

Archetype definition for analysing retrofit solutions in urban areas in Europe

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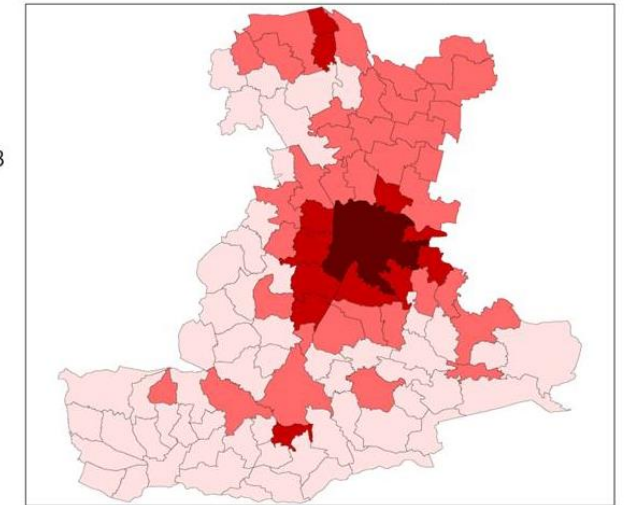
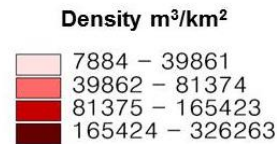
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Session no.: 4J/28.05.2019

Introduction

- Most of the buildings which need to be renovated are in urban areas.
- The H2020 project GEO4CIVHIC aims at destroying the barriers and increasing the market of Ground Source Heat Pumps in the retrofit of buildings in urban environments
- The project focuses on both existing and historical buildings
- It is hence important to define *archetypes* inside urban environments to check better the barriers and how to solve problems in the built environment.
- Beside that it is also important to define which *level of retrofit* can be done (shallow and deep) related to the envelope and/or the HVAC.

Density of residential buildings
in the Province of Padua per municipality

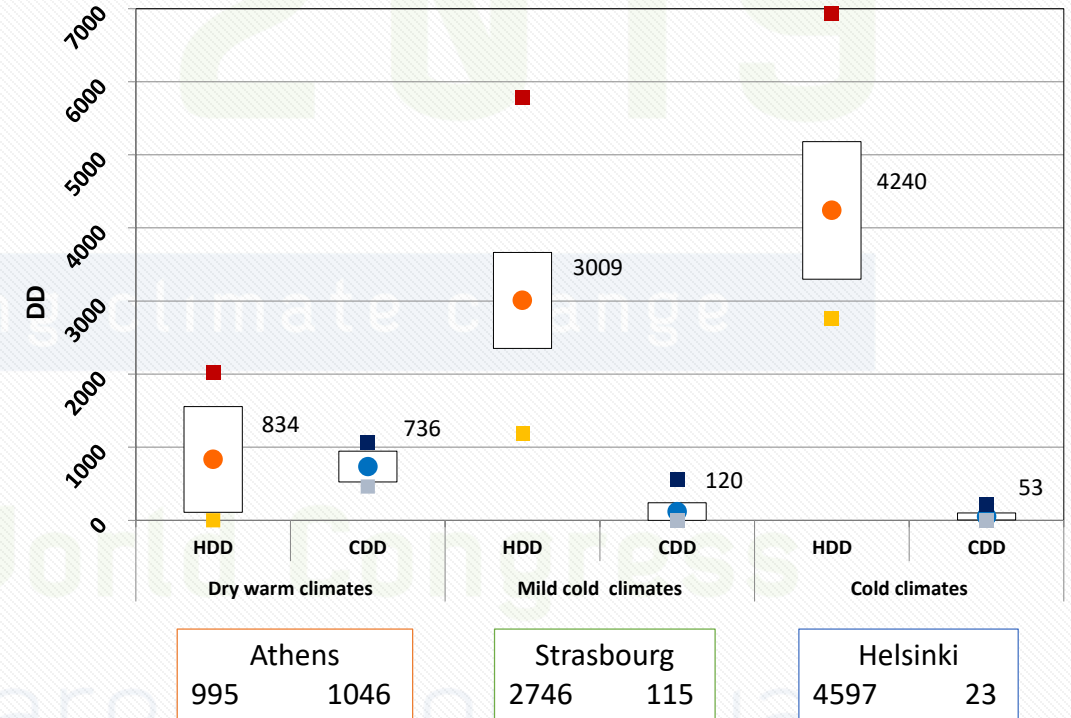


Climate definition

- The climatic conditions have to be chosen to cover *most of the climatic conditions in Europe*.
- A **statistical analysis** has been set up among the weather conditions which are considered for the standardized seasonal efficiency of the heat pumps in the EN 14825 standard, i.e.

Athens (warm climate),
Strasbourg (mild climate),
Helsinki (cold climate).

- The analysis performed has been based on degree-days for heating (**HDD**) and for cooling (**CDD**).



Archetype definition

Analysis of two projects

- COST action TU0901 “Integrating and Harmonizing Sound Insulation Aspects in Sustainable Urban Housing Constructions”
- TABULA-EPISCOPE

Linear buildings

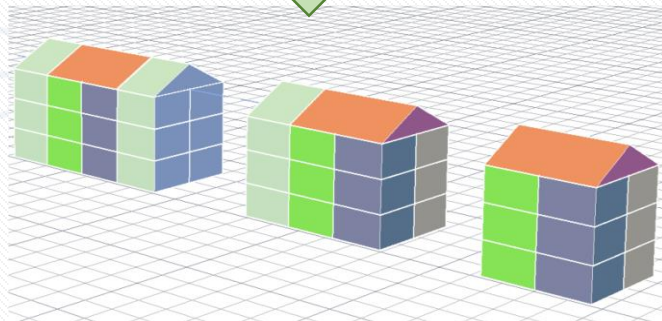


Athens

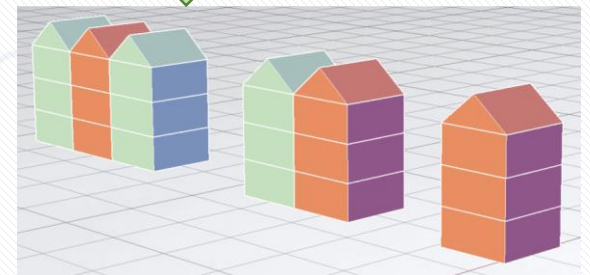
Strasburg

Helsinki

Apartment blocks



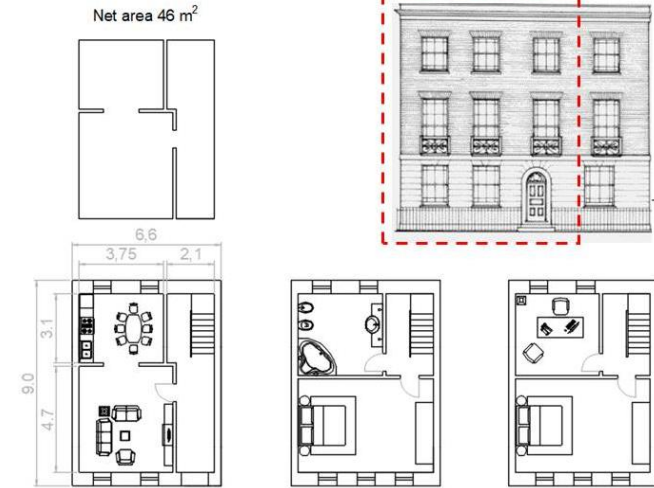
Terraced house



BUILT ENVIRONMENT FACING CLIMATE CHANGE



Characteristics of the archetypes:



Building type		Gross Volume [m ³]	A_{glazed}/A_{floor} [-]	Net Floor Area per user [m ²]
Apartment Block	Existing	5825	0.19	82
	Historical	7125	0.23	82
Terraced House	Existing	500	0.17	138
	Historical	610	0.21	138

Thermal characteristics of the archetypes

Building type	Age	Climate	U _{Roof} [W/m ² K]	U _{Walls} [W/m ² K]	U _{Floor} [W/m ² K]	U _{Windows} [W/m ² K]
Terraced house	existing	warm	1.65	0.89	1.36	3.55
		mild	0.70	1.05	1.01	2.85
		cold	0.29	0.35	0.41	2.35
	historical	warm	2.30	1.75	1.29	4.97
		mild	1.19	1.75	1.38	3.69
		cold	0.54	1.11	0.79	2.72
Apartment block	existing	warm	0.79	0.79	1.15	3.90
		mild	0.82	1.01	0.68	2.93
		cold	0.13	0.22	0.16	1.43
	historical	warm	1.76	1.35	1.07	5.19
		mild	1.80	1.81	0.95	3.41
		cold	0.32	0.59	0.66	2.50

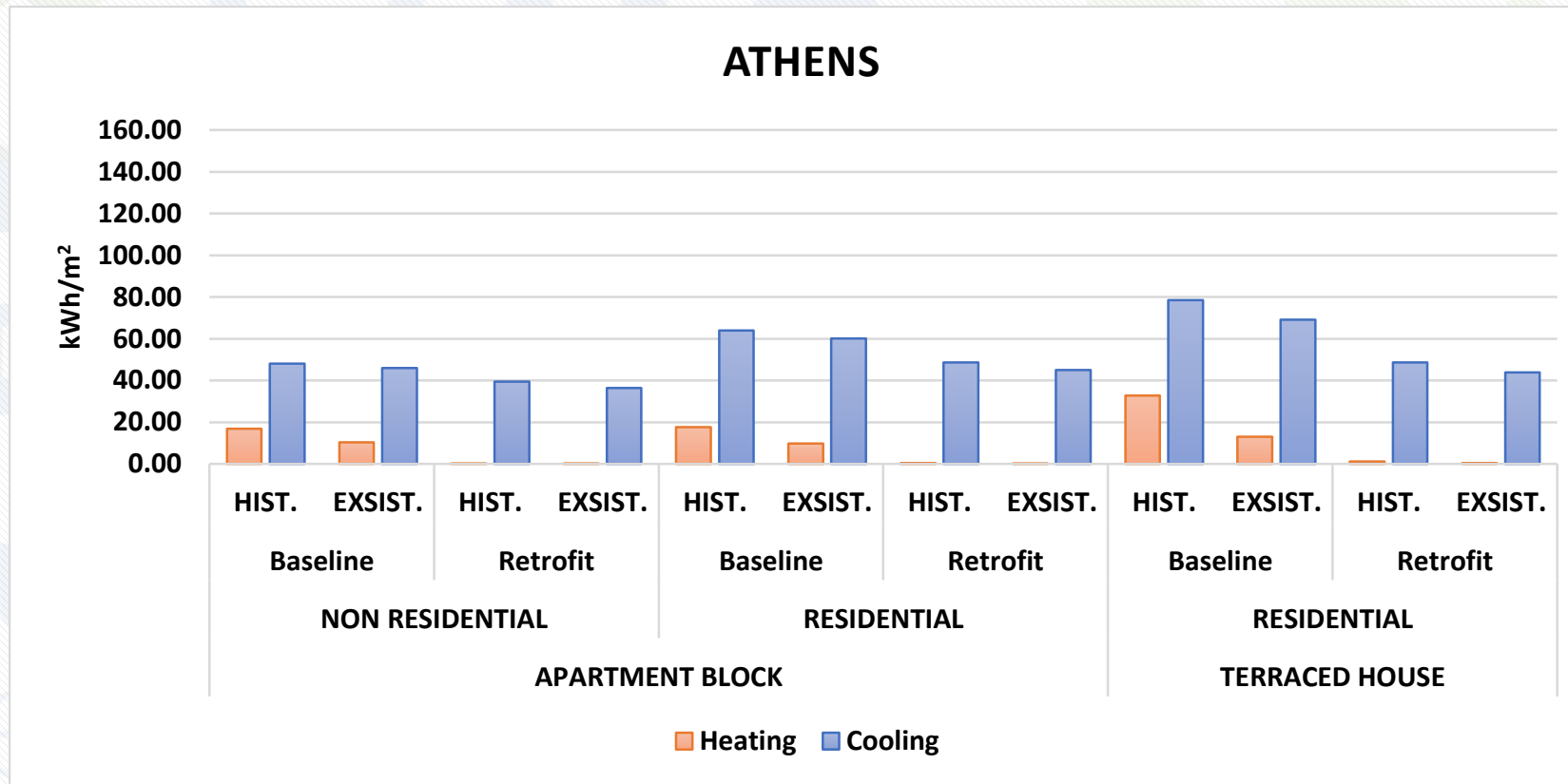
Energy dynamic simulations

	Block apartment / Office building		Single Family terraced house
	Residential building	Office building	
Existing			
Historical			

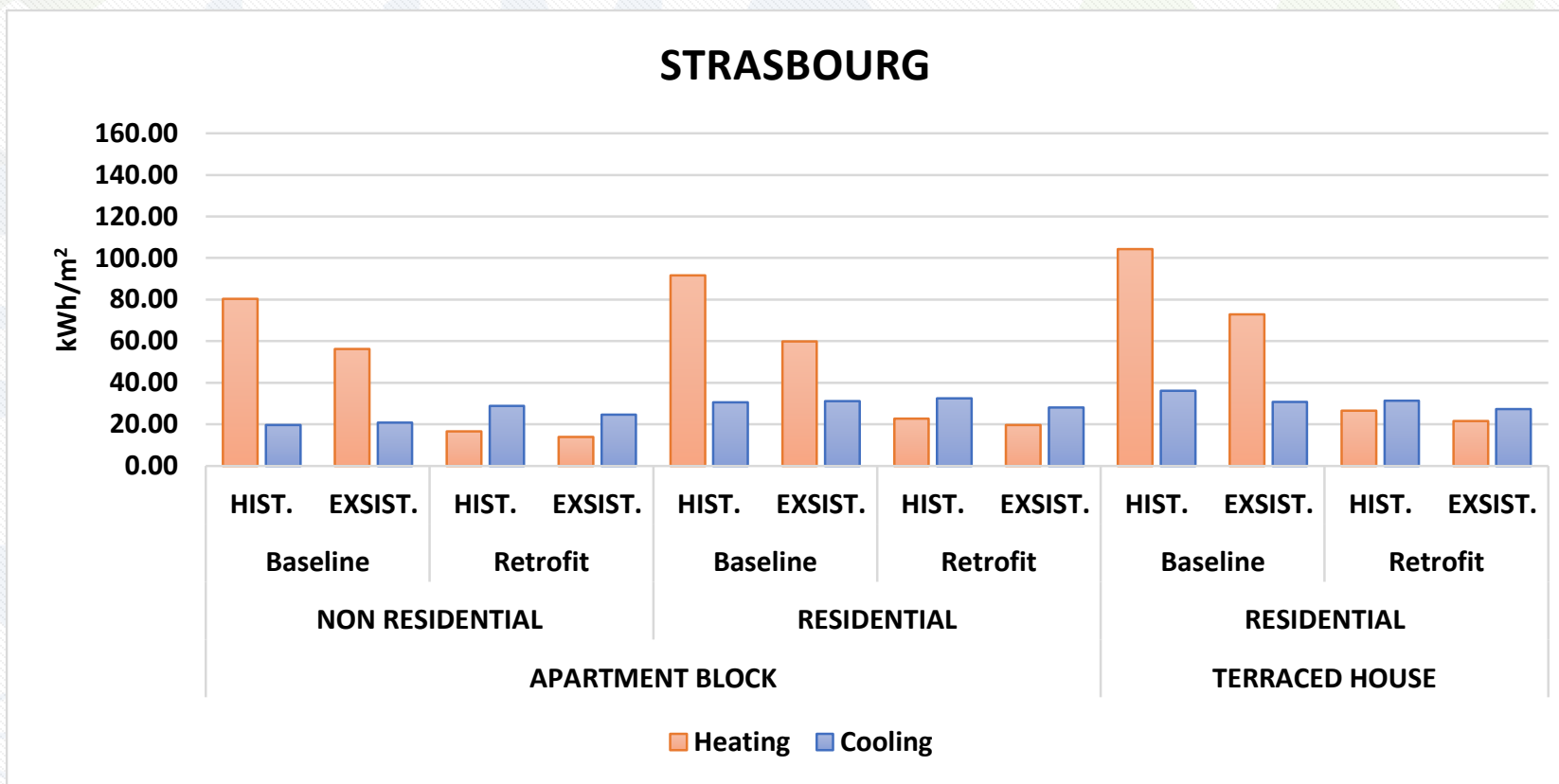
36 building simulations

- 1 block as office building
- 1 apartment block
- 1 single family house
- 2 periods of construction: historical and existing
- 2 insulation levels: original, present requirements
- 3 climatic conditions: Athens, Strasbourg, Helsinki

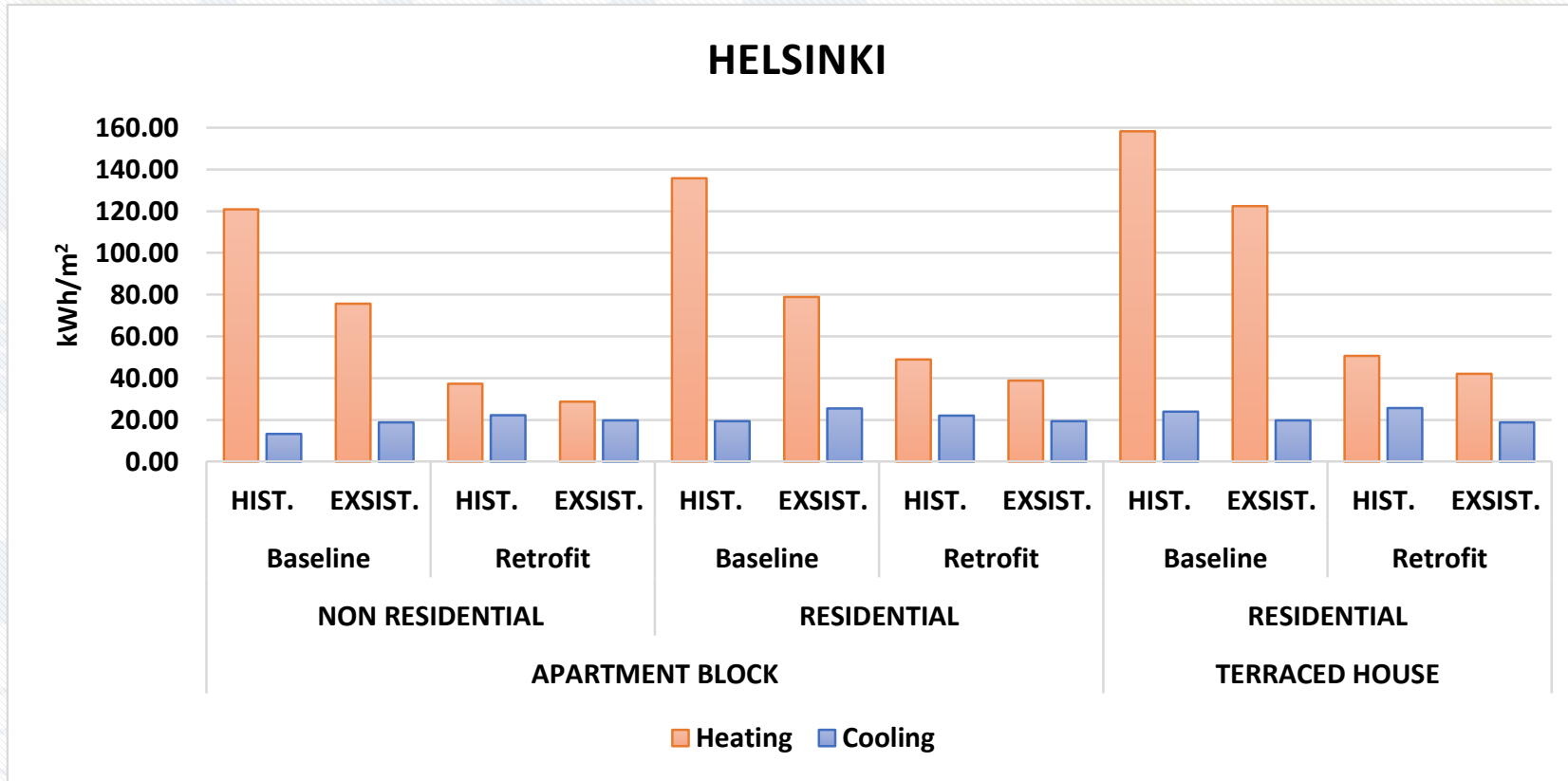
Results in Athens



Results in Strasbourg



Results in Helsinki



Discussion and conclusions

- Linear buildings have been chosen to be **representative of the urban context**: two types
 - a **multi-user building**, named **apartment block** (5 storeys with 4 units per floor) considered as residential and office building
 - a **single-user building**, named **terraced house**, which has been considered just residential.
- Geometry and thermal properties of the envelope are based on TABULA-EPISCOPE database. For the retrofitted solution a survey in the different countries has been considered.
- Three climatic locations have been considered: **Athens (warm climate)**, Strasbourg (mild climate) and **Helsinki (cold climate)**
- Overall **36 dynamic simulations** have been run to determine heating and cooling energy demands as well as the peak power for heating and cooling (including latent loads).
- The **database of energy demands and peak loads** will be used for **sizing the GSHP** in the different archetypes in order to get a **cost-benefit analysis** (work in progress).

End of the presentation

Built environment facing climate change

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