

HEAT
PUMPS
IN
SPAIN

NATIONAL WORKSHOP

11TH NOVEMBER 2024

📍 CIEMAT / Madrid

Ongoing
Spanish
Team activity
on HPT

WASTE HEAT RECOVERY FROM SUBTERRANEAN INFRASTRUCTURES

Javier Muñoz-Antón // Universidad Politécnica de Madrid
Madrid, 11th November 2024



SPAIN
NATIONAL
TEAM



Ciemat
Centro de Investigaciones
Energéticas, Medioambientales
y Tecnológicas



- Big cities
 - High thermal energy demand → CO₂ emissions → pollution (cars, buildings, ...)



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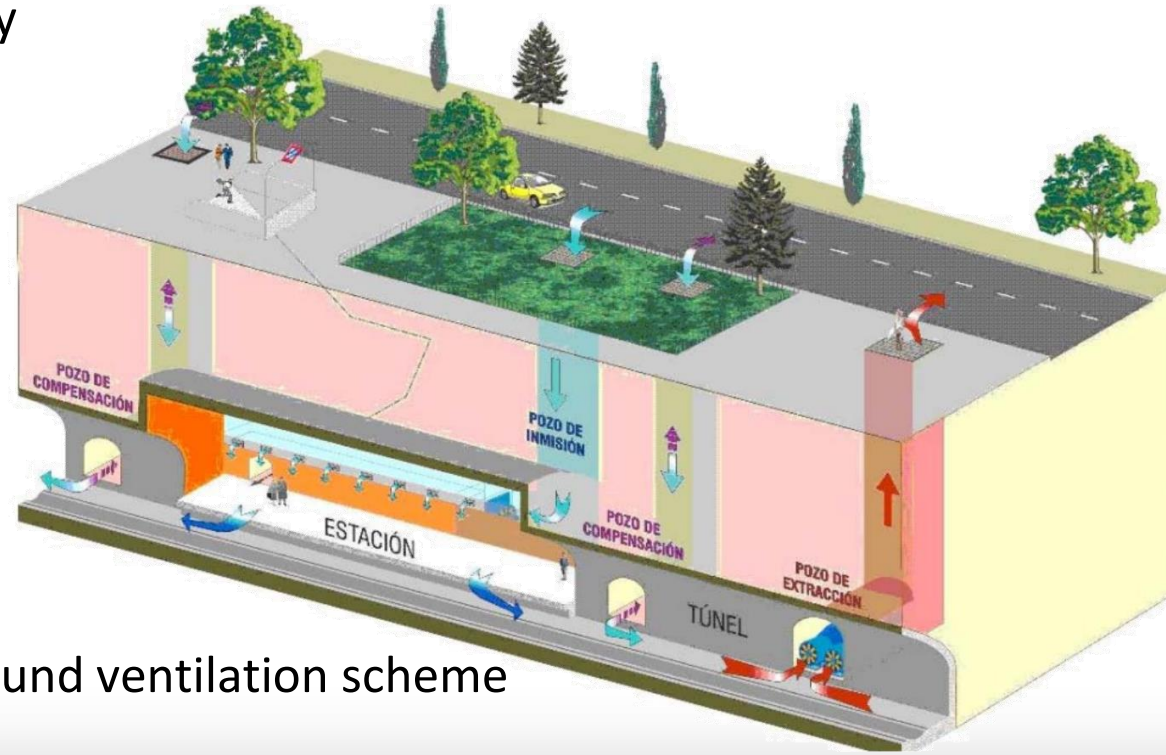
- Possibilities to reduce these problems:

- Improve energy efficiency in current systems

- Take advantage of residual thermal energy, improving it if required with heat pumps

- ...

- Where are inefficiencies/opportunities?
 - Underground infrastructures in big cities show relevant thermal energy activity



Typical underground ventilation scheme

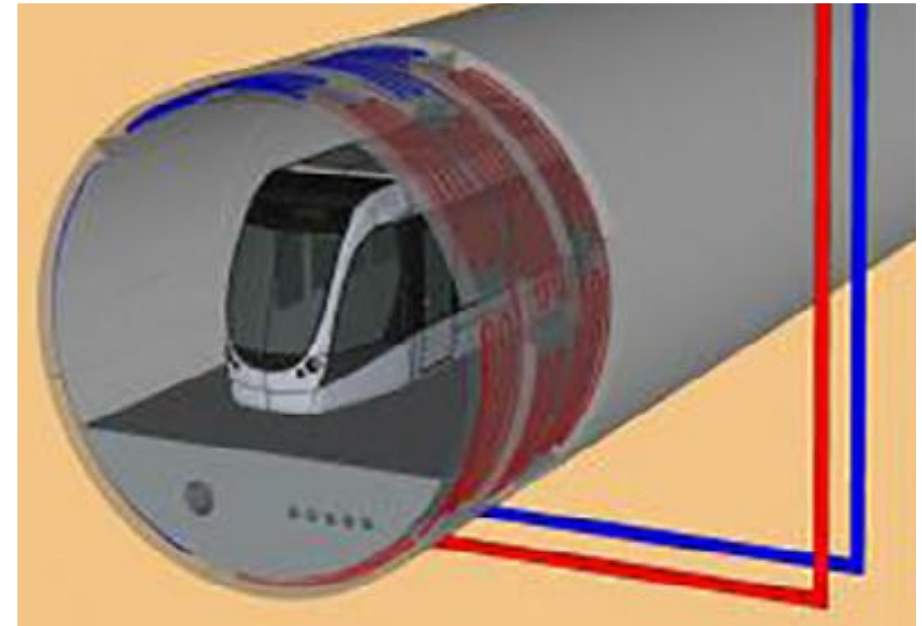
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Madrid MC30 tunnel

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 - Infrastructure thermal activation



Marco Barla, Alice Di Donna, Energy tunnels: concept and design aspects, Underground Space 3 (2018) 268–276

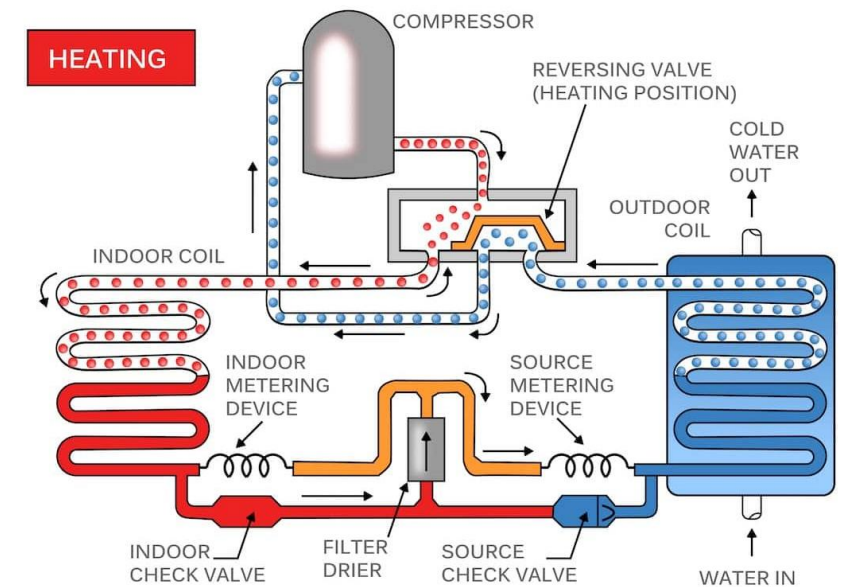
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Picture show an air/water heat exchanger



Direct Industry <https://www.directindustry.es/>

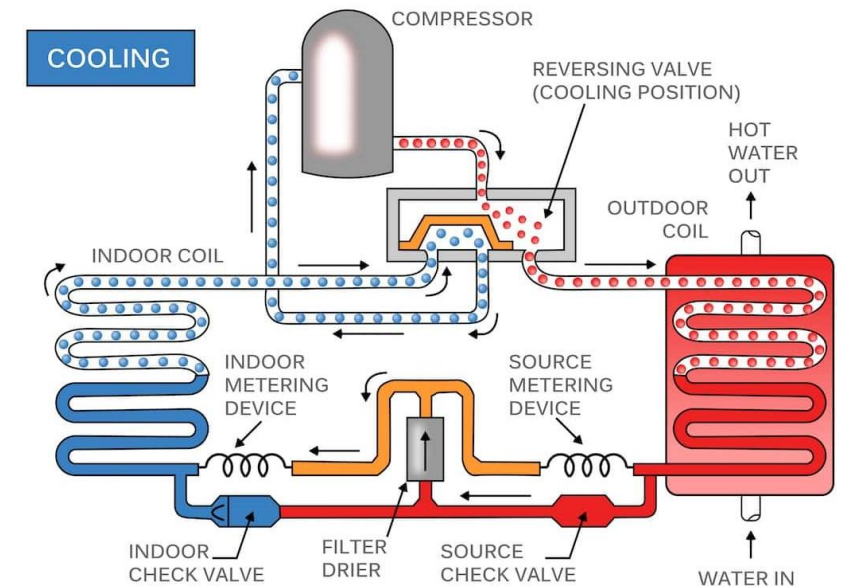
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HVAC School <https://hvacschool.com/>

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It can be coupled with an infrastructure thermal source/sink to take advantage of its thermal potential



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 - So, how can we recuperate residual thermal energy?
 - Infrastructure thermal activation
 - Heat exchangers
 - Heat pumps
 - Goals
 - Obtain a valorization of this residual thermal energy
 - Reduce CO2 emissions in big cities with underground infrastructures
 - Heating in winter, cooling in summer, DHW all year

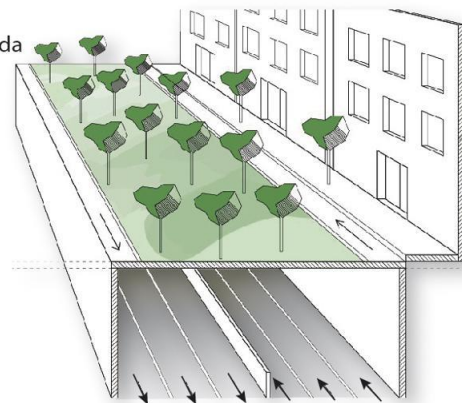
- Thermal activation

- In current infrastructures it is not possible (too expensive)
- New city-tunnels thermal activation

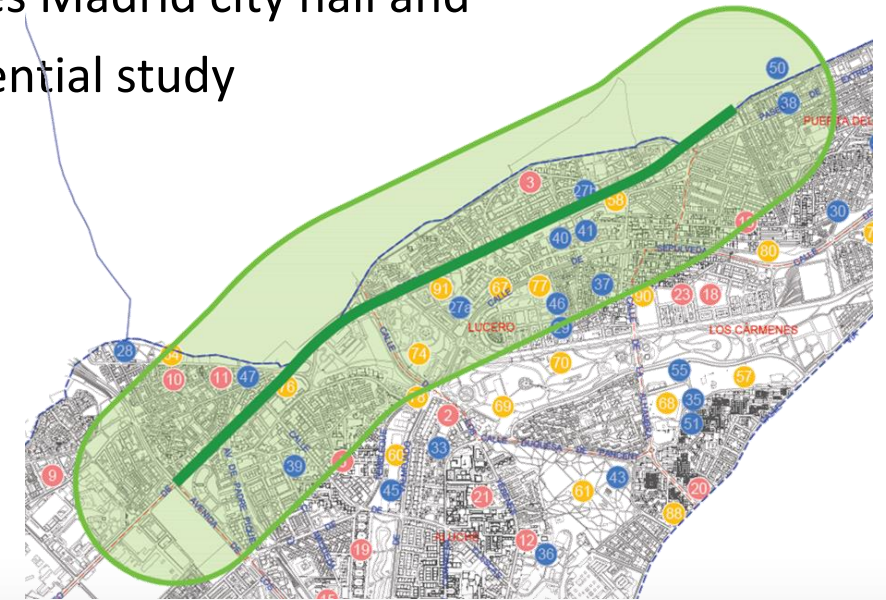
- A5 highway hiding (3km). UPM team advises Madrid city hall and carries out the district heating/cooling potential study

Así es la propuesta

- ✓ Se liberarían 90.000 m² para transformar la avenida en un bulevar peatonal con zonas verdes
- ✓ Plazo de ejecución: menos de tres años
Presupuesto: en torno a 180 mill. de euros

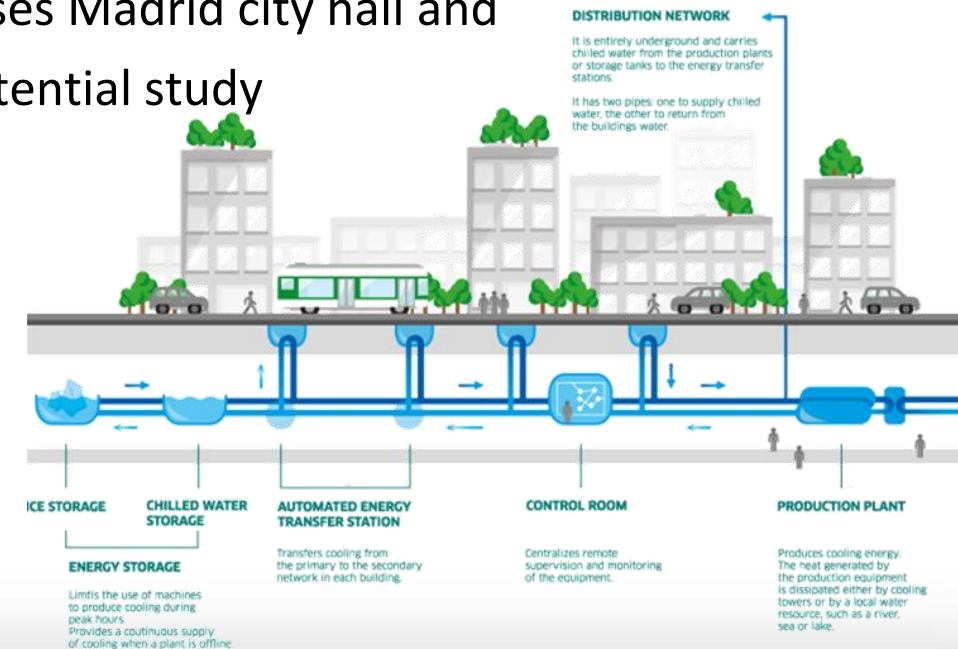


- ✓ El falso túnel tendría seis carriles, tres por sentido
- ✓ Vehículos diarios que pasarían por el túnel: 120.000



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 - New lines of Metro. UPM team advises alternatives to Metro



La Línea 11 de Metro de Madrid incluirá la termoactivación como fuente de energía renovable

03/03/2022

(<https://www.eseficiencia.es/2022/03/03/inea-11-metro-madrid-incluirea-termoactivacion-fuente-energia-renovable>)

- Heat pump use

- Metro de Madrid needs cooling the whole year
- The goal is extract enough energy to maintain adequate conditions in the infrastructure. At least, extract some quantity of heat
- Domestic hot water (DHW) appears as the more adequate way of coupling the goals of city decarbonization and residual heat extraction from Metro de Madrid
- Several studies carried out, i.e.:
 - Sol Metro Station (7000 people DHW)



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 - Sevilla Metro Station (1000 DHW)



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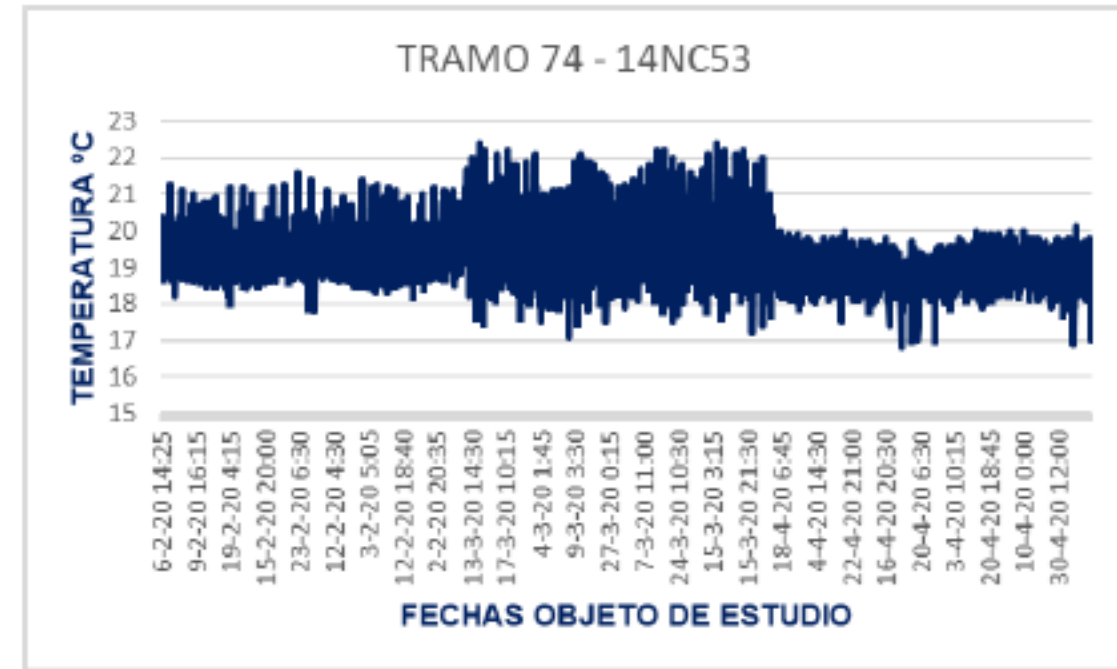
- MC30 tunnels activity produces heat all year, but its requirements allows also thermal storage → can be used to produce heat and to store heat too

- 100.000 m³/h each one



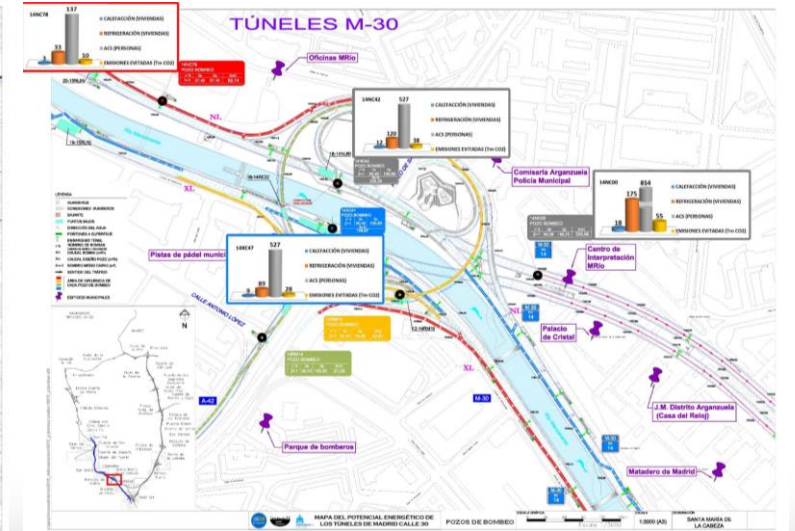
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- Several studies were carried out, main ones related with “Matadero” cultural center (former slaughterhouse), the MC30 cistern closest to the complex can provide up to 20% of heating and cooling demand of *Cineteca* and *Casa del Lector* buildings (~3000m²)



Thanks for your attention!



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