

**AIRTHIUM**





Decarbonizing  
**industrial heat**  
cost-effectively





# Who needs industrial heat?

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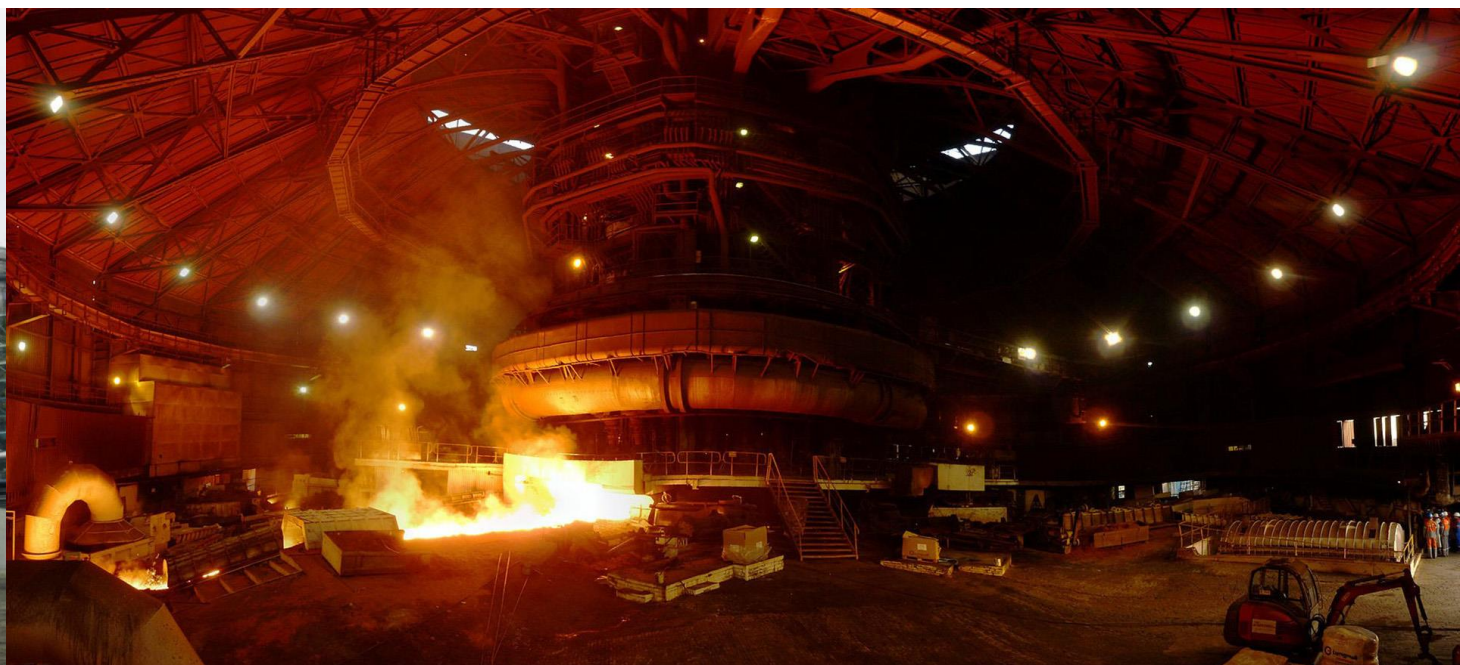
## Steam

- ↳ Chemicals
- ↳ Paper
- ↳ Mining

## Drying

- ↳ Food
- ↳ Minerals
- ↳ Chemicals

## Cement, Metals, Glass





Industrial heat is a major polluter

Industrial heat represents  
~22% of worldwide CO<sub>2</sub>  
emissions

Source: <https://doi.org/10.1016/J.JOULE.2020.12.007>

Today,  
decarbonizing  
industrial heat is  
**expensive**

Heat cost →

Natural Gas

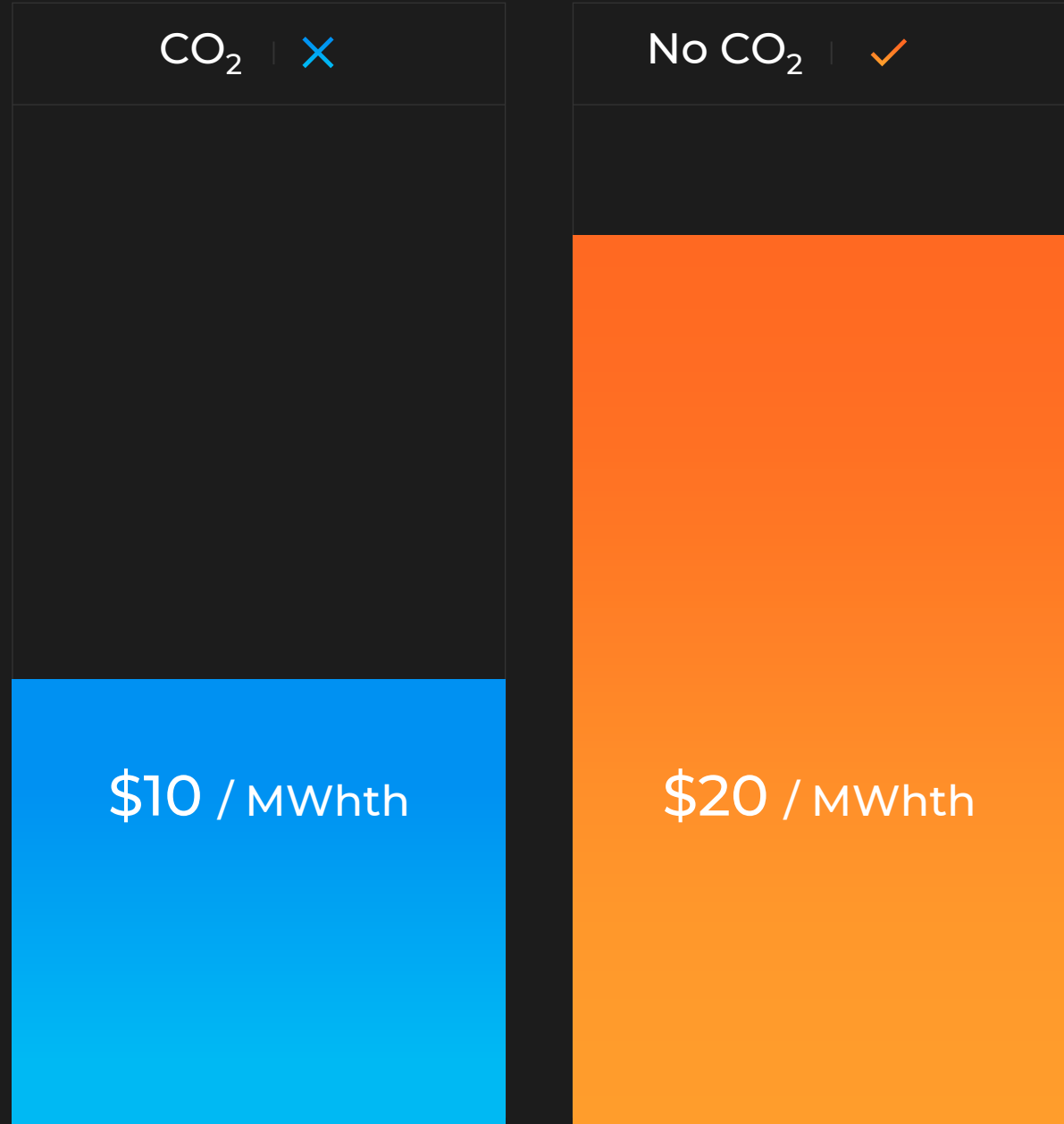
CO<sub>2</sub> | ✗

\$10 / MWhth

Green Electricity + Resistor

No CO<sub>2</sub> | ✓

\$20 / MWhth



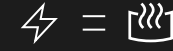
Heat pumps  
can provide  
cheap, carbon-  
free heat

Natural  
gas



\$10 / MWhth

Green electricity  
+ resistor



\$20 / MWhth

Green electricity  
+ heat pump



\$7 / MWhth



# But existing heat pumps have limitations

## Existing high temperature heat pumps

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Max Temperature	160°C
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Max lift	80°C
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OPEX	\$\$\$
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# Airthium opens up the TAM with 5x higher temperature lift support

	Existing HT Heat Pumps	Airthium HT Heat Pump
Max Temperature	160°C	550°C
Max lift	80°C	500°C
OPEX	\$\$\$	\$
TAM*	\$17B	\$30B

\* Our 160-550°C segment is 17% of the worldwide industrial heat market

Source: <https://www.iea.org/data-and-statistics/charts/industrial-heat-demand-by-temperature-range-2018>





# Our technology

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01. Stirling engine (fluid = helium)
    - ↳  $T = 100\text{-}550^{\circ}\text{C}$ , Load following, batch processes
- 
02. Fast near-isothermal compression
    - ↳ COP up to 3.5
    - ↳ Up to **86% of Carnot efficiency**
- 
03. No sliding/rotating seals
    - ↳ 5x less maintenance
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# Case study 1:

## Airthium's Heat Pump vs Electric Boiler

Heat source  
= Waste heat at  $\sim 60^{\circ}\text{C}$

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Heat supply  
= Steam at  $180^{\circ}\text{C}$

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COP up to 2.3  
= 2.3x more efficient

Up to **57%**  
electricity saving  
vs resistive boiler



## Case study 2:

# Airthium's Heat Pump vs Electric Hot Air Generator

Heat source  
= Waste heat at  $\sim 60^{\circ}\text{C}$

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Heat supply  
= air at  $200^{\circ}\text{C}$

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COP up to 2.1  
= 2.1x more efficient

Up to **53%**  
electricity saving  
vs resistive HAG

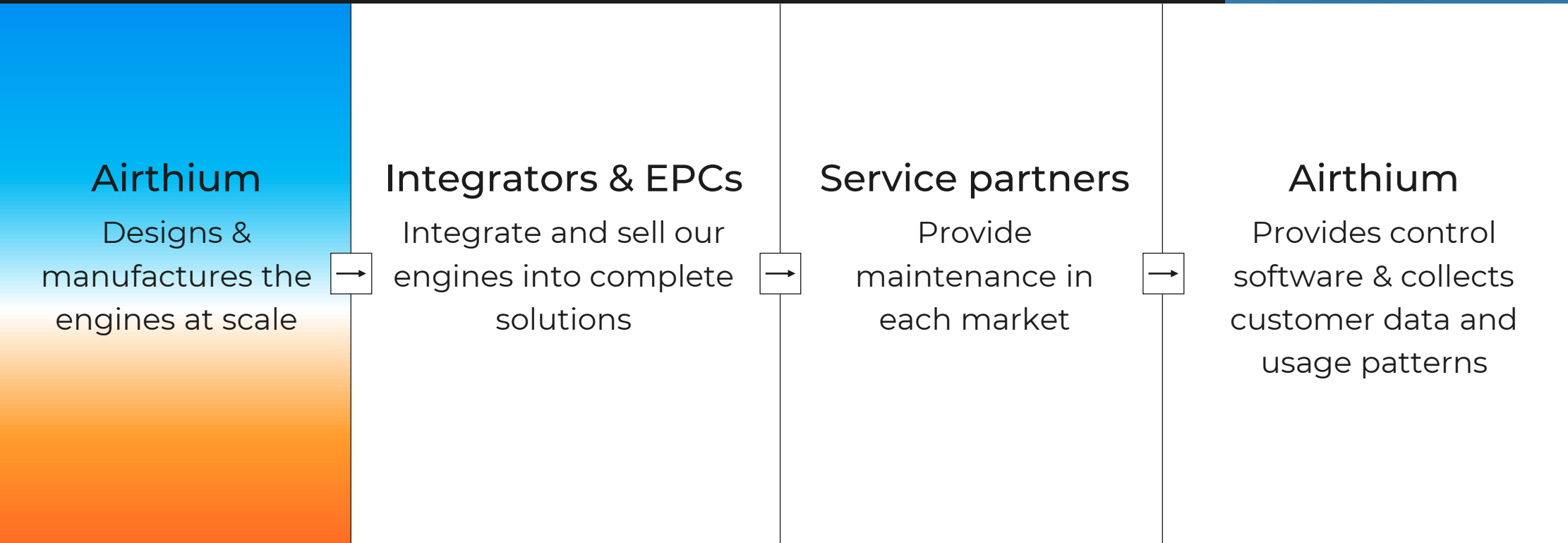




# Competition

Technology	Rankine HTHP	Stirling	Mechanical Vapor Recompression	Solar Thermal	Biofuels	AIRTHIUM
Max temp (°C)	160	180	275	400	500	550
Reliability	\$\$\$	\$\$\$	\$	\$	\$	\$
Efficiency	++	+	++++	+++	+++	+++
Lift (°C)	80	150	30	400	500	500
Cost	\$	\$\$\$	\$	\$\$\$	\$\$\$	\$
TRL	9	7	9	9	9	4

# Go to Market Strategy



# The Airthium team



**12** Team members



**4** Advisors



**Andrei KLOCHKO**  
**CEO/CSO, Co-founder**

**Ph. D.** plasma physics,  
Ecole Polytechnique



**Franck LAHAYE**  
**COO, Co-founder**

**Ex-Sales Director EMEA,**  
Intelsat. Entrepreneur



**Gaetan LERISSON**  
**CTO**

**Ph.D.,** Post-doc fluid  
mechanics, EPFL

**+9** employees

4 Engineers	1 Scientist
3 Sim. Eng.	1 admin

**6 PhDs in the team**



**Jonathan HOWES**  
**Technical Advisor**

**Former CTO**  
Isentropic Ltd. (2004-2016)



**Jerome PECRESSE**  
**Business Advisor**

**CEO**  
GE Renewable Energy



**Philippe KAVAFYAN**  
**Business Advisor**

**CEO**  
Aker Offshore Wind



**Alex RAGUET**  
**Finance Advisor**

**President**  
French Tech Austin



# Our history

2016

Founded



2017

Y Combinator  
Pre-seed round



2019

Hosted by  
Air Liquide



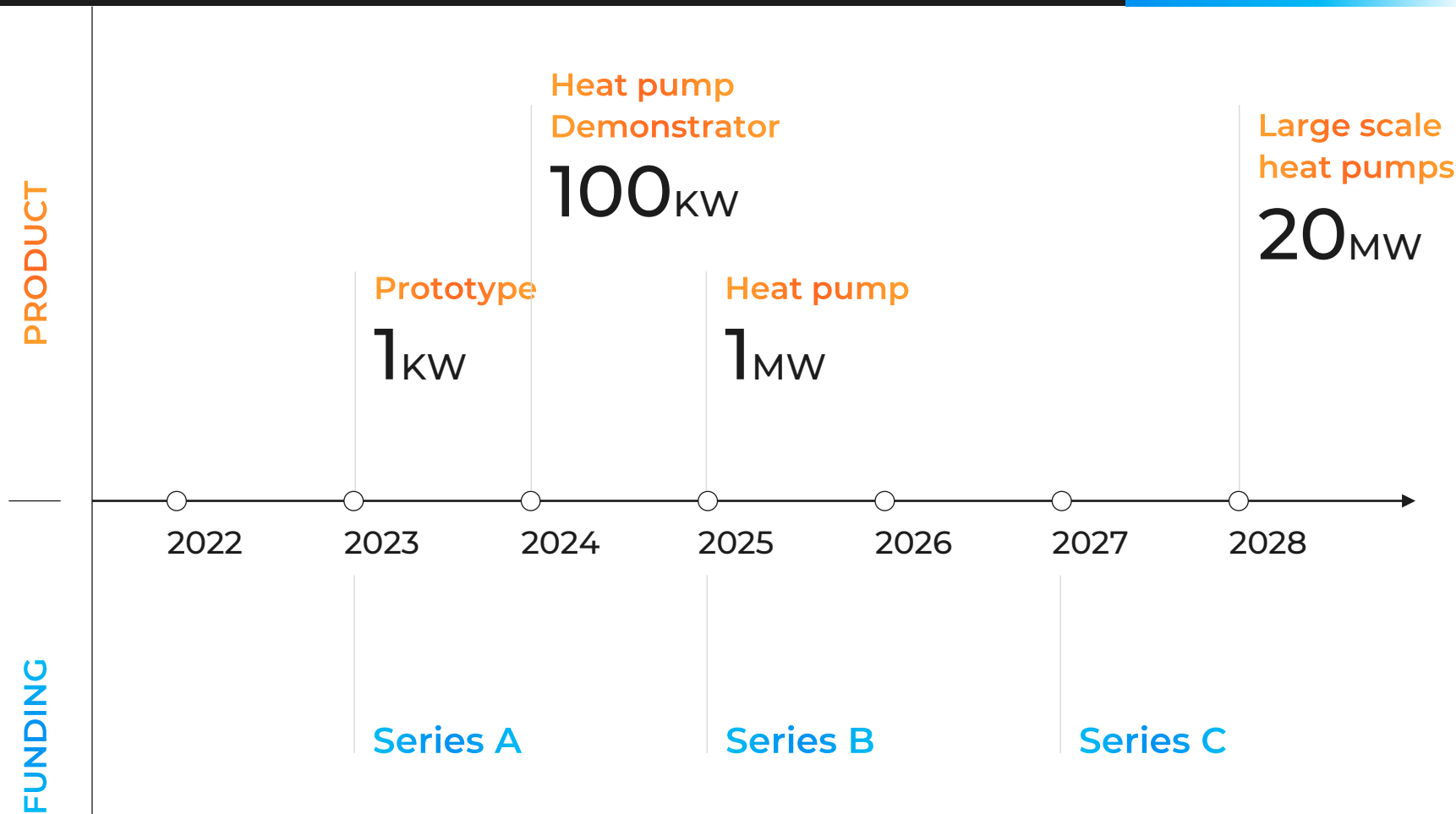
2021

Seed round  
\$1.3M raised



[wefunder.com/airthium](https://wefunder.com/airthium)

# Our vision



# Our vision





# Stirling engine for Seasonal electricity storage



## 01. Same Engine

↳ Our Stirling engine will be scaled up

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## 02. Thousands of hours of storage, anywhere

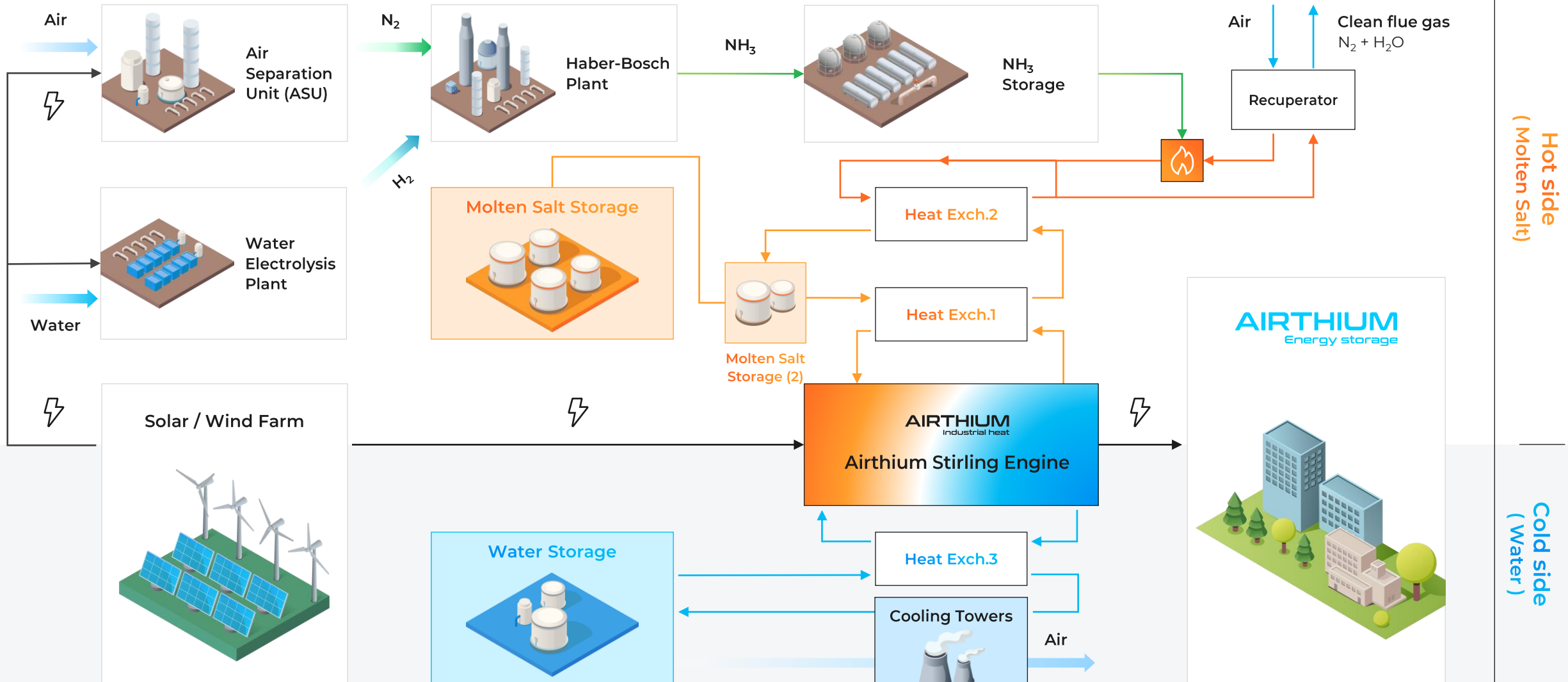
↳ Using green ammonia and thermal storage

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## 03. 100x cheaper than lithium-ion

↳ \$2/kWh capital cost

# Stirling engine for Seasonal electricity storage





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Decarbonizing industrial heat production  
cost-effectively



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Heat pumps supplying 100°C to 550°C



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Raising a \$5M seed round on [wefunder.com/airthium](https://wefunder.com/airthium)