

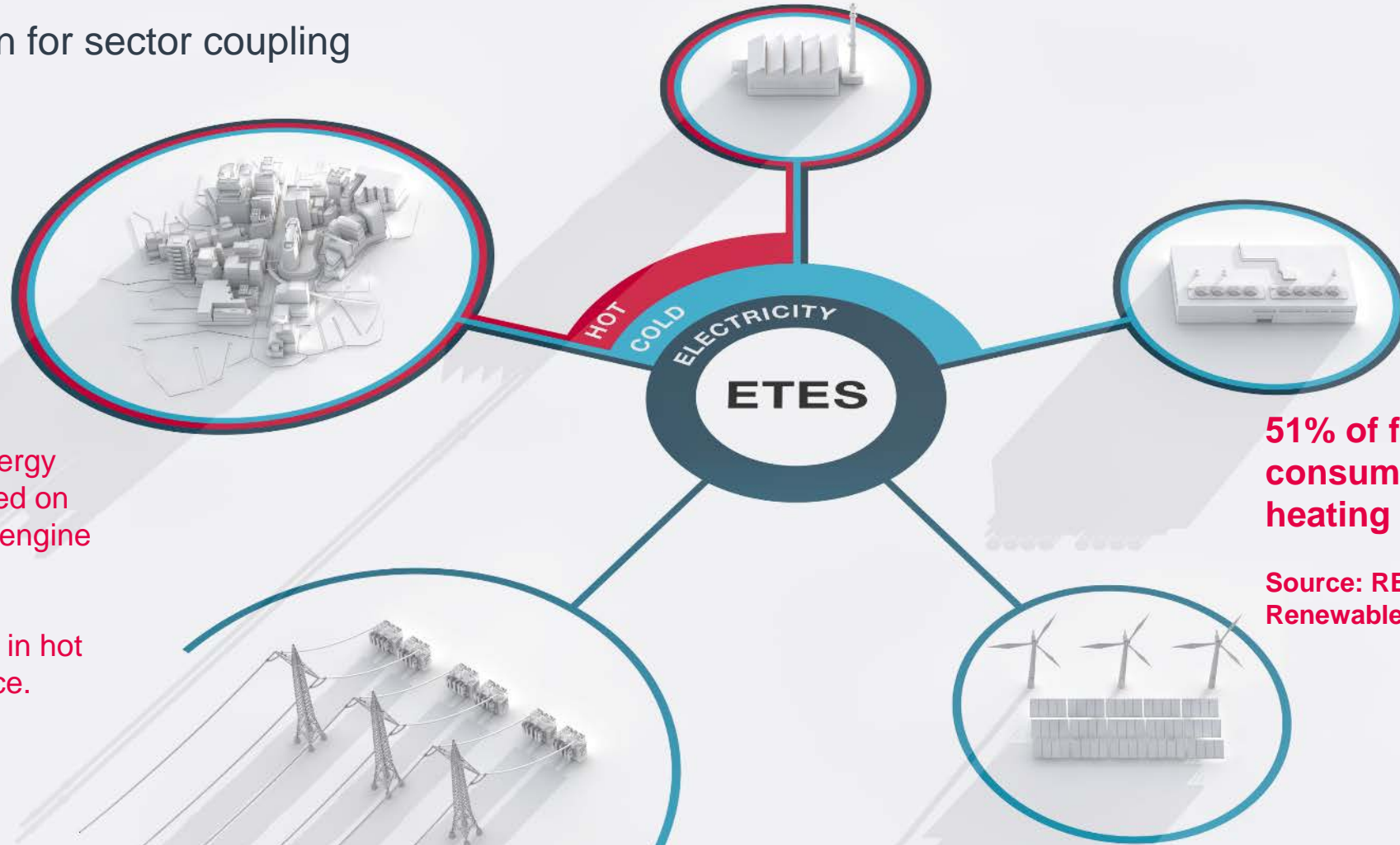
Electro-Thermal Energy Storage (ETES)

Thermal-Mechanical-Chemical Energy Storage (TMCES) Workshop
Fast Pitch Session
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MAN ETES – Electro-Thermal Energy Storage

The ideal solution for sector coupling



51% of final energy consumption is used for heating or cooling

Source: REN21 Advancing the Global Renewable Energy Transition, 2019

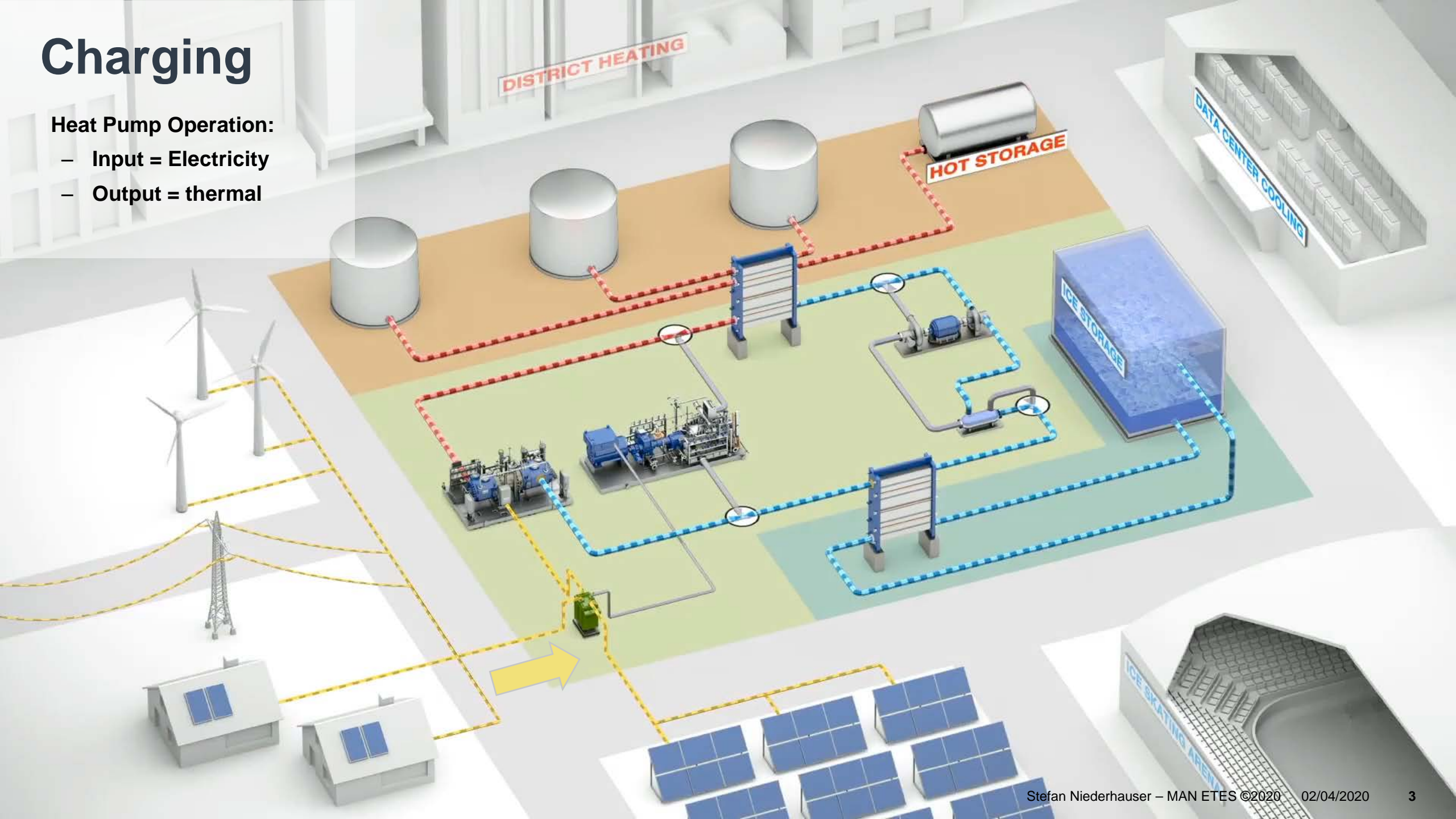
MAN ETES is a bulk energy storage technology based on heat pump and thermal engine technologies utilizing transcritical CO₂ cycles, storage of pumped heat in hot water and cold water / ice.

**MAN ETES is a tri-generation energy management system:
Providing heat & cold & electricity at large scale on demand to numerous industries**

Charging

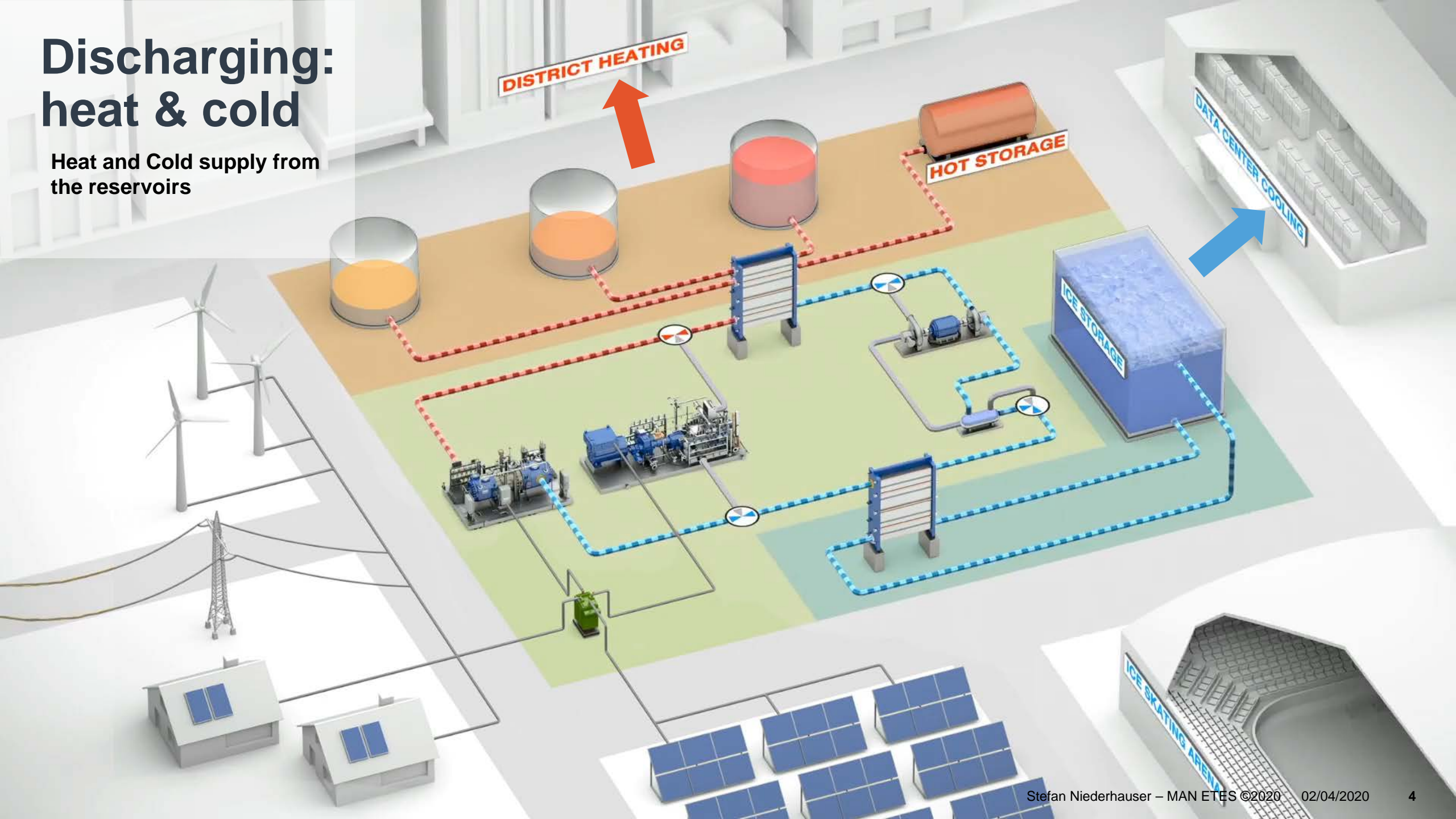
Heat Pump Operation:

- Input = Electricity
- Output = thermal



Discharging: heat & cold

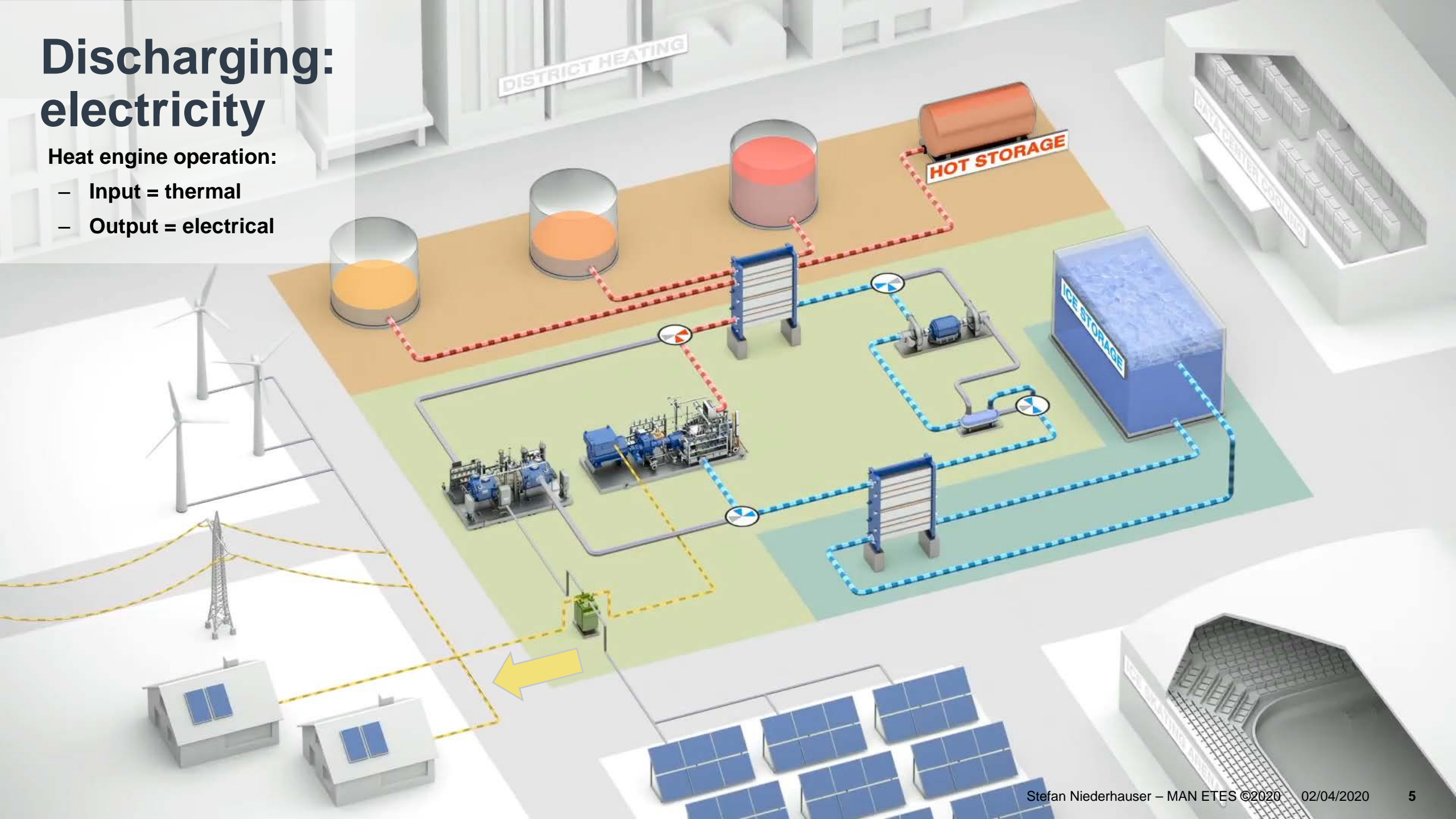
Heat and Cold supply from
the reservoirs



Discharging: electricity

Heat engine operation:

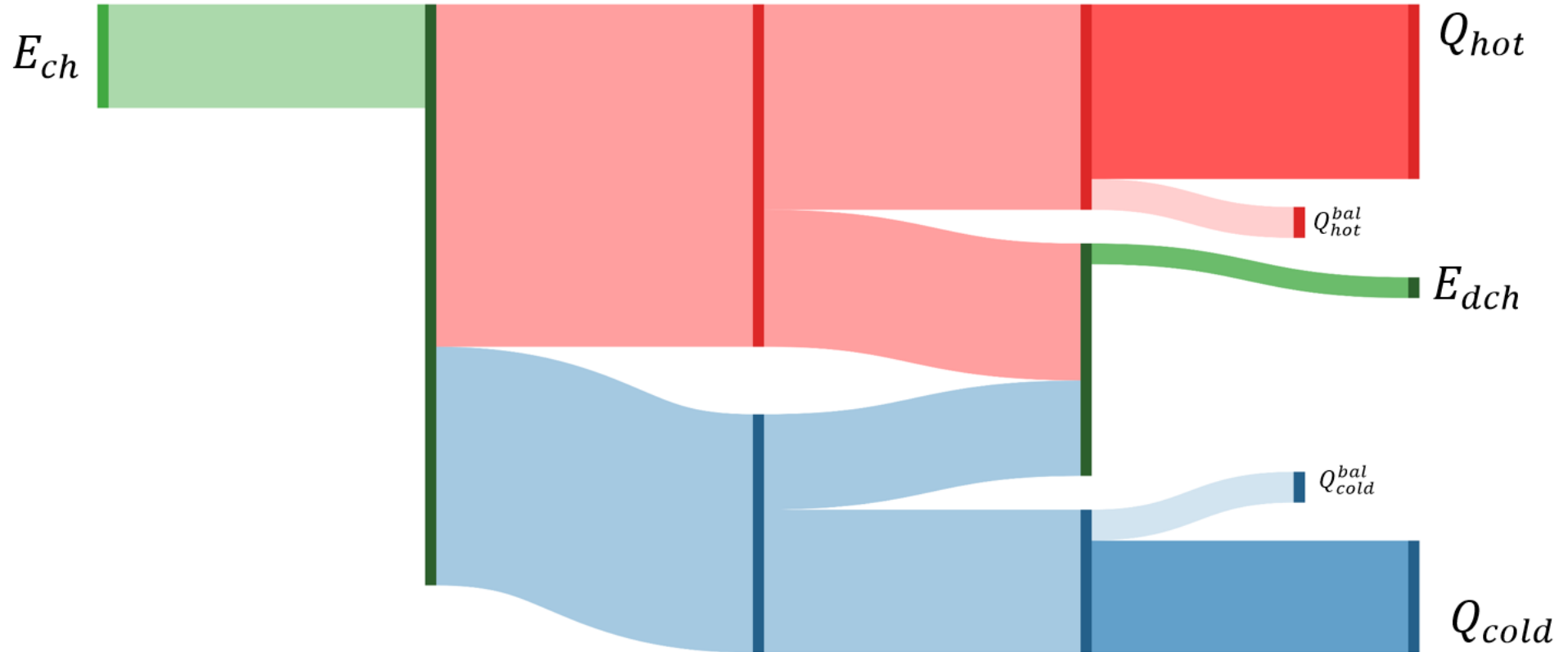
- Input = thermal
- Output = electrical



Flexibility of ETES

0% – 100% Thermal Share

60% Thermal Share

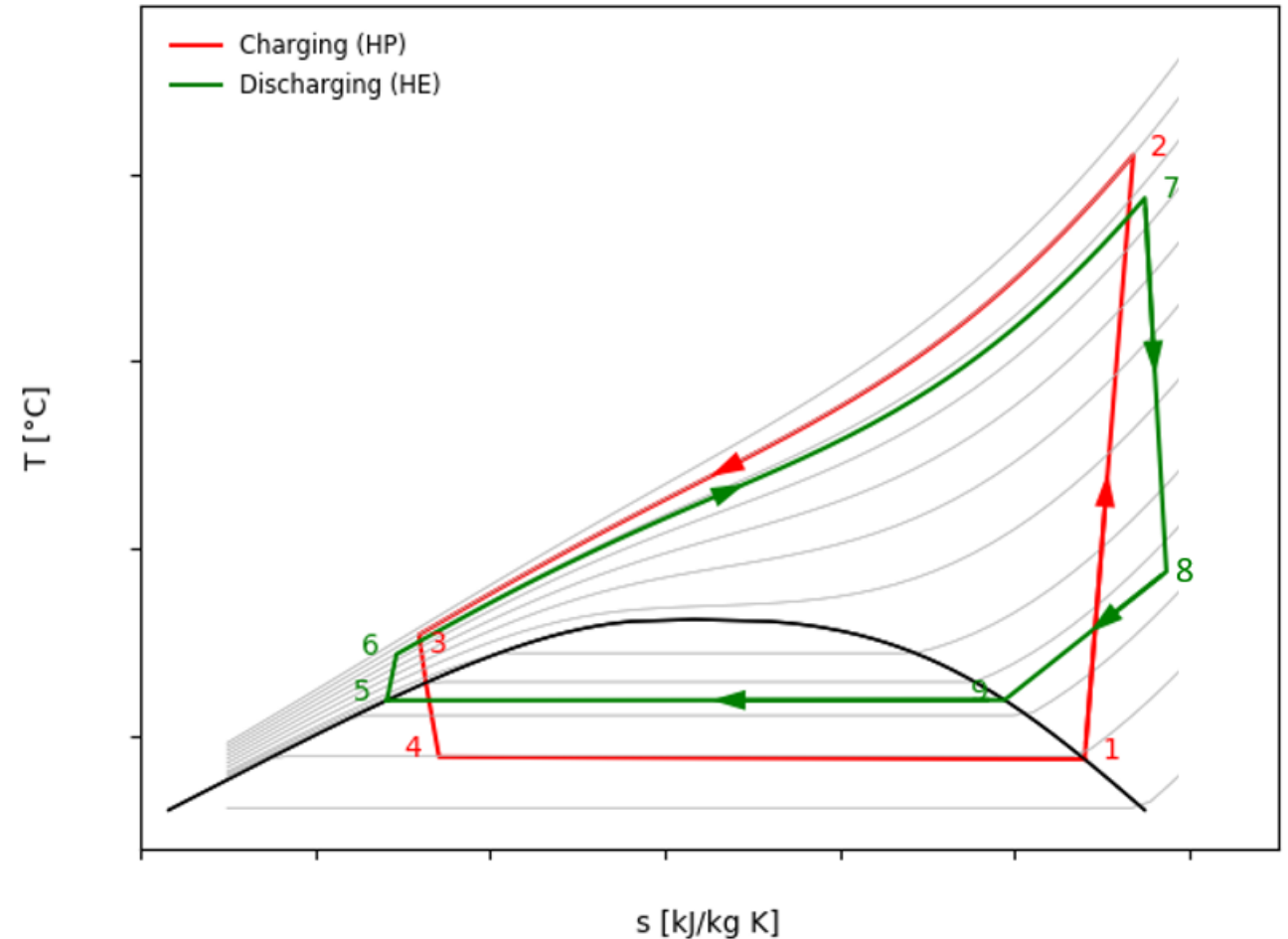


ETES can be designed for thermal share between 0% and 100%, which makes the system extremely flexible.

Working Fluid for ETES: CO₂

Advantages of using CO₂ as working fluid:

- Low critical point and high energy density
 - favorable heat transfer
 - moderate design pressure of process key equipments (“off-the-shelf” products)
- Very compact turbomachinery
- Use of transcritical (for latent heat exchange) and supercritical conditions (for sensible heat exchange)
- Available everywhere at moderate costs (site independent)
- Stable, non-flammable and non-toxic (safety)
- Natural refrigerant, low GWP (sustainability)



ETES – Plant Layout



MAN Energy Solutions
Future in the making



Thank you very much!

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