 MWe unit

- + 3.500 tons CO<sub>2</sub> emission reduction in average in its lifetime



# Thank you

**UNDA Engineering Inc.**

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