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The Effect of Individual Temperature Set-point Control for Conducting Demand Response in a District Heated Office Building

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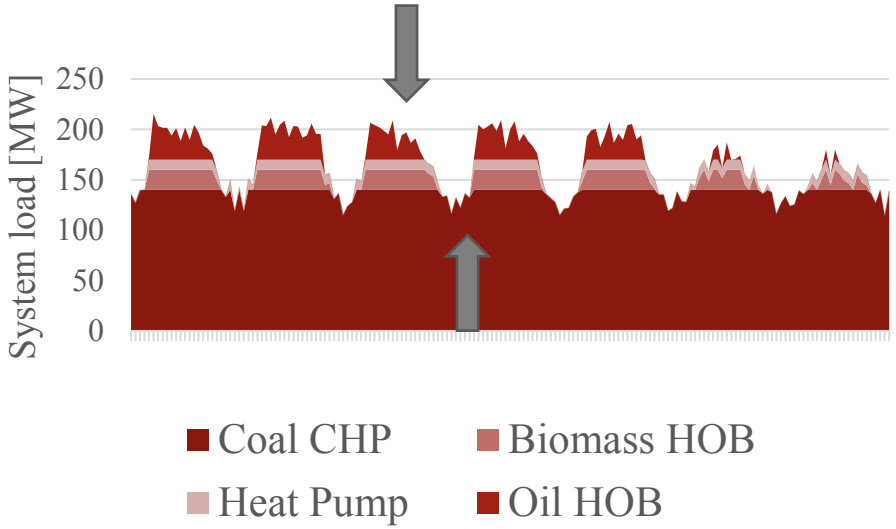
Motivation

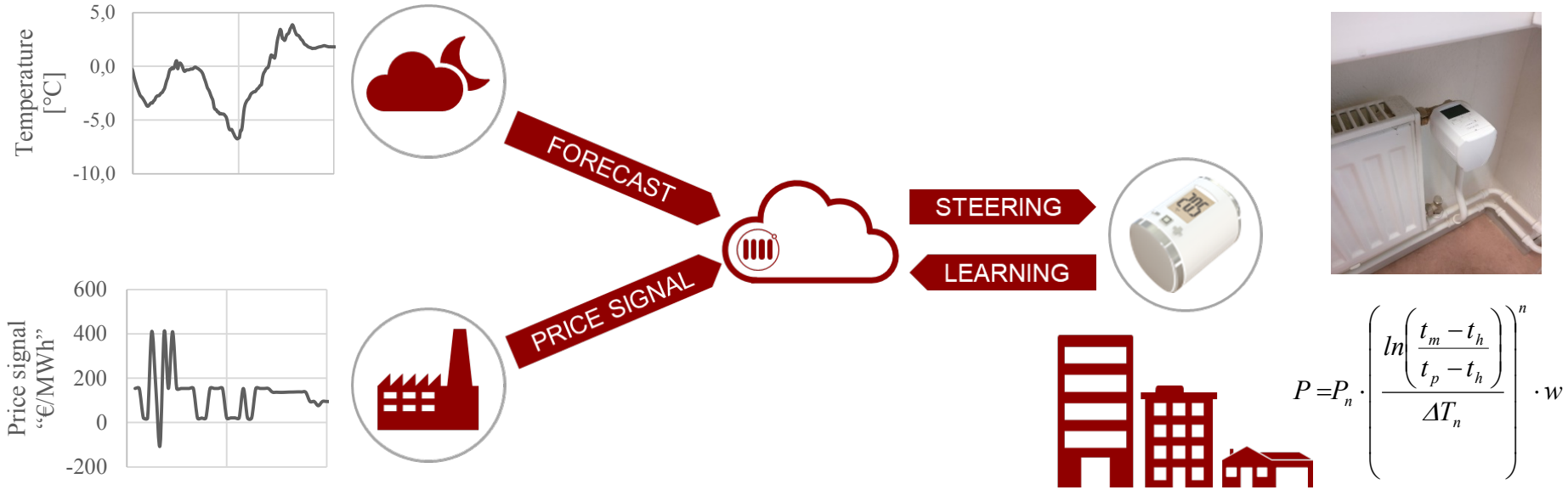
What benefits do room-specific heating demand control enable?

- Intelligent buildings
  - External control
- Peak cutting
- Using RES in thermal grid
- User-centric approach
- REINO research project
  - IoT to Optimize Buildings' Energy Usage

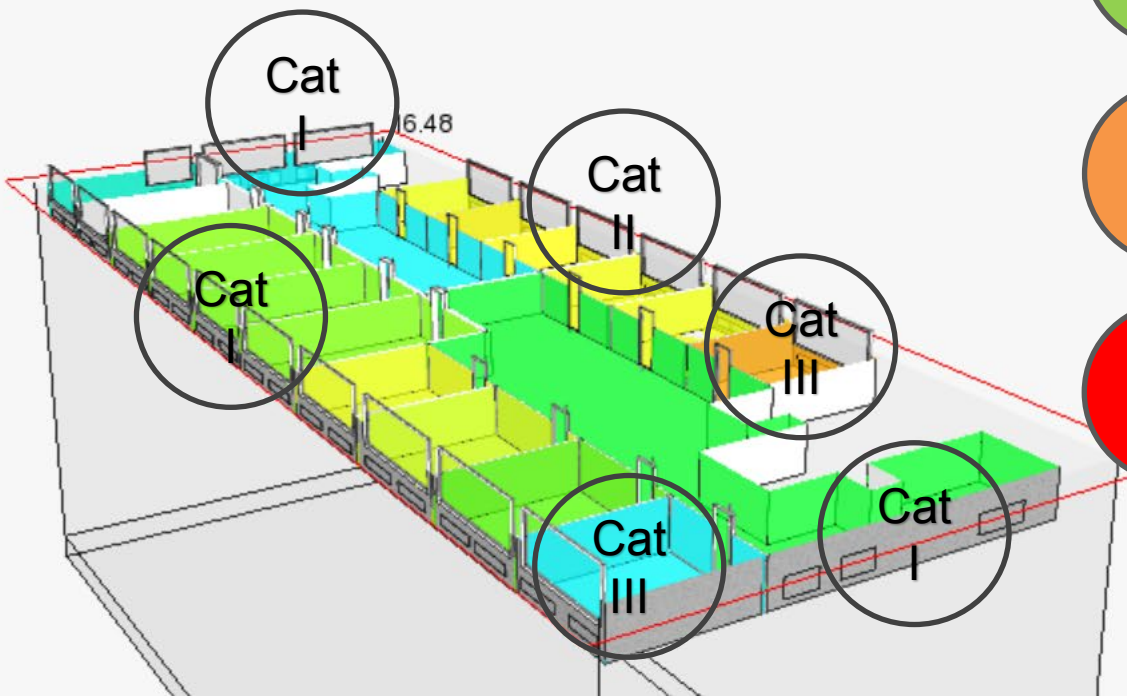


Salo (2016)

Methodology - Ecosystem



Methodology - Algorithms



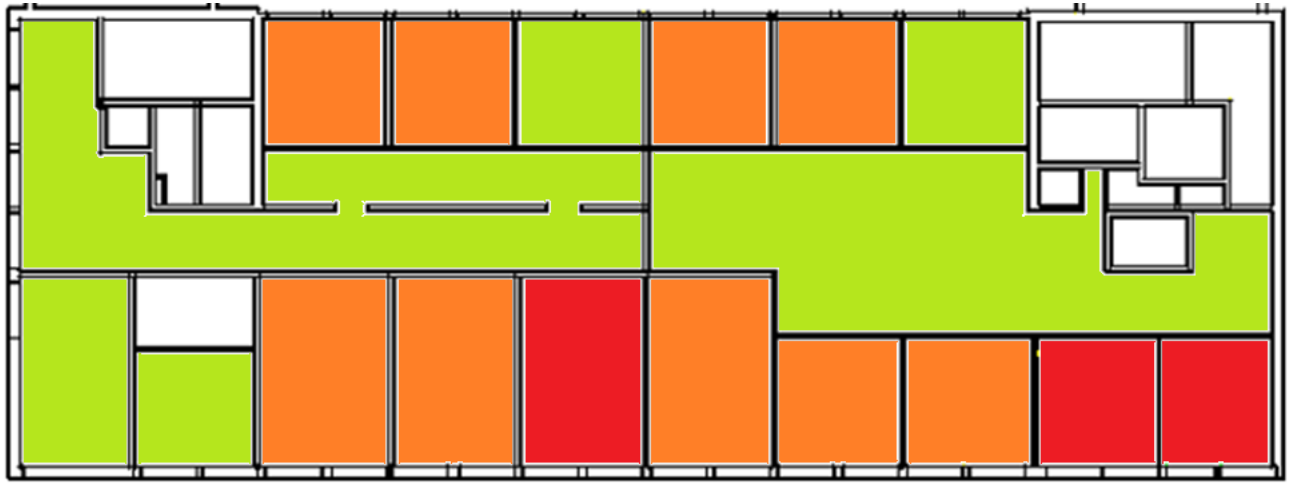
Cat I — Large flexibility → ±2 °C

Cat II — Moderate flexibility → ±1 °C

Cat III — Limited flexibility → ±0.5 °C

Otaniemi3D

Methodology – Test Site

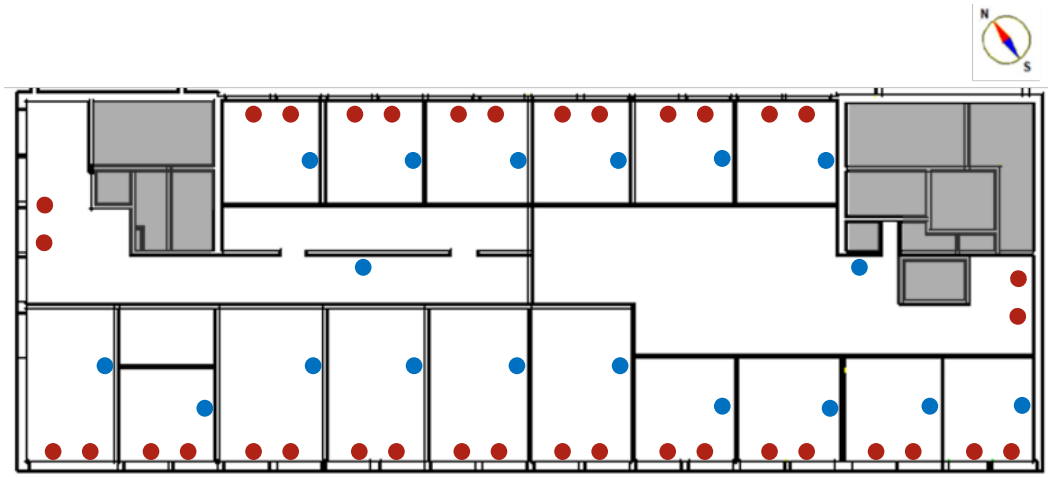


Cat I

Cat II

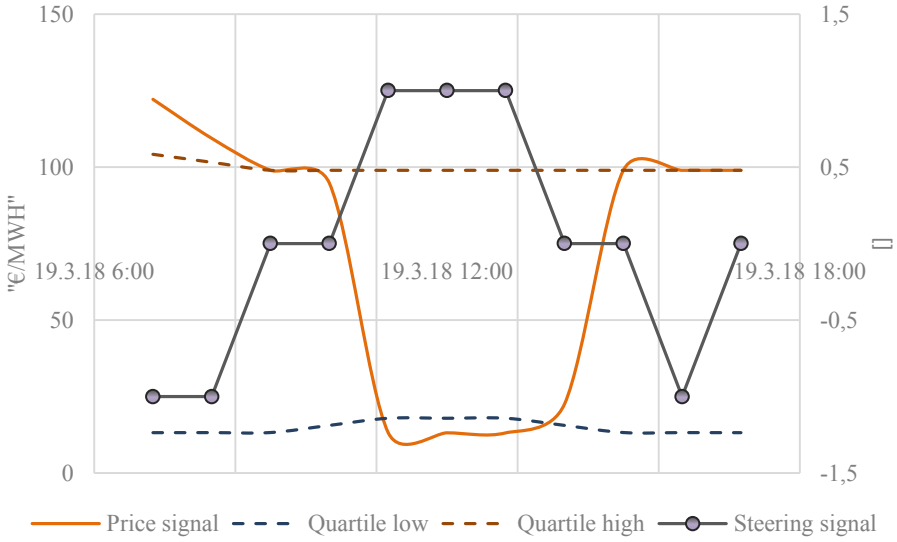
Cat III

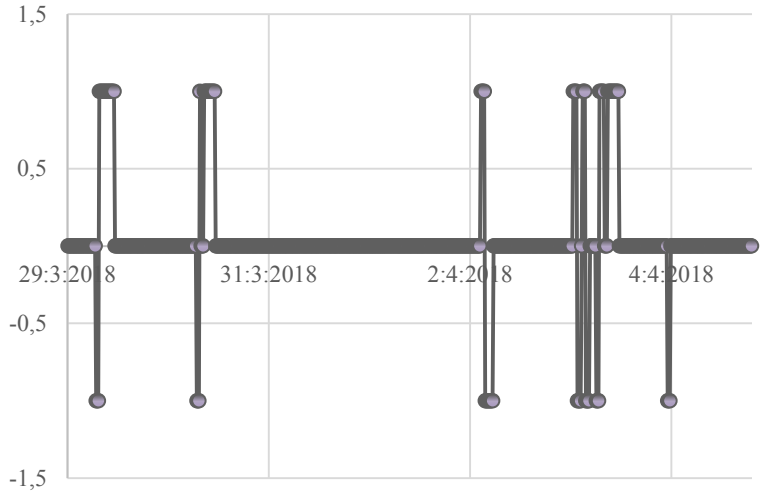
Methodology – Test Site



Results – Steering Signal

- Higher and lower quartile with 12-hour moving average





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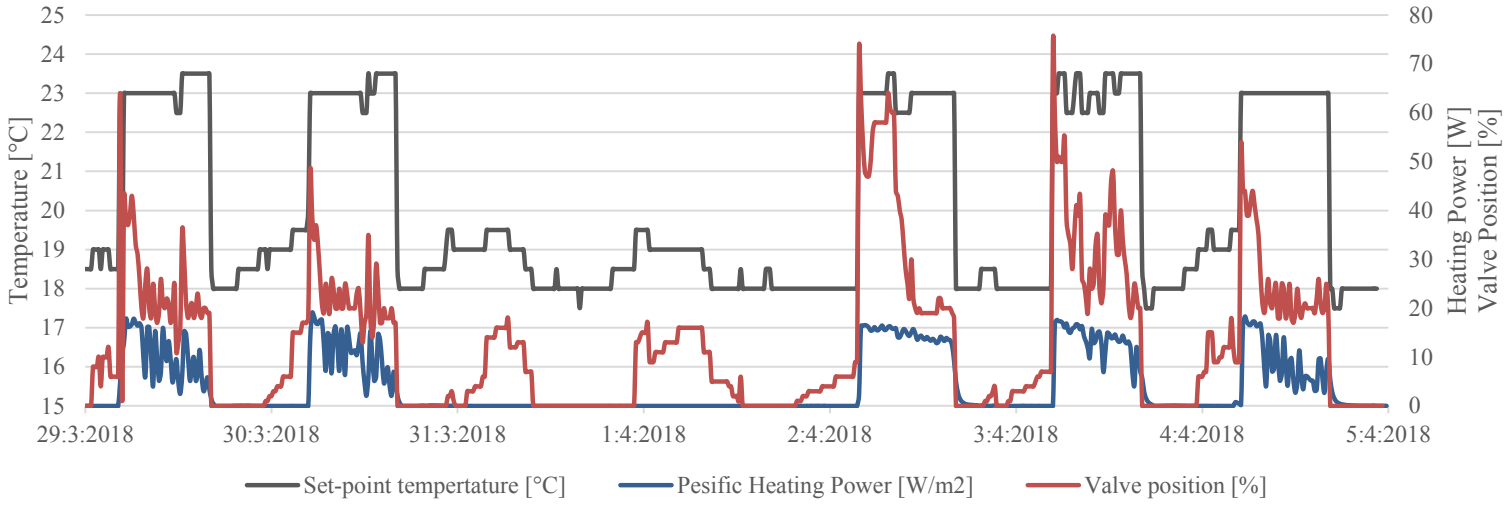
Results – Load Shifting



Category	DR event	Radiator power [W]	Specific heating power [W/m²]	Change in power	Valve opening	Change in valve opening
±0.5	+	186.23	41.37	**99 %**	18.89 %	112 %
	avg	188.76	41.82	**100 %**	16.94 %	100 %
	-	157.85	34.77	**84 %**	15.63 %	92 %
±1	+	279.66	67.39	**127 %**	23.90 %	125 %
	avg	220.95	53.24	**100 %**	19.09 %	100 %
	-	161.27	38.86	**73 %**	12.66 %	66 %
±2	+	331.84	79.96	**204 %**	24.37 %	158 %
	avg	162.46	39.15	**100 %**	15.39 %	100 %
	-	85.92	20.70	**53 %**	0.00 %	0 %
	night drop	11.46			2.35 %	

Cat I

Cat II

Cat III

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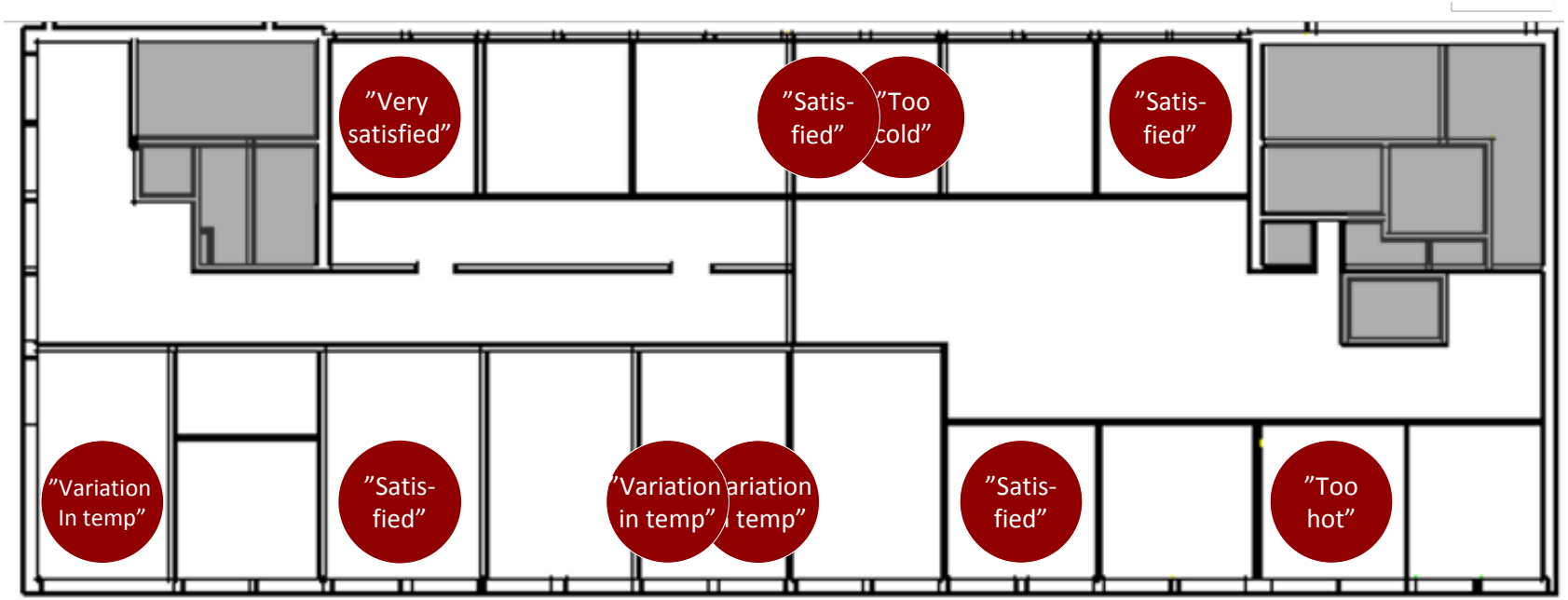
Results – Perceived Temperature



3.4.2018
Note: Not exact places of answers

Discussion and Conclusion

- Individual set-point control for demand response of a district heated office building
- Price signal not comparrable to actual marginal cost
  - Market initiatives not yet defined and dependent on local DH producer
- Indoor air quality sustained according to national classification S2 level (good indoor environment)
- Rule-based method to categorize each room's DR amplitude
- Load could be reduced momentarily
  - Cat I: 16%
  - Cat II: 27%
  - Cat III: 47%

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THANK YOU!

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