The role of heat pumps in future heating systems

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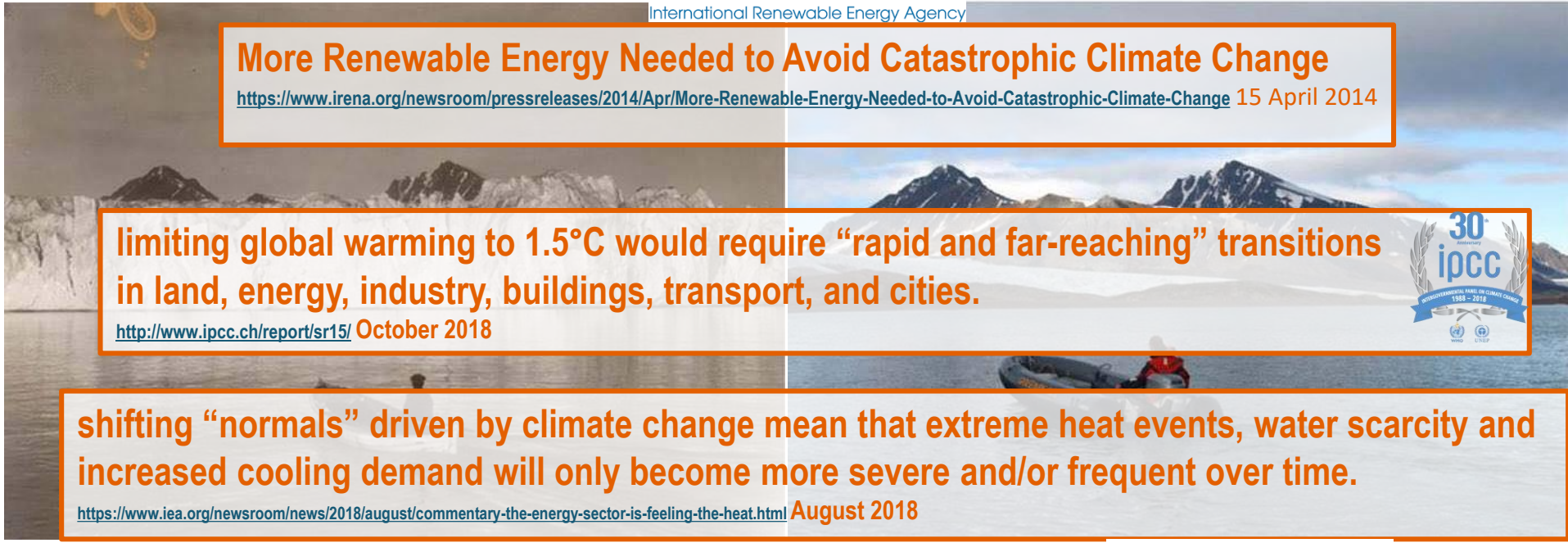
Backgroud

Climate Change



IRENA
International Renewable Energy Agency

More Renewable Energy Needed to Avoid Catastrophic Climate Change

https://www.irena.org/newsroom/pressreleases/2014/Apr/More-Renewable-Energy-Needed-to-Avoid-Catastrophic-Climate-Change 15 April 2014

limiting global warming to 1.5°C would require "rapid and far-reaching" transitions in land, energy, industry, buildings, transport, and cities.

http://www.ipcc.ch/report/sr15/ October 2018

shifting "normals" driven by climate change mean that extreme heat events, water scarcity and increased cooling demand will only become more severe and/or frequent over time.

https://www.iea.org/newsroom/news/2018/august/commentary-the-energy-sector-is-feeling-the-heat.html August 2018

Picture:
https://www.reddit.com/r/pics/comments/80wu8l/the_arctic_100_years_ago_and_today/

iea International Energy Agency

Climate Change: European Union

- **The 2015 Paris Agreement (COP 21)**
- **The Energy Union and the Energy and Climate Policy Framework for 2030:** reduce greenhouse gas emissions further by at least 40 %
- **European Climate Change Programme:** developing a sustainable, competitive, secure and **decarbonised** energy system by 2050. Member States decarbonising the building stock, responsible for 36 % of all CO_2 emissions in the Union

nearlyZEB

nZEB Definition

Directive 2010/31/EU(1) defines a **nearly ZEB** (**nZEB**) as 'a building (residential, office, civil) that has a very high energy performance.

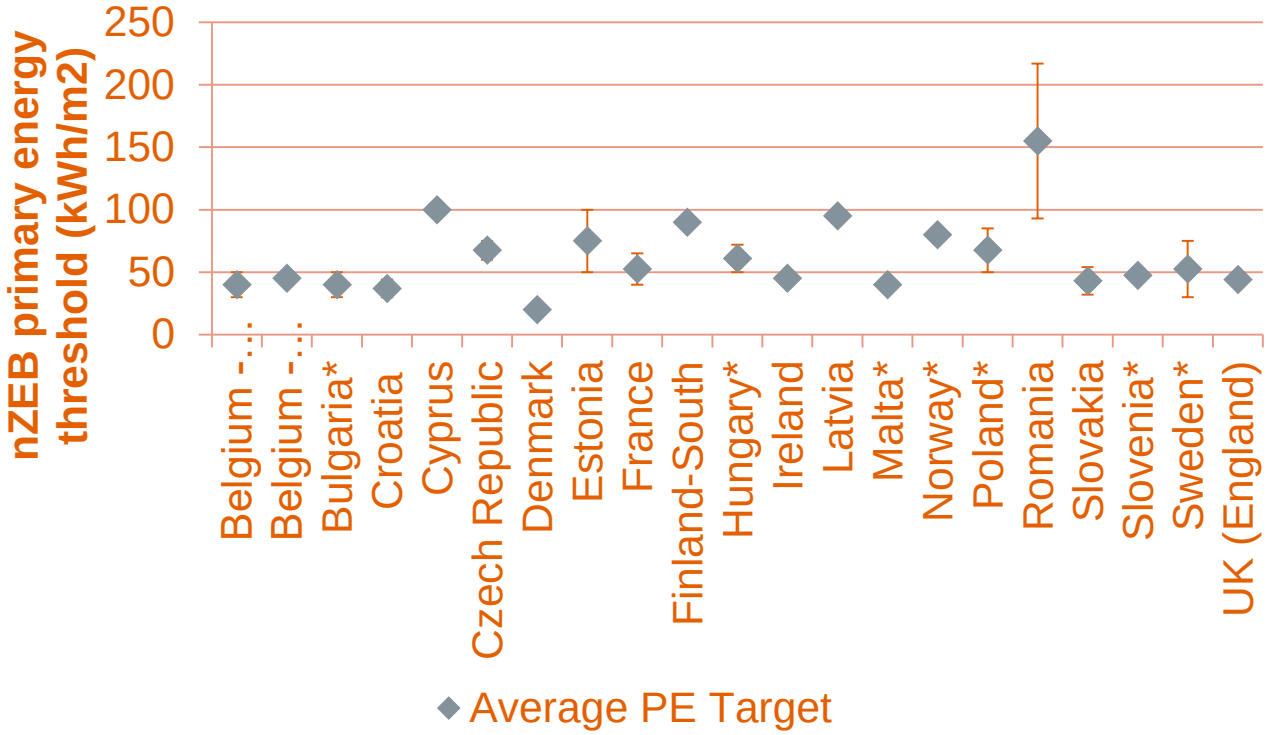
The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby'.

Directive requires **all new buildings** to be **nZEB** by the **end of 2020** and all new public buildings to be nearly zero by 2018.

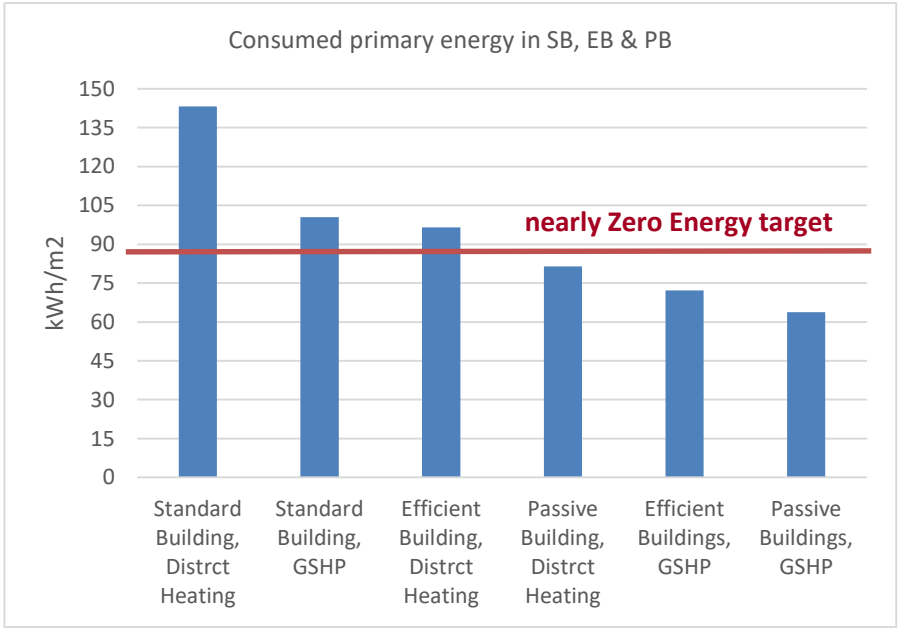
The Member States must integrate nZEBs in their national plans
EPBD, metric to quantify energy use in an nZEB is primary energy expressed in kWh/m2

(1) EU Commission, Directive 2010/31/EU of the European Parliament, (2010) 23. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&from=EN.

Definition: National nZEB thresholds



GSHP & DH nZEB solutions



Standard

Energy efficient

Passive

nZEB easier to achieve by using **GSHP**

Hypothesis:

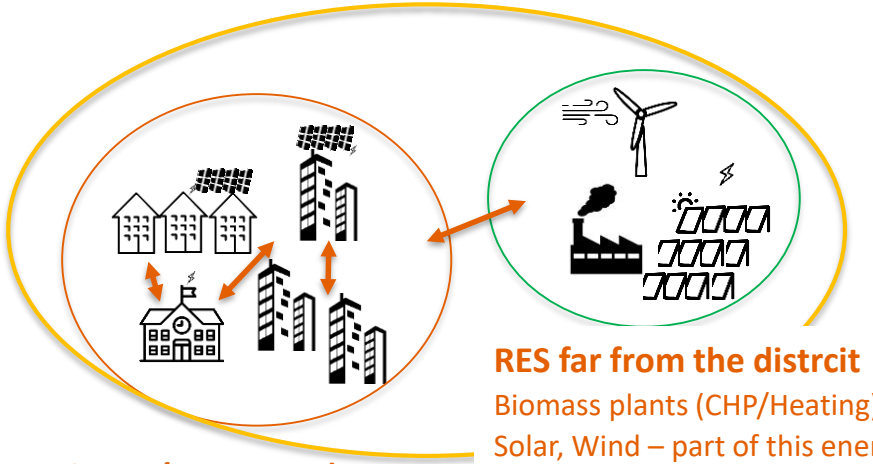
- more realistic energy demand profiles of home appliances and internal heat gains
- more realistic picture of the building's energy demand.

SET carbon-free district vision

Beyond buildings not individual entity

- Hyper-connected buildings able to share energy **between them**

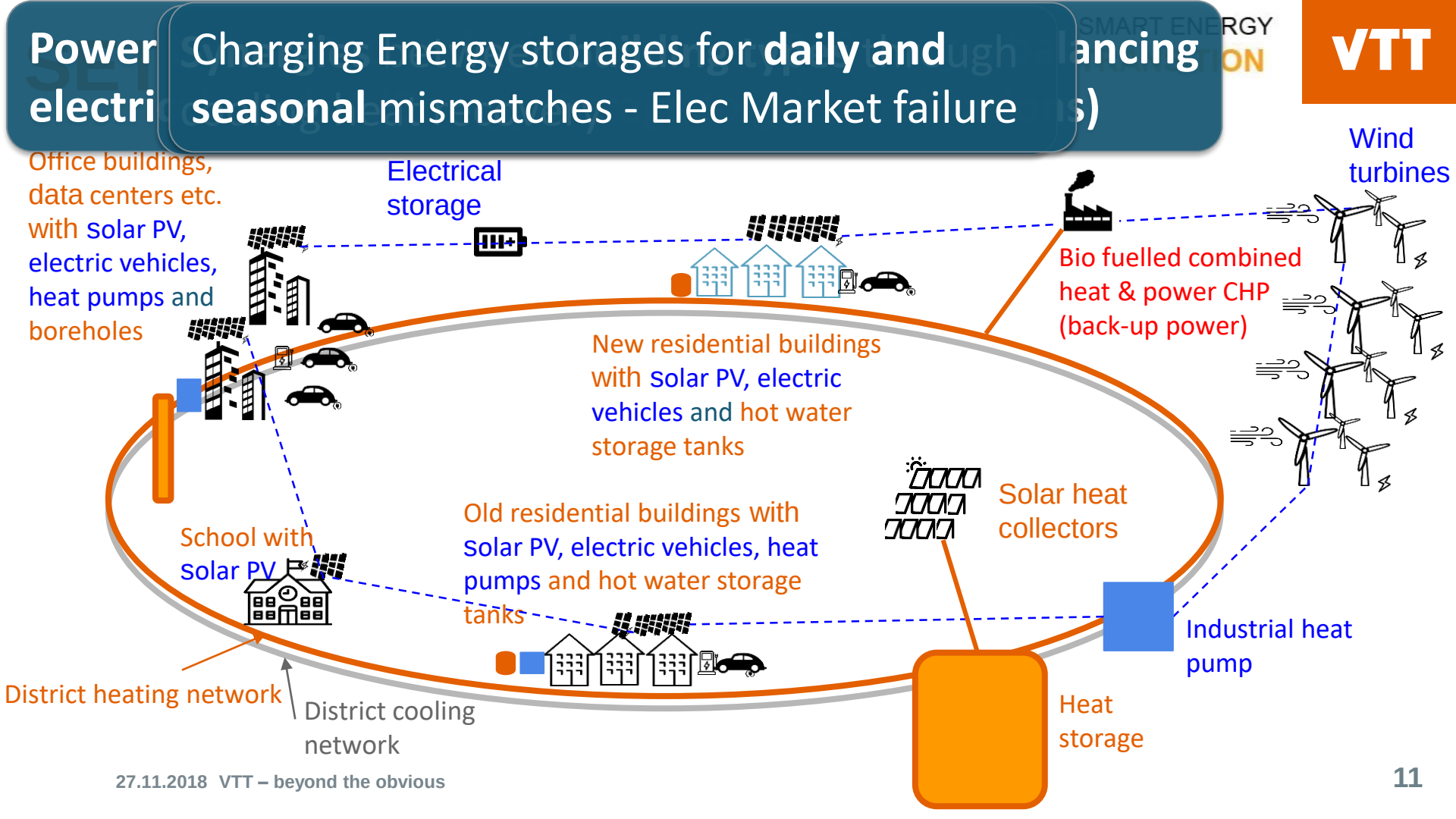
- Smart Urban network manage energy consumption and the energy flow **between buildings and the wider energy system**



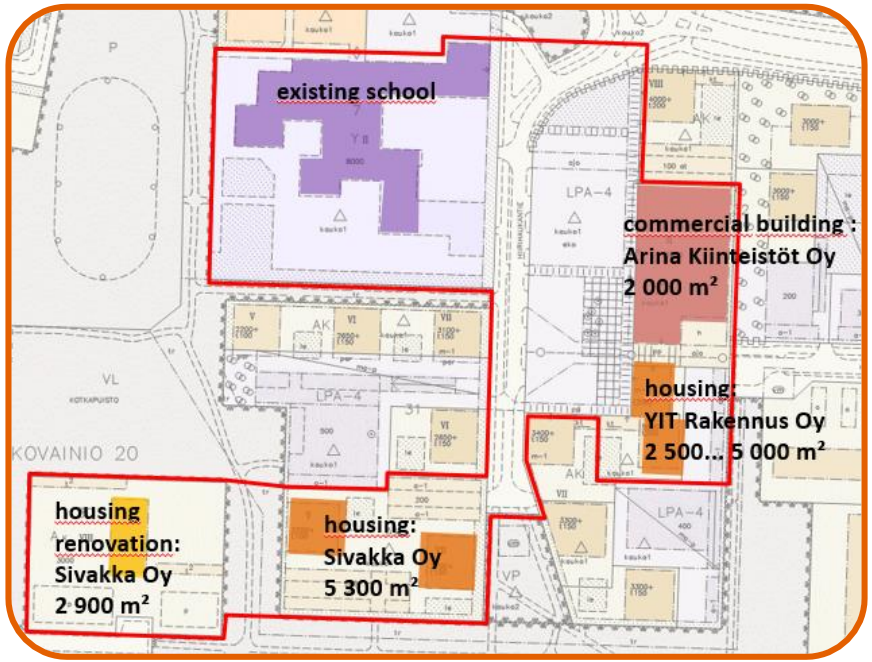
Physical boundaries/same area)
Exchange energy between buildings and grid – no pollutant in the area! *Healthy lifestyle and attractive place to live*

RES far from the distrcit
Biomass plants (CHP/Heating)
Solar, Wind – part of this energy contribute to the energy supply of the district – VirtualPowerPlant

Power electri… Charging Energy storages for **daily and seasonal** mismatches - Elec Market failure …ancing …s)

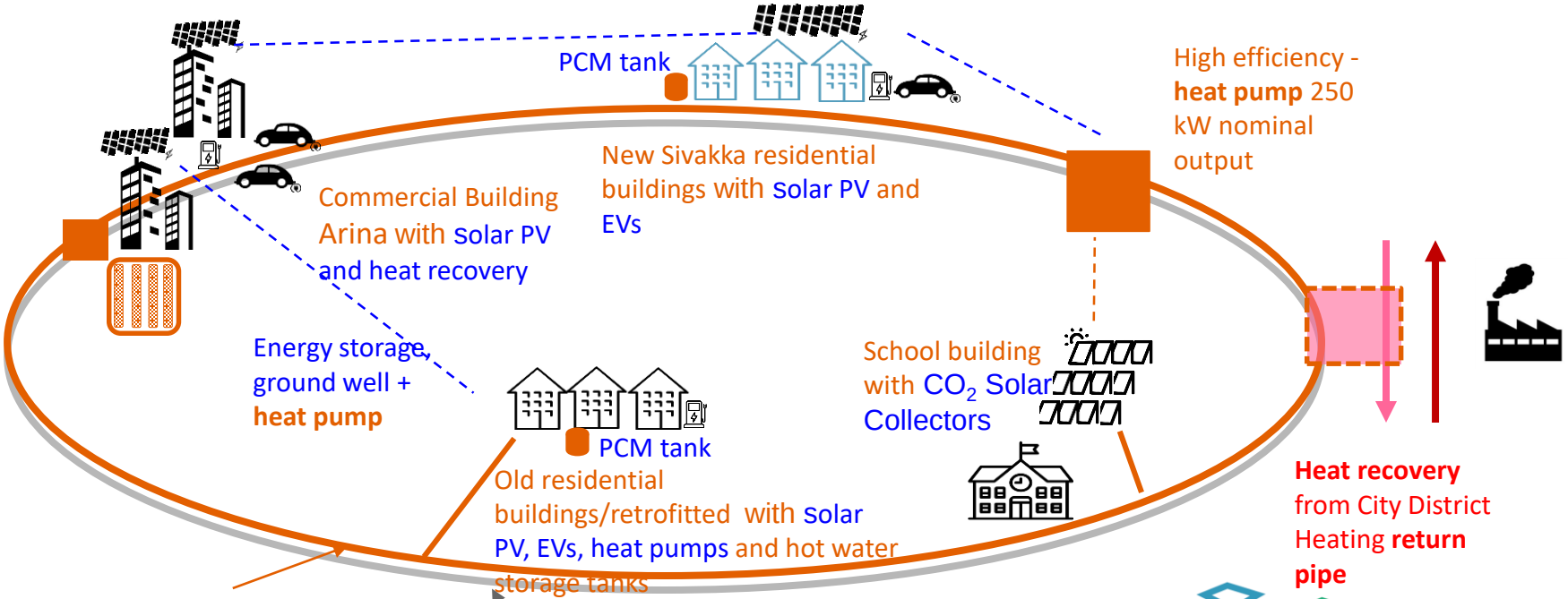


+eDistrict, Oulu case



- Heat distribution between the buildings on site
- **Solar thermal plant** (70 kW nominal output) on the roof of the school building
- High efficiency - **Heat pump**
- **Retrofitting** old building. Low temperature distribution
- **Decentralized PV**
- **Energy storages** (wells, PCM tank)
- **Heat recovery** from buildings and return pipe main District-heating

+eDistrict, Oulu case



Conclusions

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Single building application

- nZEB easier to achieve by using GSHP

Future district application

- Power to heat technologies: increase RES usage, balancing electrical market (Energy storage to grid applications)
- Synergies between building types through cooling heat recovery
- Charging Energy storages for daily and seasonal mismatches - Elec Market failure

Thanks!

VTT

Let the SMART ENERGY TRANSITION continue!

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