INTEGRATED APPROACHES TO COOLING IN ENERGY SYSTEMS

HEAT PUMPING TECHNOLOGIES (HPT TCP)

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The HPT TCP is part of a network of autonomous collaborative partnerships focused on a wide range of energy technologies known as Technology Collaboration Programmes or TCPs. The TCPs are organised under the auspices of the International Energy Agency (IEA), but the TCPs are functionally and legally autonomous. Views, findings and publications of the HPT TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

What is the HPT TCP?

- A Technology Collaboration Programme (TCP) within the IEA since 1978
- An international framework of cooperation and networking for different HPT actors
- A forum to exchange knowledge and experience
- A contributor to technology improvements by RDD&D projects

HEAT PUMPING TECHNOLOGIES

Includes:
- Heating and cooling
- Air conditioning
- Refrigeration

Covers applications in
- Residential and commercial buildings
- Industries
- Thermal grids in cities and communities
- Other applications



HPT Annexes = International Collaboration Projects





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CHALLENGES AND POSSIBILITIES

The **increasing cooling demand** will predominantly appear in **households**. To avoid extensive increase in energy demand for and global warming impact from cooling

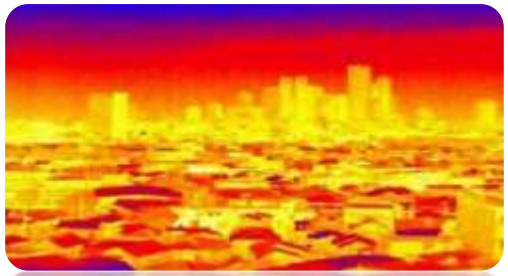
- **Minimize the demand for conventional cooling while meeting thermal comfort – first option**
  - No over cooling – cool to sufficiently low temperature – not more!
  - Part time - part space
  - Appropriate building envelopes, apply solar shielding where possible
- **Increase cooling efficiency, decrease leakage, use low GWP refrigerants**
  - Decrease temperature lift – apply large heat exchanger surfaces
  - Decouple sensible and latent cooling demand
  - Existing buildings – efficient equipment
  - New buildings – system integration – using both sides of the HP cycle
- **Increase the share of renewable energy sources – decrease the use of fossil fuel**
  - Local and central PV/wind electricity and energy storage (thermal and electric)



System integration

SYSTEM INTEGRATION

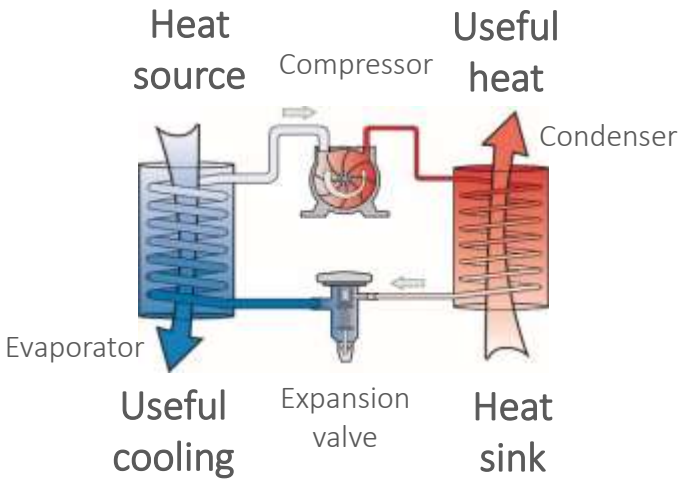
- Possibilities to use both sides of the HPT cycle?



Urban areas = Hot islands



Space cooling





Process heating

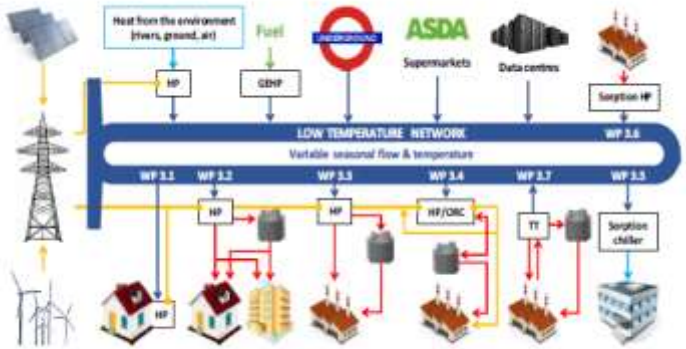


Hot water heating

SYSTEM INTEGRATION

On different levels

- On household/apartment level
- On building level – residential and commercial buildings (supermarkets, hotels)
- On district/city level



Source: N. Hewitt, HPT Magazine #3 2019



Source: Carsten Wemhoener Annex 49 HPT Magazine #2 2019

Façade-integrated PV driven AC for space cooling



Annex 49



Annex 48

DHW heat pump cools and dehumidifies indoor air

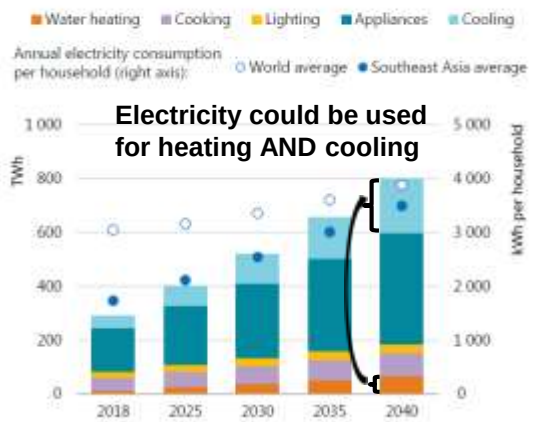




Annex 46

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Residential electricity demand by end-use and electricity consumption per household, per year in Southeast Asia in the STEPS

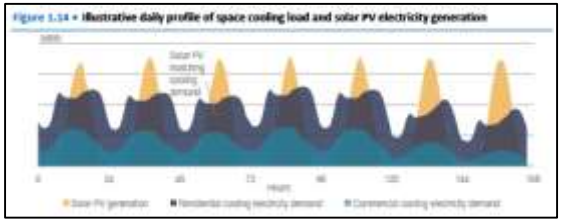


Source: The Future of Cooling in Southeast Asia, IEA, 2018

SYSTEM INTEGRATION

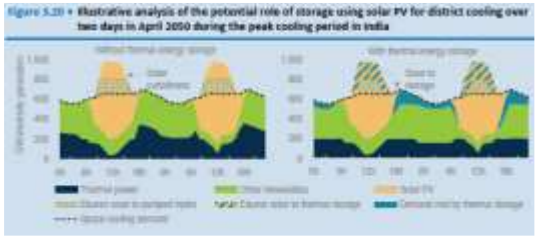
In combination with

- Renewable energy sources (PV, wind etc)
- Energy storage (thermal and electrical)
- Smart, integrated control (including buildings , industry, transport)



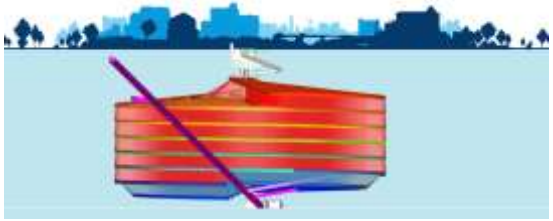
Source: The Future of Cooling, IEA, 2018

Cooling demand and solar PV generation have overlap to some extent



Source: The Future of Cooling, IEA, 2018

Using thermal storage together with solar PV and district cooling decreases the need for fossil fuels



Source: Thermal energy underground storage: Annex 47 case TES

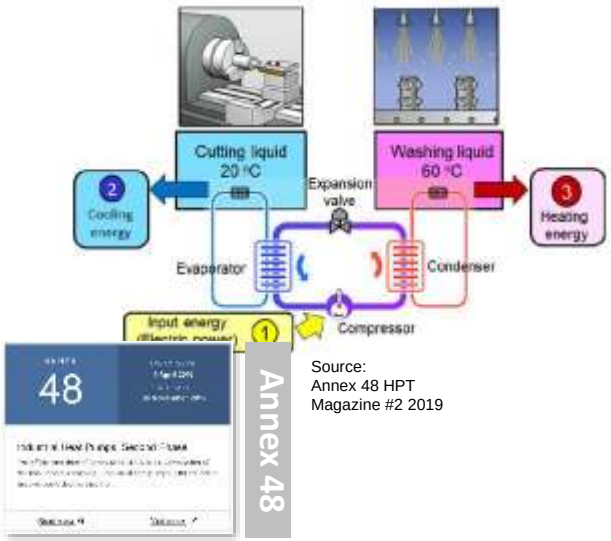
Thermal energy underground storage



Electric energy storage

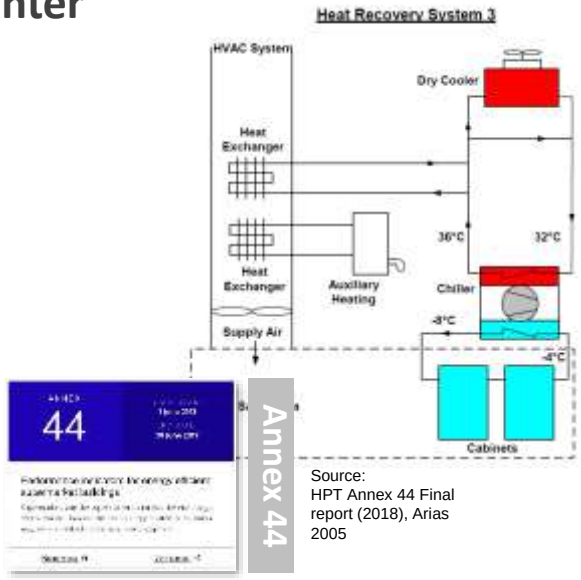
SYSTEM INTEGRATION

- Industry, Supermarkets, Datacenter



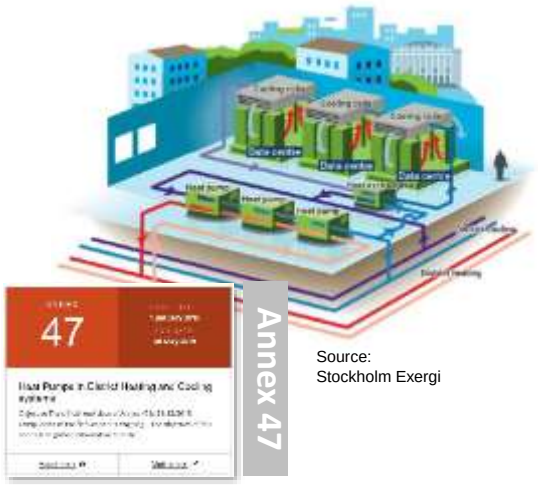
Source:
Annex 48 HPT
Magazine #2 2019

Replacing crude oil and a conventional cooling machine by a heat pump in an automobile parts factory in Japan decreased annual running cost of energy by 79%



Source:
HPT Annex 44 Final report (2018), Arias 2005

Waste heat from supermarket refrigeration recovered for space heating



Source:
Stockholm Exergi

Cooling of data centers integrated in the district heating and cooling system of the city – waste heat recovered!

ABSORBTION HEAT PUMP CYCLE

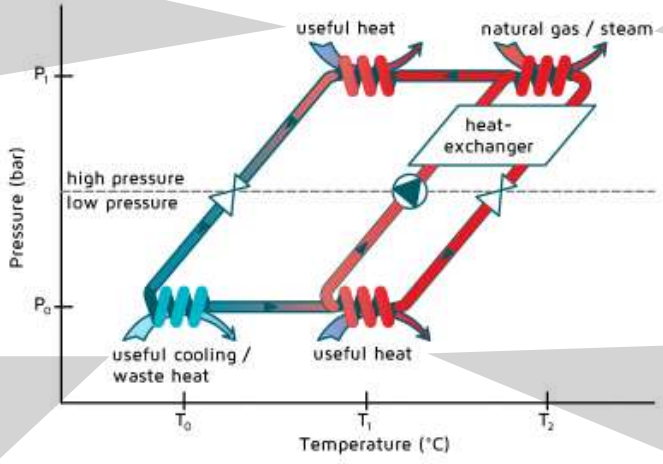
–Solving Multiple Challenges



Hot water heating
(district heating)



Space cooling
(district cooling)





Waste incineration
(Combined Heat and Power)



Waste heat

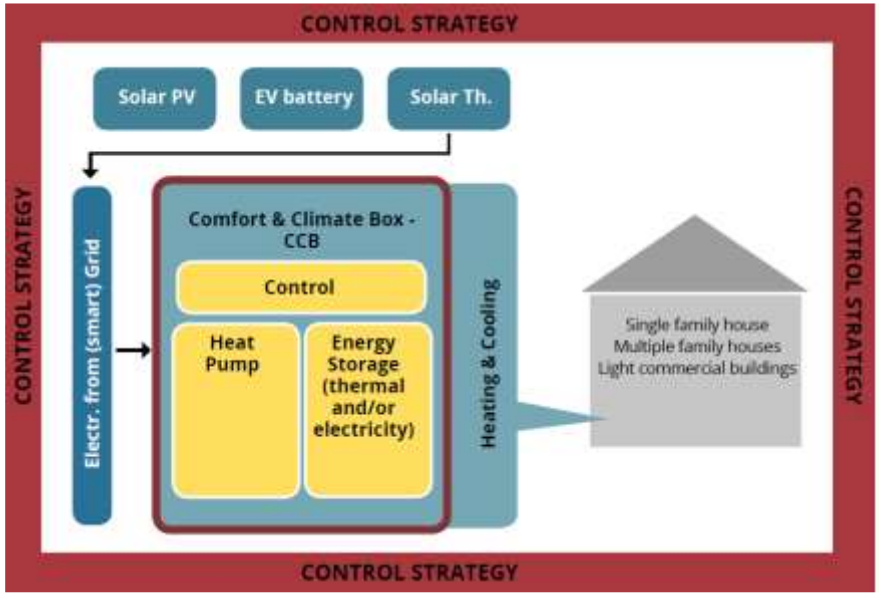
RECOMMENDED ACTIONS

- **Use both sides of the heat pump cycle when possible** – match simultaneous heating and cooling demand, strive to minimise temperature lift
- Match **generation** of **renewable** drive energy and simultaneous **cooling demand** - when **mismatch** in time – **apply energy storage** (thermal, electrical)
- **Design new** buildings and districts for **matching** energy needs and supplies
- Increase **boundaries** to find matches



PLANNED FUTURE ANNEX:

Comfort and Climate Box for warm and humid climates





Comfort and Climate Box

– Speeding up market development for integrating heat pumps and storage packages (for cold and average climates)

A collaboration with Mission Innovation #IC7

www.heatpumpingtechnologies.org

HPT TCP and other TCPs

Collaboration is vital



Welcome to contact us

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