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ADREAM: Energy Consumption Optimization through Dynamic Simulations for the development of a platform of Intelligent Energy Management

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Context and Objectifs

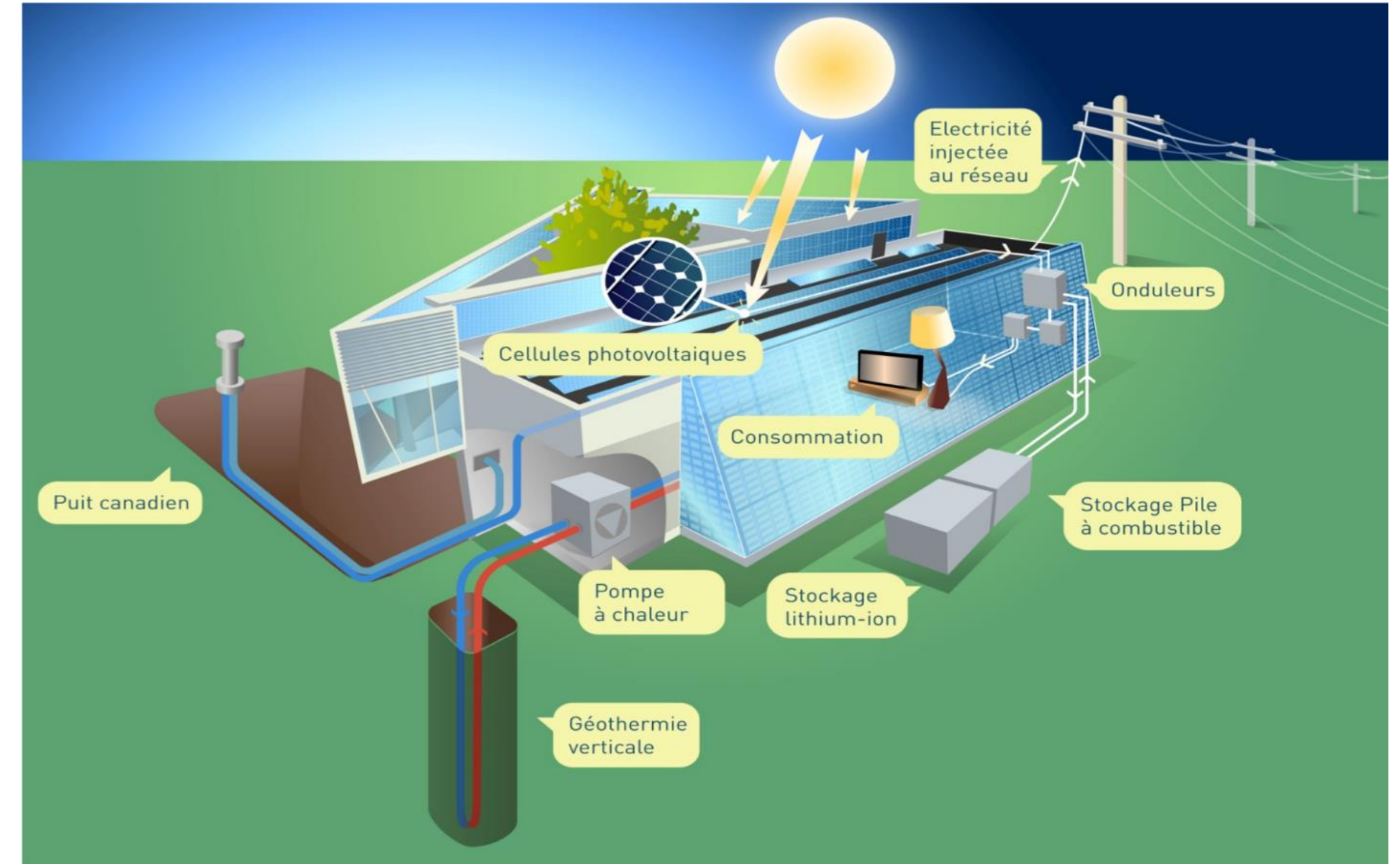
- Energy Optimization Project of the ADREAM Building



→ How can we optimize the ratio Consumption/Production with a focus on HVAC systems?

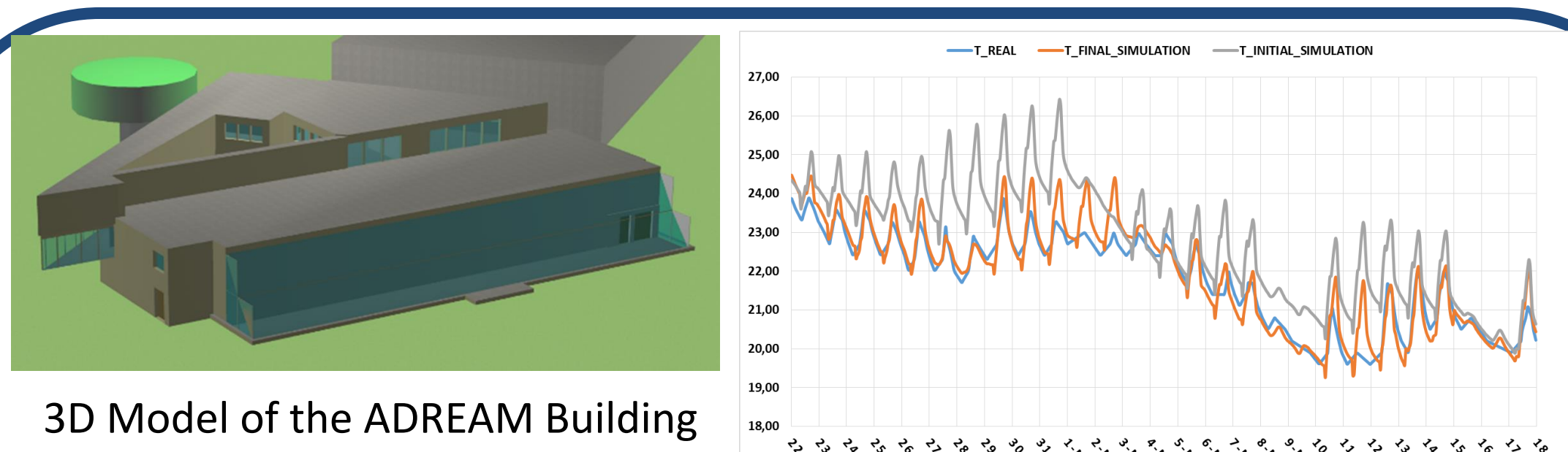
- Development of precise models
 - Identification of inputs and outputs for every modelled element
 - Model calibration with the use of sensors data
 - Prediction of the systems' electrical consumption
 - Optimization of the systems' regulation

ADREAM Building : Energy Systems



Dynamic Energy Simulations

Dynamic Thermal Simulation



Consumption Source	Real Consumptions [MWh/an]	Simulated Consumptions [MWh/an]	Relative Error [%]
Heat Pump 1	9,03	35,41	3,05
Heat Pump 2	16,71		
Heat Pump 3	9,67		
Air Handling Unit	17,79	17,55	1,35
Distribution Pumps	69,64	63,63	8,63
Electronic Equipment	65,77	63,43	3,56
Lighting	12,03	11,89	1,16
TOTAL	200,64	192,88	3,82

Calibration of measured and simulated temperature for an office (RRMSE = 2,84%)

Energy gain through parametric variation: 20% after replacement of distribution pumps

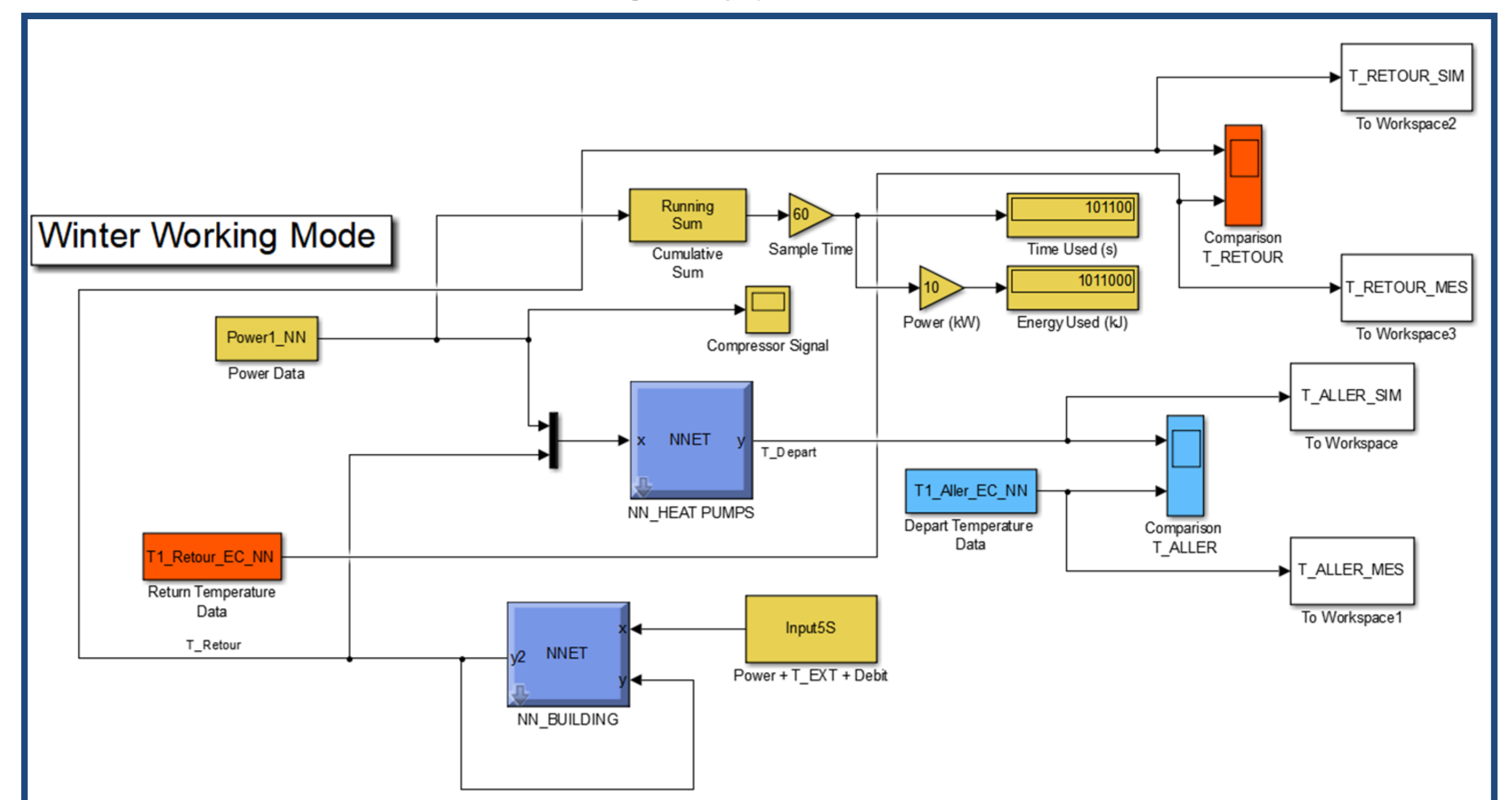
Comparison of the HVAC electrical consumption after the replacement of the pumps

	2014		2017	
	Consommations CVC [MWh]	T° Ext [°C] Min/Moy/Max	Consommations CVC [MWh]	T° Ext [°C] Min/Moy/Max
Fevrier	10,1	5,5/10,52/17,1	9,9	5,6/11,12/16,9
Mars	11,48	6,3/12,73/20,4	9,69	7/12,99/21,7
Avril	9,63	Max 22,6	8,18	7,3/14,69/23
Mai	11,95	10,9/16,71/23,5	8,59	11,3/18,76/29,4
TOTAL	43,16		36,36	
Gain Energétique			15,8%	

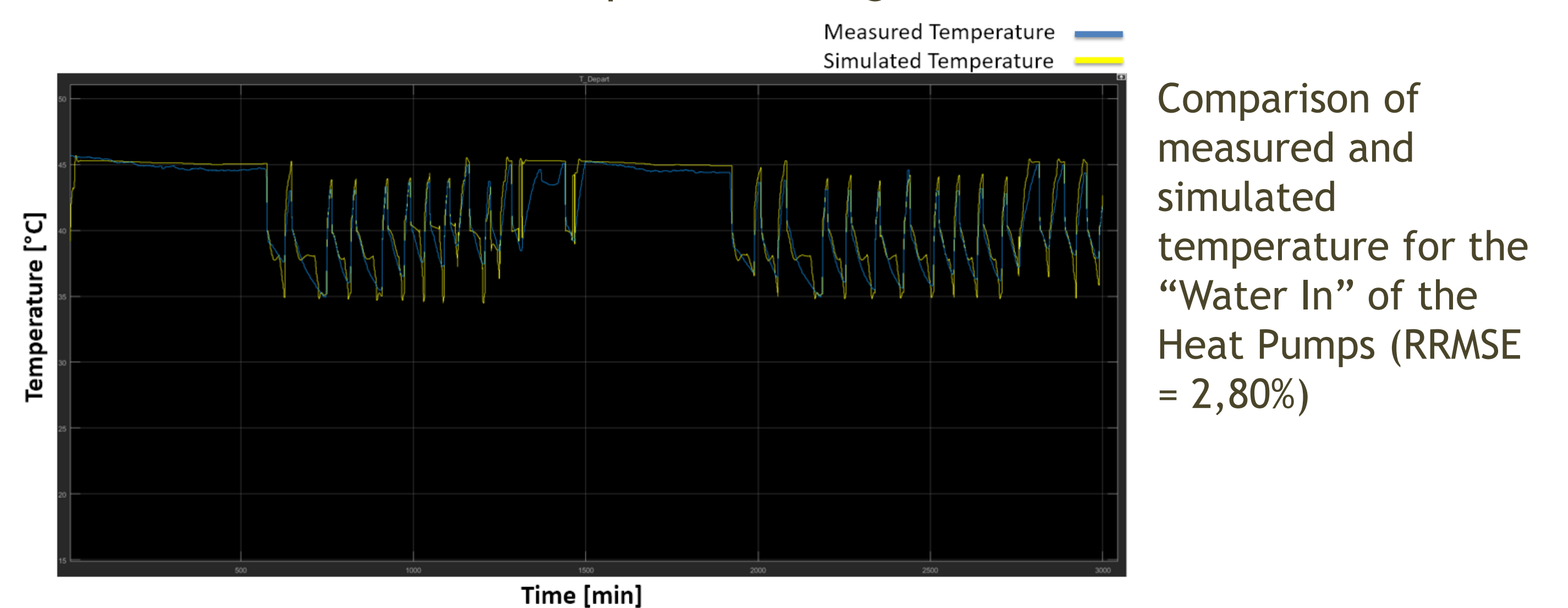
Model Methodologies Tested

- Physical Modeling of the HVAC Systems
- “Black Box” Modeling
- Artificial Neural Networks Modeling
- Hybrid Modeling (Simulink)

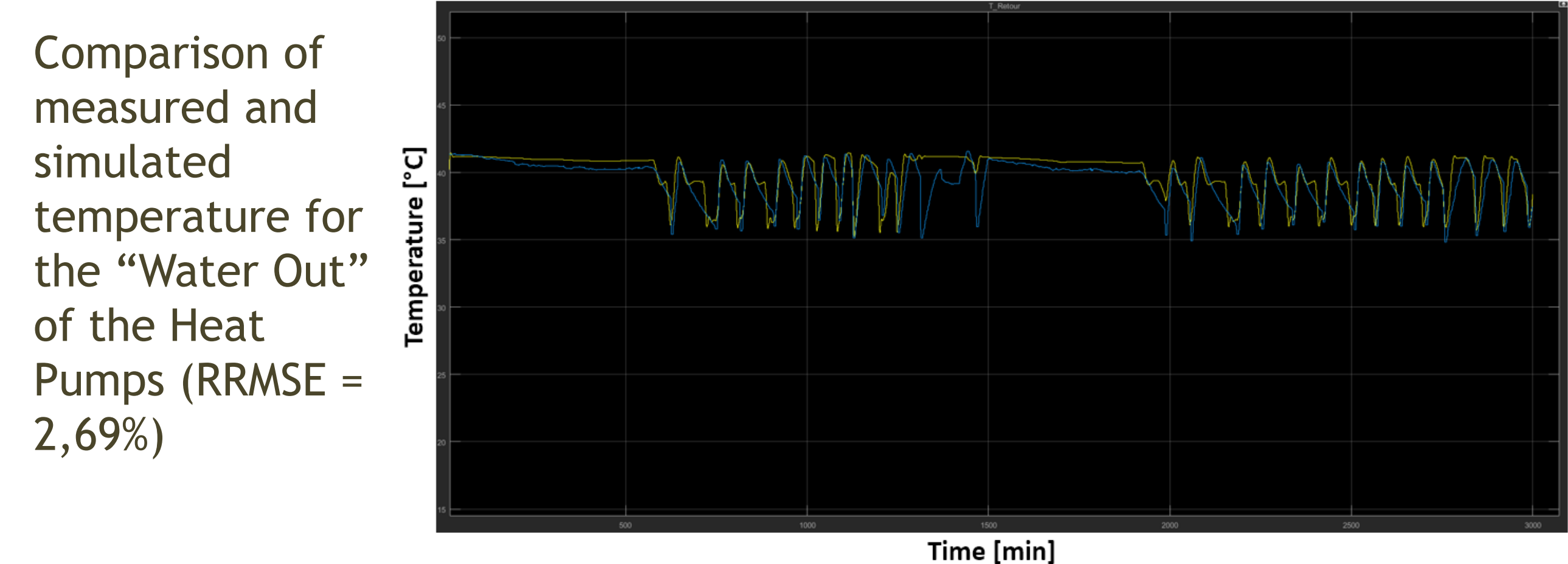
“Heat Pumps + Building” Model in Simulink



Prediction of “Water Out” and “Water In” temperatures of the Heat Pumps on heating mode



Comparison of measured and simulated temperature for the “Water In” of the Heat Pumps (RRMSE = 2,80%)



Comparison of measured and simulated temperature for the “Water Out” of the Heat Pumps (RRMSE = 2,69%)

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