CampusEnergy2021

BRIDGE TO THE FUTURE

Feb. 16-18 | CONNECTING VIRTUALLY

WORKSHOPS | Thermal Distribution: March 2 | Microgrid: March 16

Reversible piping network in DHC: An Alternative to Increase Cost Effectiveness

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Q&A Will Not Be Answered Live

Please submit questions in the Q&A box.
The presenters will respond to questions off-line.

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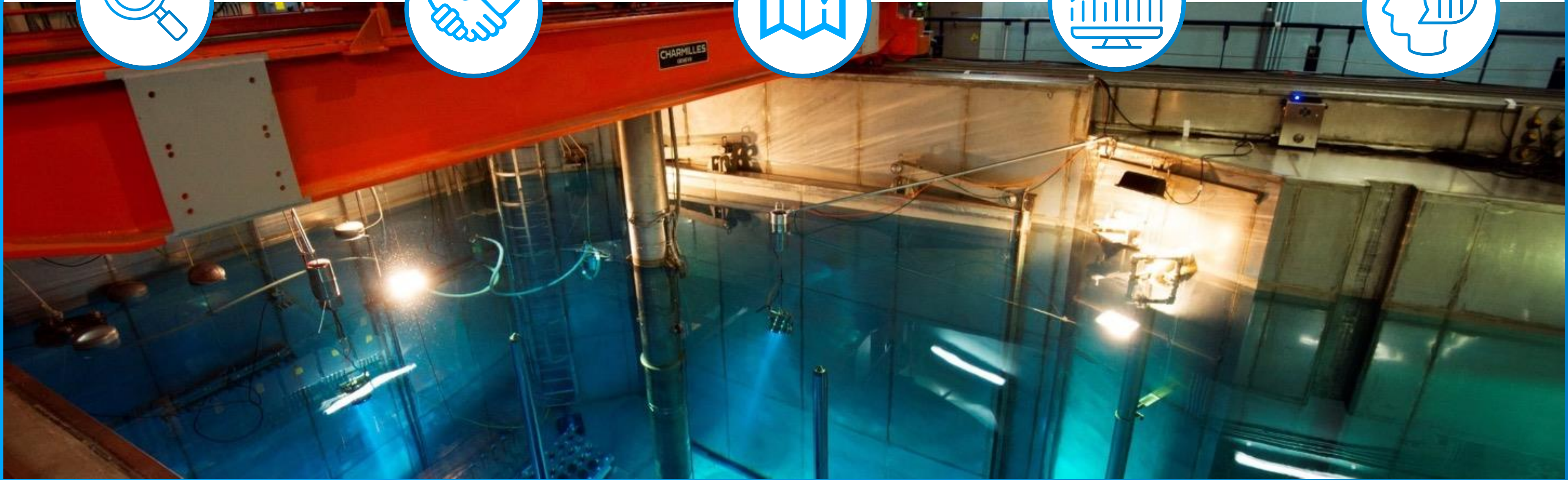
Reversible piping network in DHC



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Problem identification

1. Problem Identification

Conceptualization of reversible piping systems

Pre-feasibility studies

« Several studies in Chile and Colombia. »

CAPEX intensive

« The main barrier to implementing DHC»

Where are the highest costs ?

« Identify which factor contributes more to the CAPEX and OPEX. »

How to reduce costs ?

« Several models optimize the layout of the distribution network or the insulation. »

Solution

« How do we capitalize our investment the most? »

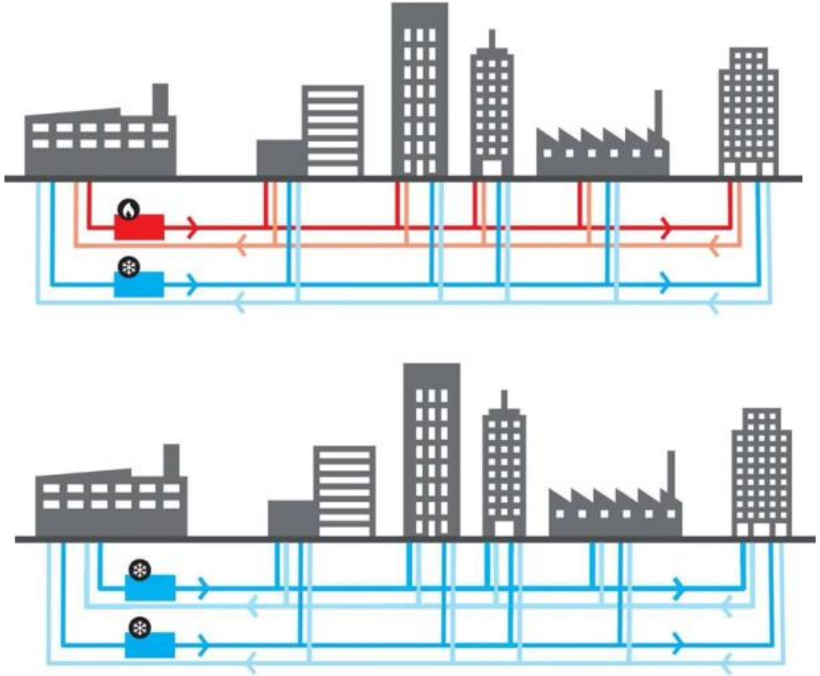
2

Reversible Piping Network as a Potential Solution

2. Potential Solution

Applying reversible lanes strategy in highways to the piping system

Reversible lanes

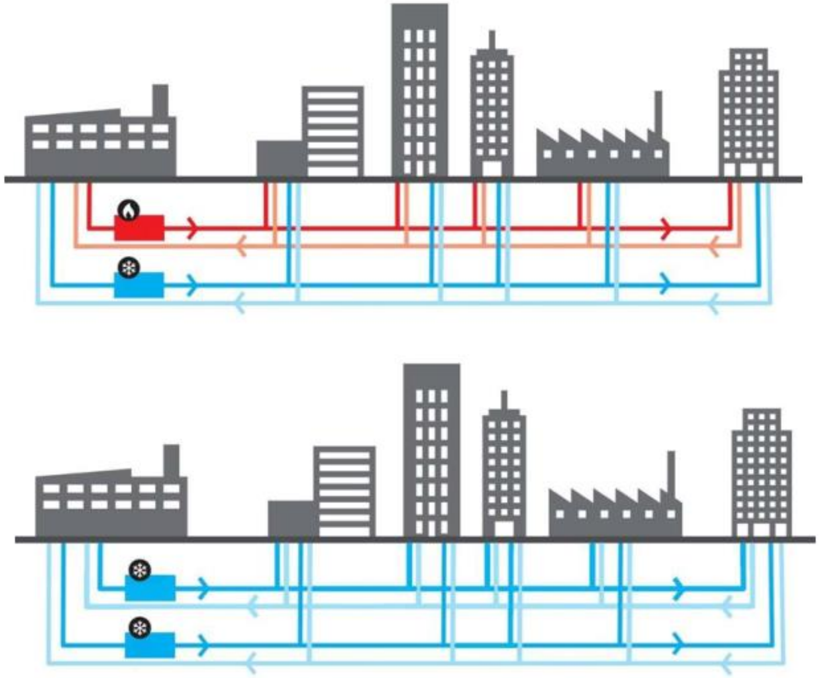


INTERNAL

2. Potential Solution

Better efficiencies in cities with highly seasonal weather

- Oriented to both **new projects,** but also implementation in **existing projects**
- The **transfer station** is the boundary of our study.
- The equipment works longer at its nominal load (higher efficiency).
- Requirements for success :
  - Cities with **highly seasonal weather**.
  - **3rd generation** DHC network.



3

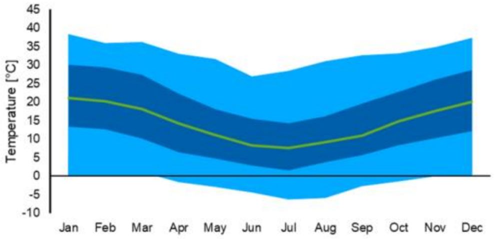
Case Study

3. Case Study : Santiago de Chile

Independencia, a municipality with high potential for district energy

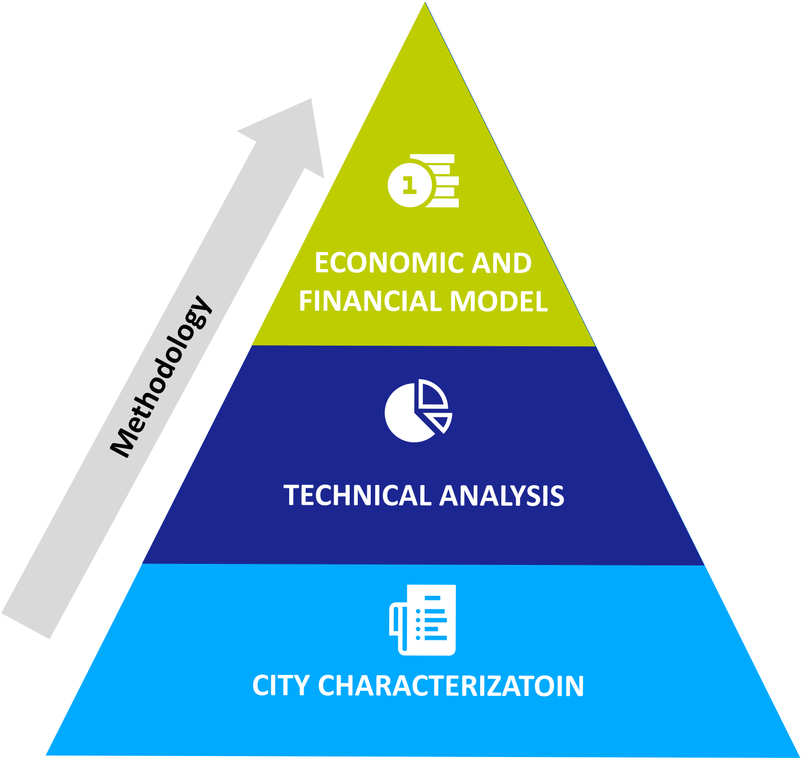
DISTRICT ENERGY IN CITIES INITIATIVE

UN environment programme



38 ºC

- 6 ºC



3. Characterization of the Area

Mix of customers and key clients

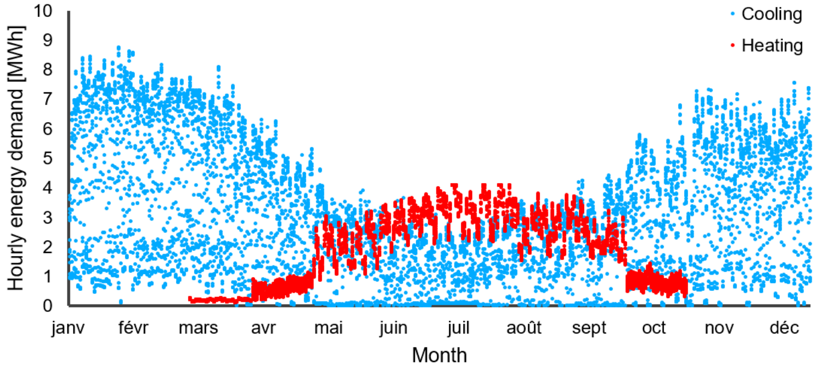
46,400 m²
Residential

26,900 m²
Office

55,000 m²
Commercial

101,400 m²
Education

160,400 m²
Health



4.1 MW
Heating capacity

8.4 GWh
Yearly heat demand

2,721 h
EFLH heating

8.8 MW
Cooling capacity

41 MW
Yearly cooling demand

2,806 h
EFLH cooling

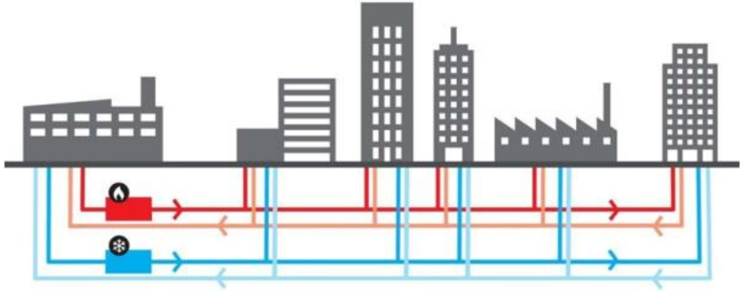
4

Technical and Economic Analysis

4. Technical Economic Analysis

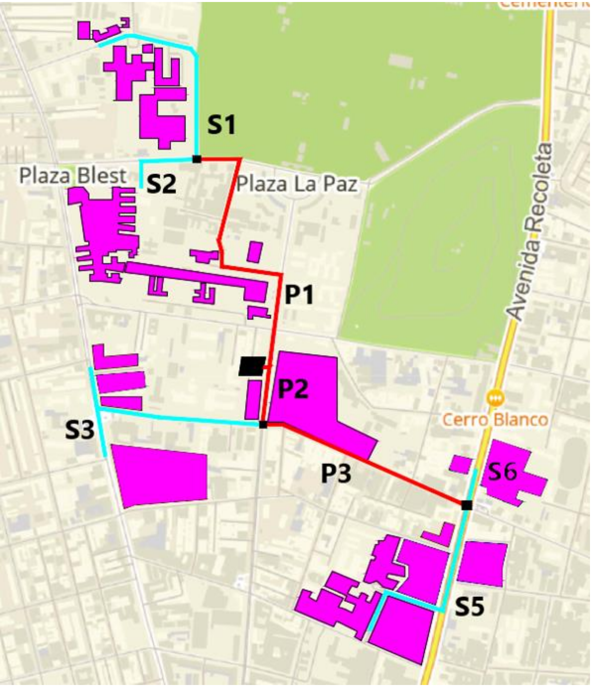
Reversible district energy: alternative independent of the energy sources.

- DHC with heat pumps
- **Reversible** DHC with heat pumps
- DHC with trigeneration
- **Reversible** DHC with trigeneration

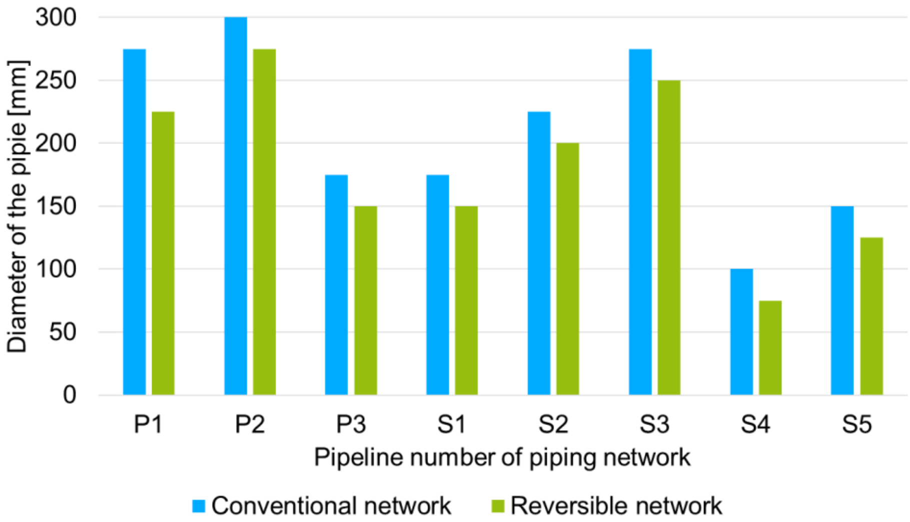


4. Piping Sizing

The piping diameter can be reduced in nearly 20%.



Distribution system layout.

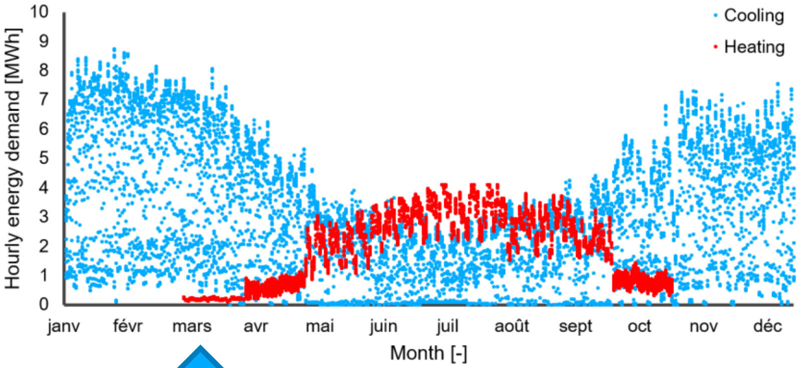


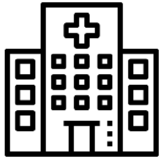
275 [mm] → **225 [mm]**

4. Operation Strategy

Key clients have priority in case of hourly conflict.

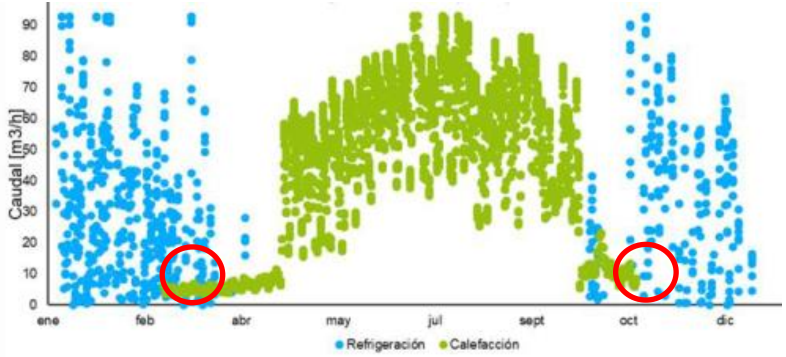
- Hourly conflicts arise when there is a **peak cooling demand** and simultaneous heating demand (transition between summer and autumn).
- To manage peak demand:
  - **Isolated problems** (only one hour of the day)
    → **Thermal inertia** of buildings.
  - **Several hours** in a day
    → Priority to **key clients.**



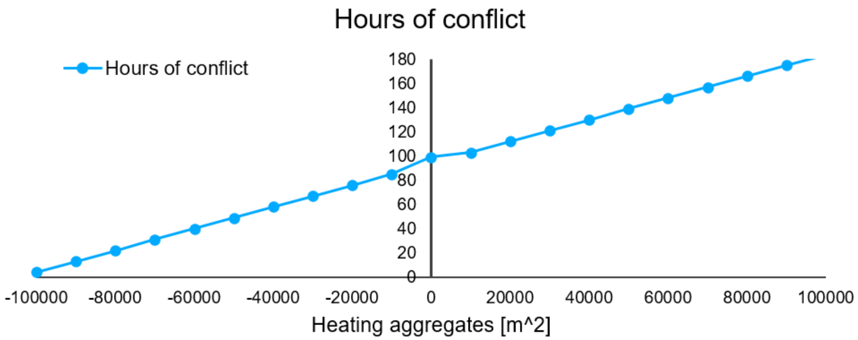


4. Sensitivity Analysis: Conflict Hours

79 hours of conflict where demand is not met have been identified



Heating aggregates [m²]	Peak cooling flow [m³/h]	Peak heating flow [m³/h]	Hours of conflict
-30,000	920	124	70
-20,000	920	131	79
-10,000	920	138	91
0	920	141	79
10,000	920	148	112
20,000	920	152	119
30,000	920	155	123



4. Environmental Perspective

In addition to economic, there are also environmental and logistical benefits

Environmental impact of DHC pipe

This is directly proportional to the diameter of the pipe. A potential reduction is achieved.

Insulation performance improvements

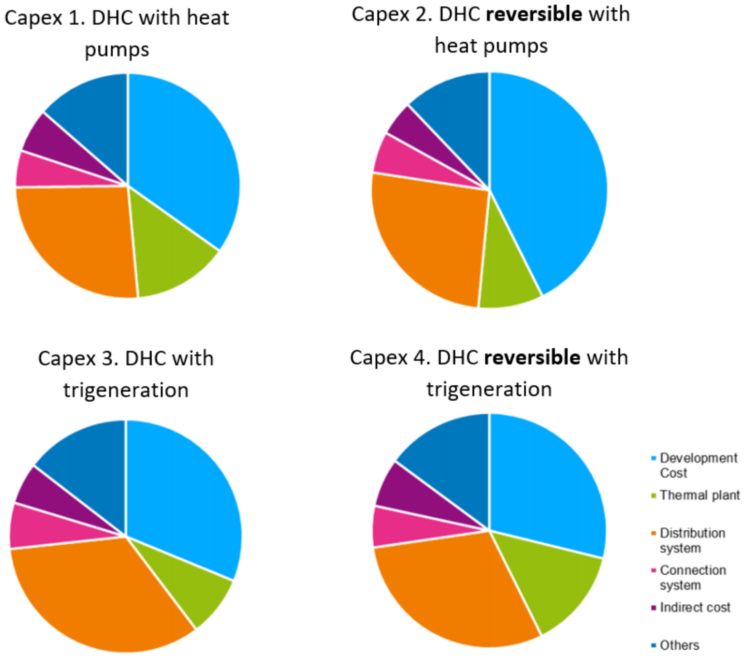
The losses associated with the transfer of heat can be reduced more effectively.

Availability of spaces

In emerging economies such as Chile's, there is uncertainty in the availability of spaces to install the distribution network in cities.

4. T&E Analysis : CAPEX

The distribution system presents **31%** of the total cost.

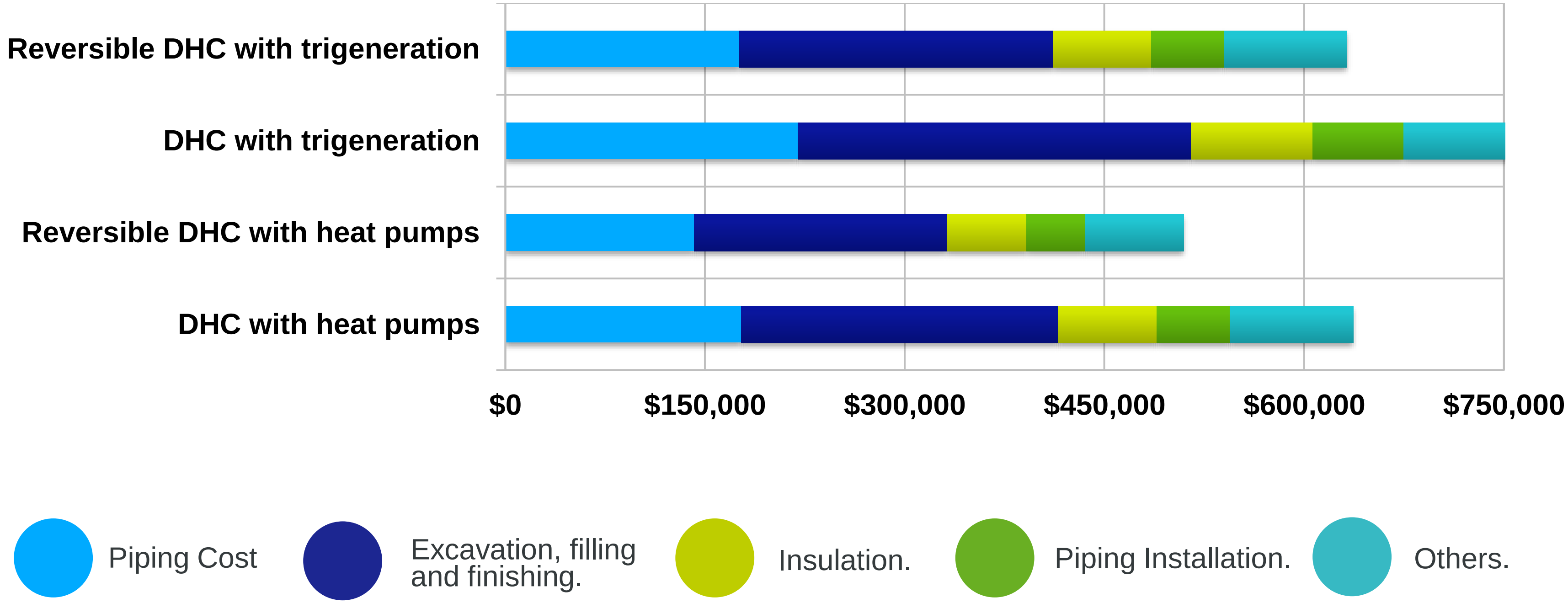


Reducing piping diameter also reduces de cost of :

- Insulating.
- Trench width.
- Trench depth.
- Total section filling.

4. T&E Analysis : CAPEX

Comparison between conventional and reversible cooling distribution systems.



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5
Conclusions and Next Steps

5. Conclusions and Next Steps

An alternative to increase cost effectiveness

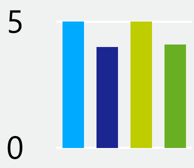
Initial results show that reversible district energy systems can be more **economically efficient** than conventional systems.

This new concept has great potential to increase cost-effectiveness in cities with **highly seasonal weather**.

PIPING DIAMETER

- 20%

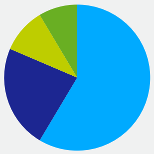
Diameter can be reduced on all layouts in the distribution system.



CAPEX DISTRIBUTION

The distribution system represents a large percentage of the total cost.

31%



COST VARIATION

- 15%

Variation of the total cost of the cooling distribution system.

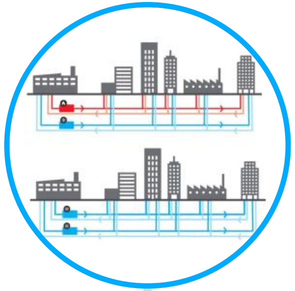
172,000 USD

Cost Savings

4%

Total Cost

5. Conclusions and Next Steps



Since some CAPEX is reduced, for contexts where district energy is yet to be massively deployed, this reduction could enable the implementation of these systems.

Future studies should include the impacts on the ETS.

The concept may be applied for systems with idle distribution systems or systems that require major upgrades.

Other cities with higher weather seasonality may produce improved results.

Reversible piping network in DHC :
An alternative to increase cost effectiveness

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