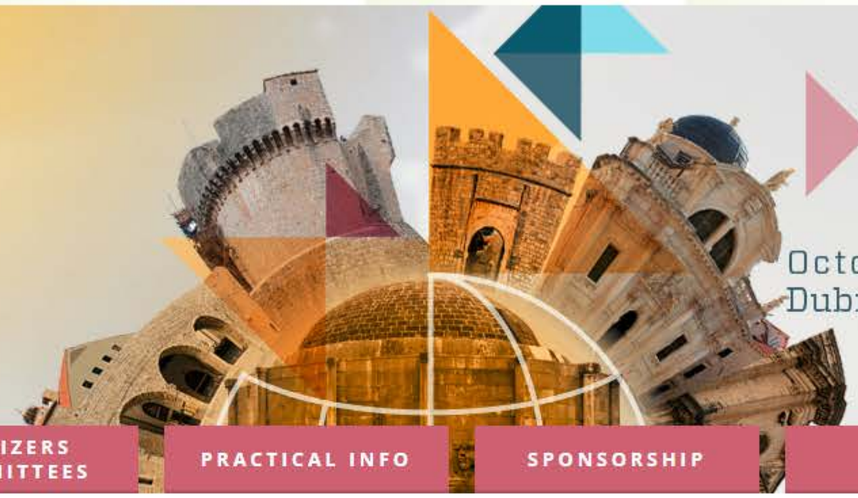
12th sdewes Conference Dubrovnik 2017



October 4-8, 2017
Dubrovnik, Croatia

MEDIA

05.10.2017, Thursday

Opening Session

Modelling P2H – Potentials for Austria

from the project

P2H-Pot: Potentials, Economic assessment and system solutions for Power-to-Heat

Project Duration: September 2014 – October 2017

Presenting: Sara Fritz

Gerhard Totschnig, Richard Büchele, Lukas Kranzl, Andreas Müller, Johannes Nagler

Sdewes 2017, Dubrovnik, 06.10.2017

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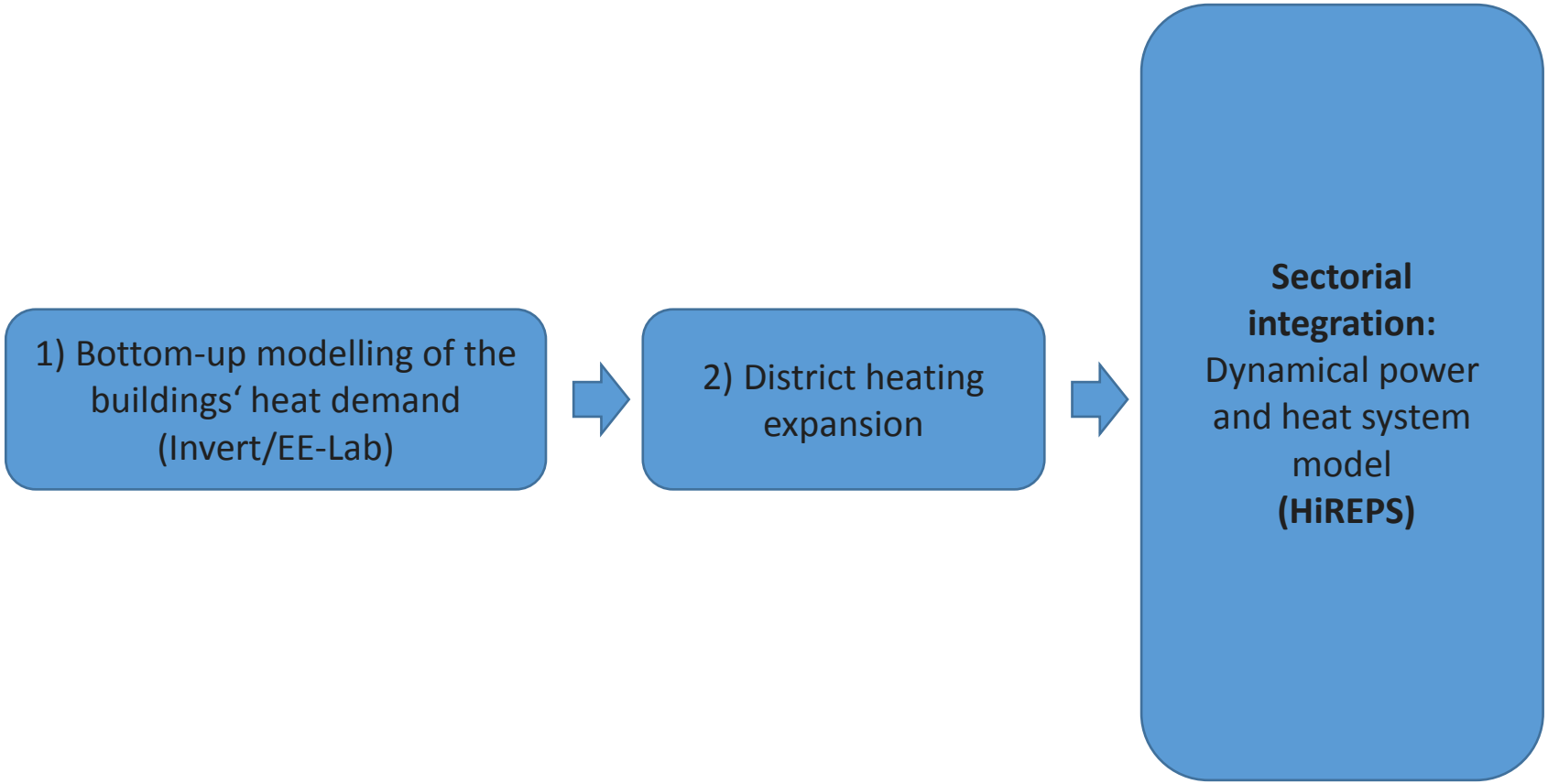
Transitional challenges

- What are the economic viable potentials for renewables resp. P2H in central heat supply?
- What are the barriers to implement P2H technologies in Austria?

Objectives of the project

- Identify **economic potentials** for heat pumps with **different heat sources and system configurations** in **existing** Austrian **district heating networks** until 2050
  - Take into account the spatial and energetic characteristics of each area
  - Detailed analysis of the district heating potential per region
  - Focus on the sectorial integration of the electricity and heating sector

Integrated modelling approach



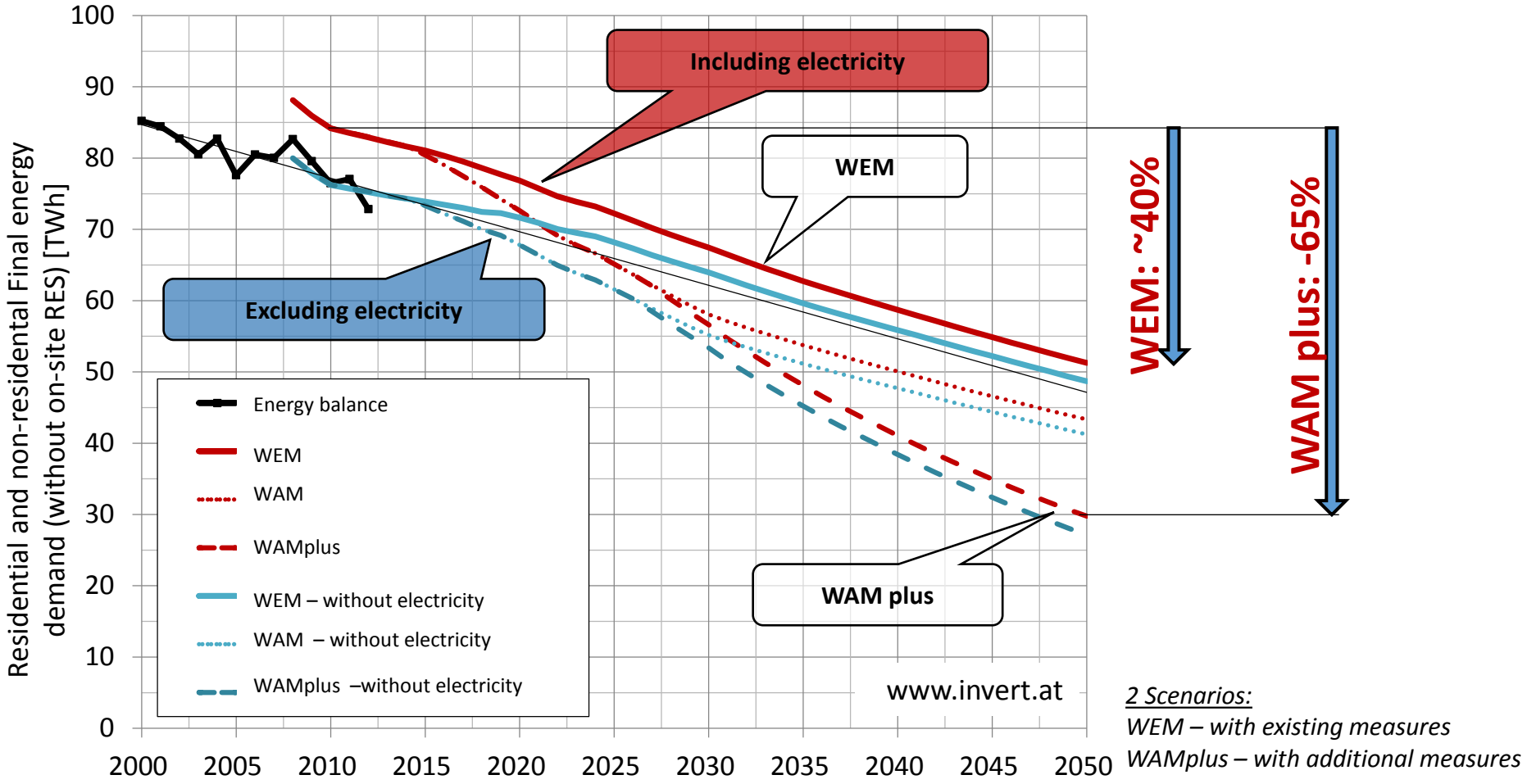
Characterisation of district heating areas

- Clustering of the 11 district heating types in Austria regarding
  - Heat density
  - District heat demand
  - Share in total heat demand
  - Existing supply infrastructure
    - Incineration plant
    - Excess heat
    - CCGT / heat plant
    - Biomass CHP
    - Biomass heat plant
  - Potential for
    - Industrial excess heat
    - Geothermal
    - Heat pumps

	Description	number of cities	Heat density [GWh/ km²]	district heating demand [MWh]
Type 1	CCGT, Biomass CHP, waste incineration, geothermal, river, excess heat potential	1	58	5,870,000
Type 2	waste incineration, CCGT, biomass CHP, excess heat, river, excess heat potential	1	30	1,160,000
Type 3	excess heat, CCGT, excess heat potential, river	2	28	1,780,000
Type 4	incineration plant, heat plant, river	2	23	460,000
Type 5	excess heat, river	8	26	420,000
Type 6	biomass CHP, river/lake	4	27	740,000
Type 7	geothermal otential and biomass plant	4	25	160,000
Type 8	biomass CHP >10MWth	ca 25	20	1,000,000
Type 9	biomass CHP <10MWth	ca 40	15	600,000
Type 10	biomass plant >2 MWth	150-200	10	1,600,000
Type 11	biomass plant <2MWth	1000-1800	10	1,100,000

1) Development of buildings heat demand in Austria up to 2050

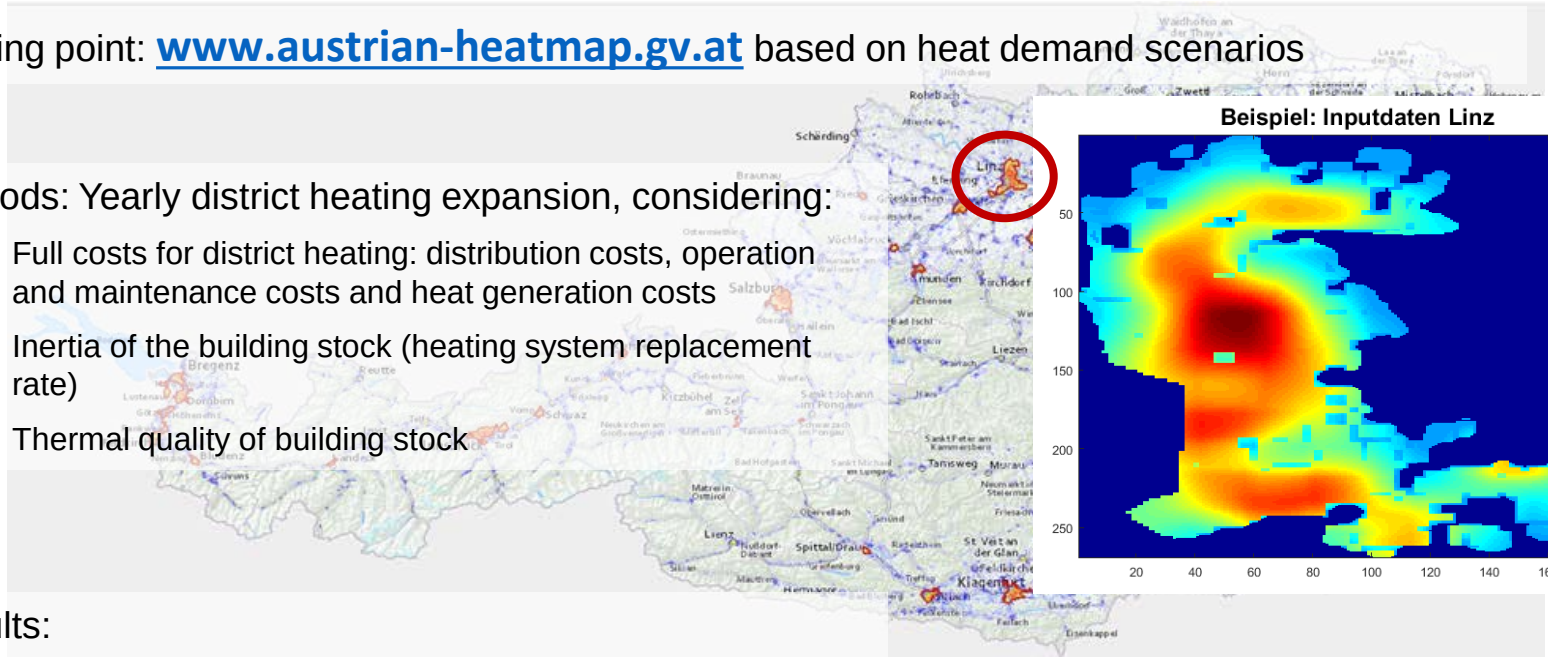
- Methods: Application of bottom-up building stock model Invert/EE-Lab for 2 scenarios



Source: Energieszenarien bis 2050: Wärmebedarf der Kleinverbraucher. Erstellung von energiewirtschaftlichen Inputparametern und Szenarien zur Erfüllung der Berichtspflichten des Monitoring Mechanisms. Wien. 2015.

2) District heating expansion

- Starting point: **www.austrian-heatmap.gv.at** based on heat demand scenarios



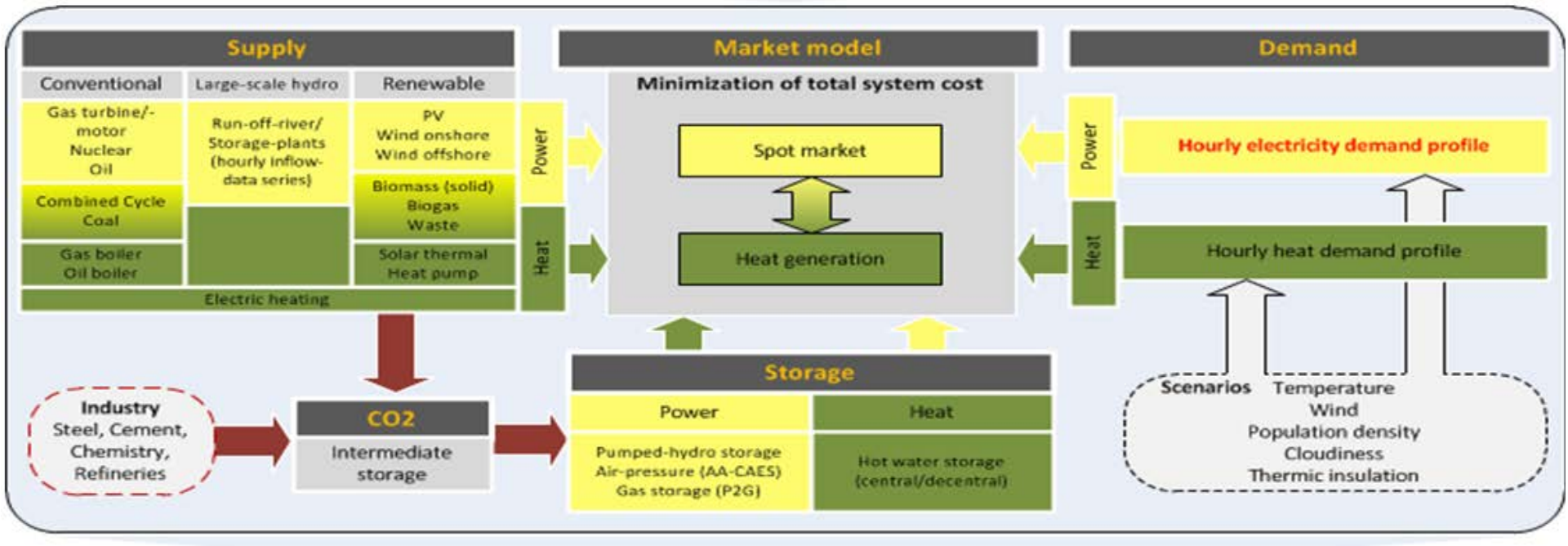
- Methods: Yearly district heating expansion, considering:
  - Full costs for district heating: distribution costs, operation and maintenance costs and heat generation costs
  - Inertia of the building stock (heating system replacement rate)
  - Thermal quality of building stock

- Results:

Regions and district heating demand [GWh]	WEM-Scenario				WAMplus-Scenario		
	2015	2020	2030	2050	2020	2030	2050
Wien	6,064	7,351	9,898	8,128	7,012	8,594	5,303
Linz	1,209	1,357	1,225	935	1,197	924	526
Graz	1,108	1,303	1,477	1,164	1,234	1,243	741
Salzburg	746	864	944	718	818	808	460
Kirchdorf an der Krems	46	44	39	30	55	41	24
Braunau am Inn	53	64	78	63	64	58	36
District heating remaining regions	9,492	10,217	11,092	8,639	10,196	10,038	6,350
Total district heating demand Austria [GWh]	18,718	21,200	24,753	19,677	20,576	21,707	13,440
Total heat demand Austria [GWh]	99,605	95,643	83,359	65,856	92,935	71,434	42,363
Share of district heating in total demand [%]	19%	22%	30%	30%	22%	30%	32%

HiREPS: Dynamic power and heat system model

- Hourly optimization of costs and simulation of
  - Hydropowerplants
  - Thermal powerplants (incl. CHP)
  - Wind and solar
  - Heat supply
    - District heating and decentral heat supply
  - Storages



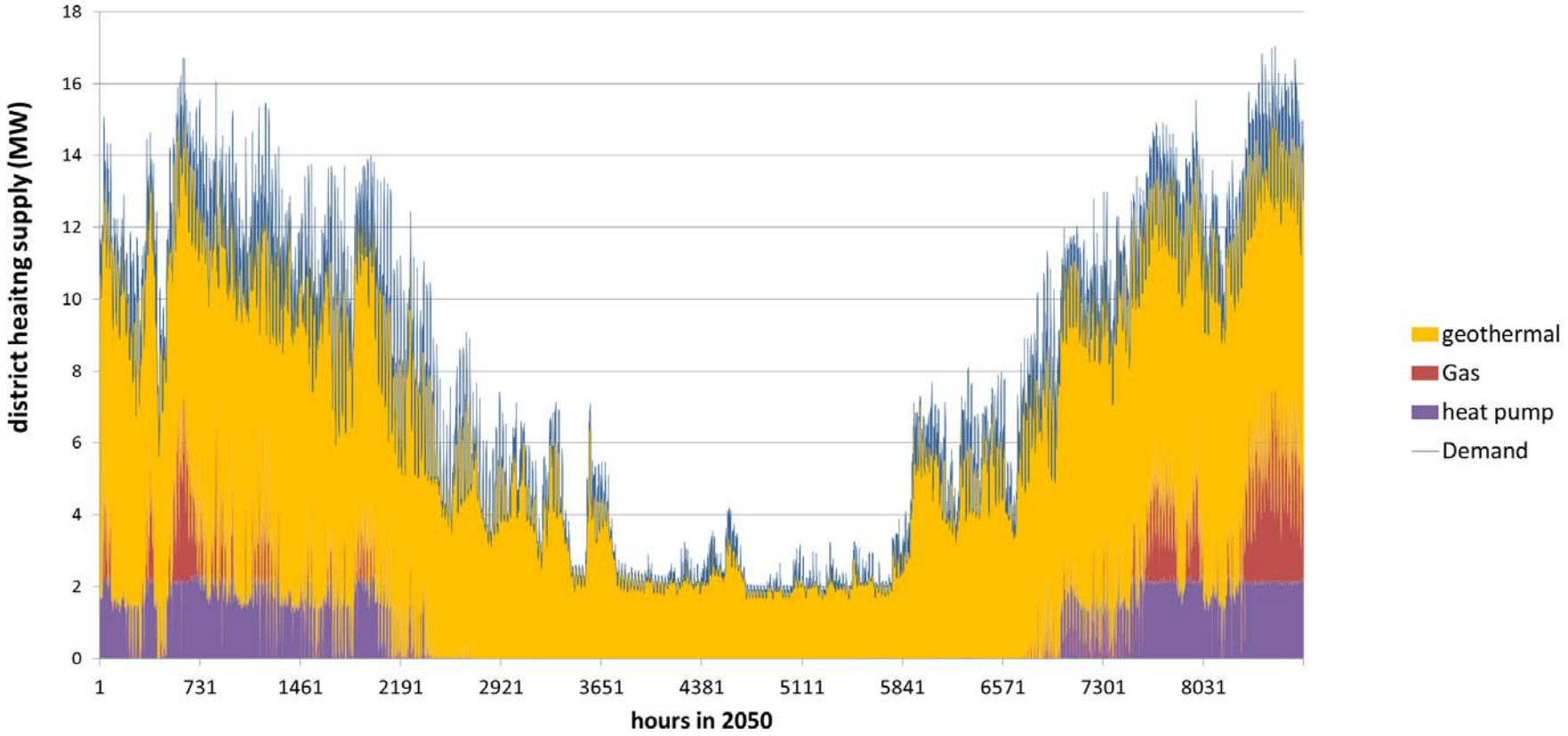
Overview

- Assumptions:
  - Scenario – WEM – with existing measures
  - No investment costs for existing technologies
  - -84 % CO_2 reduction for Germany and Austria
    - Requires ~ 200 €/tCO_2
- Two variants of regulatory framework:
  - with taxes on electricity and gas
  - without taxes
- Three configurations, differ regarding existing technologies:
  - Geothermal energy at 80°C and gas is available
  - Biomass CHP is available
  - CCGT, biomass CHP and excess heat is available

Type 7: Geothermal and gas available

Assumptions:

- Taxes on electricity and gas

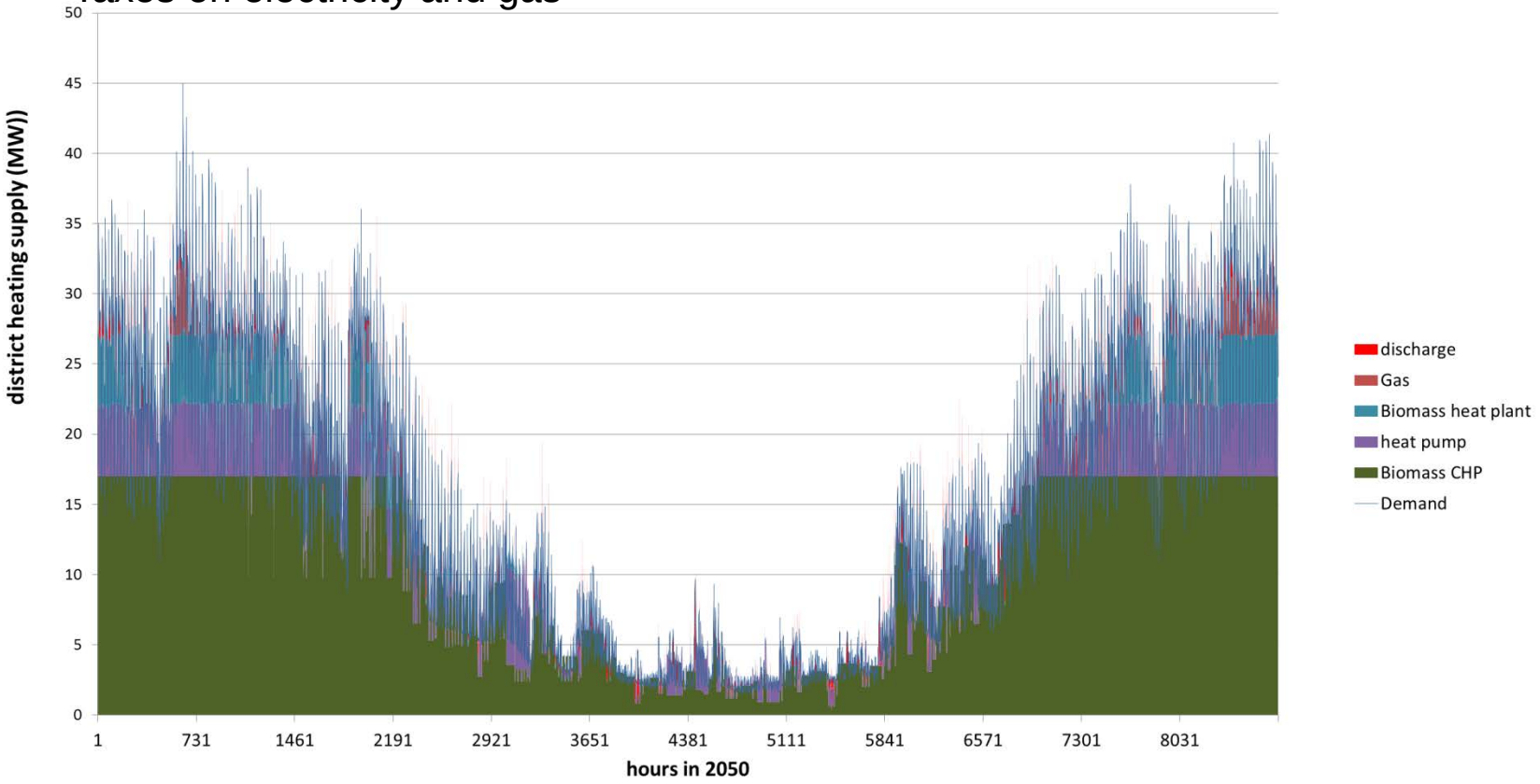


- P2H-Potential (heat pump) = 10 % of the annual district heating demand

Type 6: Biomass CHP available

Assumptions:

- Taxes on electricity and gas

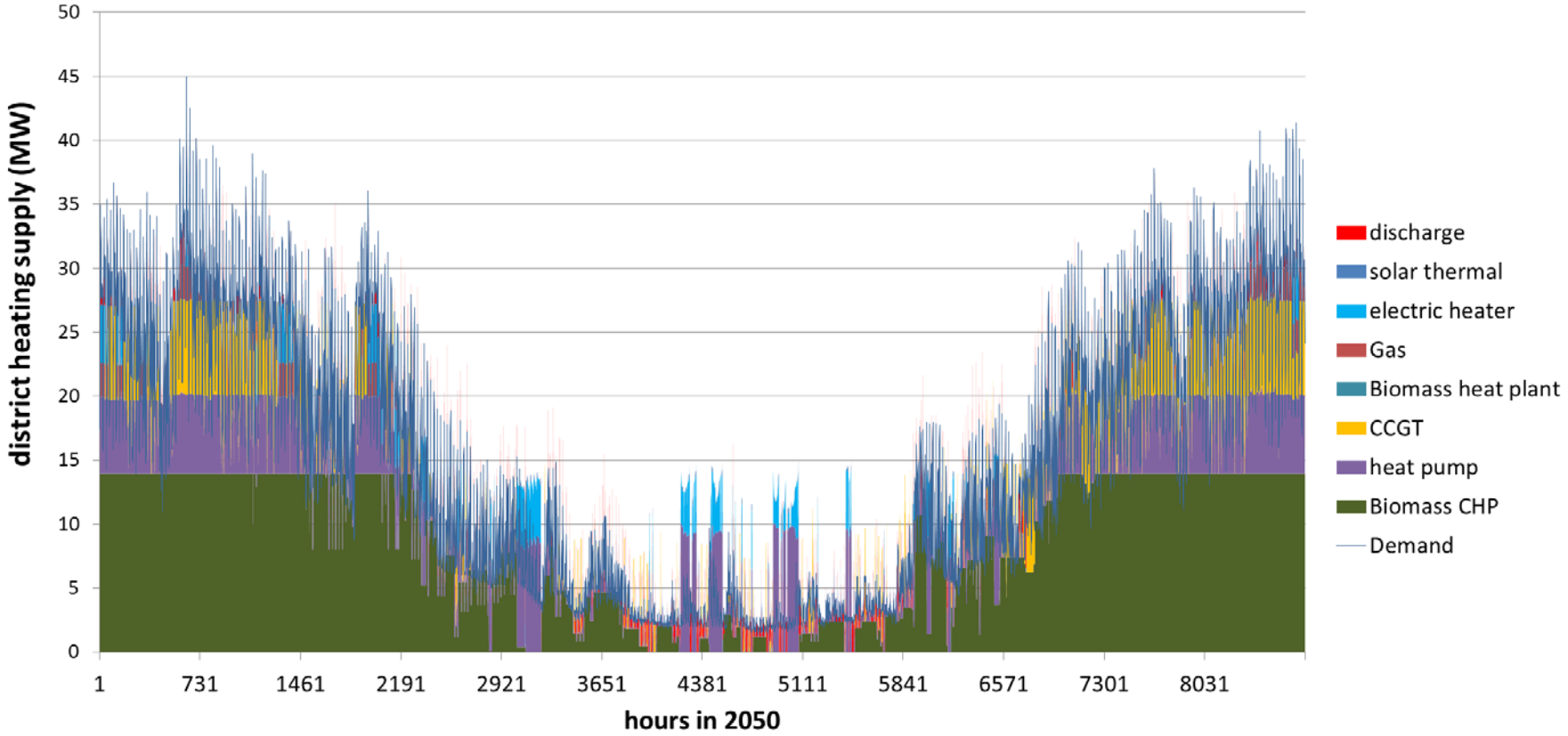


- P2H-Potential = 17 % of the annual district heating demand

Type 6: Biomass CHP available

Assumptions:

- NO Taxes on electricity and gas



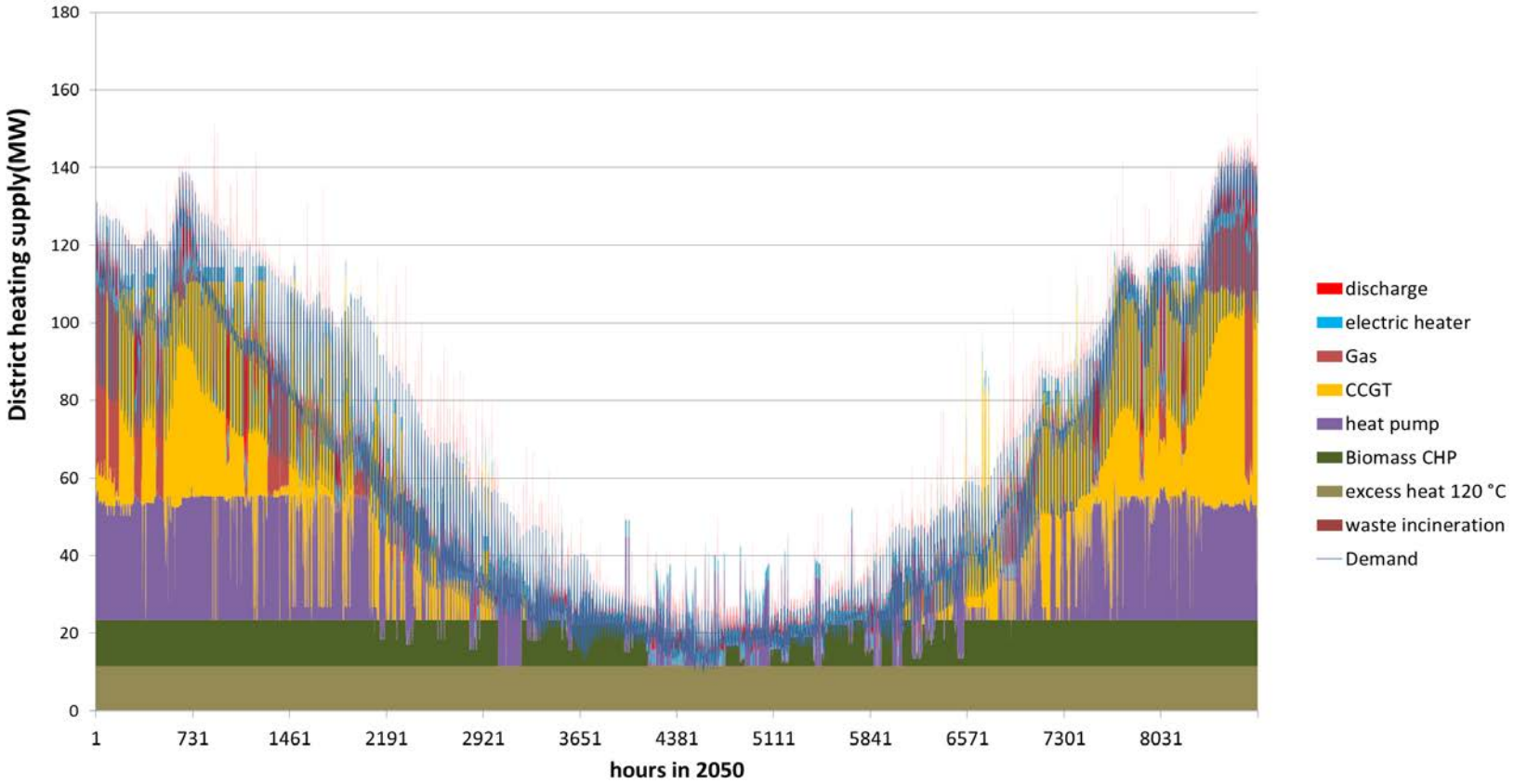
- P2H-Potential = 28 % of the annual district heating demand

BUT: decrease of biomass heat plant and increase of Gas

Type 3: CCGT, biomass CHP and excess heat

Assumptions:

- Taxes on electricity and gas

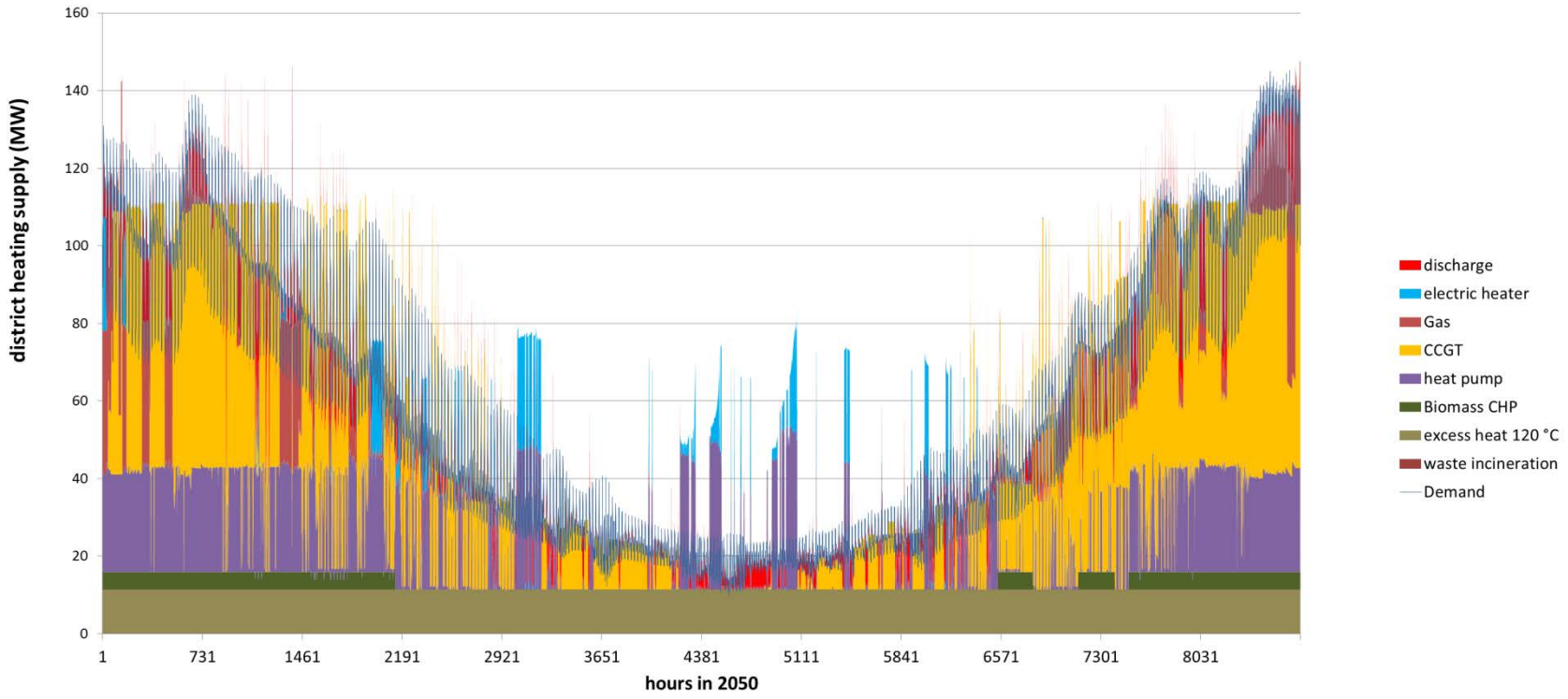


- P2H-Potential = 28 % of the annual district heating demand

Type 3: CCGT, biomass CHP and excess heat

Assumptions:

- NO Taxes on electricity and gas



- P2H-Potential = 28 % of the annual district heating demand
  - Less heat pump and increase of electric heater
  - Increase of gas and reduction of biomass CHP

Conclusions

- Heat pumps are reasonable option for Austrian district heating networks.
- P2H options are related to the district network characteristics and the system configurations.
- Shares of P2H up to 28 % are possible.
- Considering high COPs for heat pumps, taxes on electricity and gas are no disadvantages for heat pumps in comparison to CCGT.
- Still natural gas in the system – further reduction of heat demand as in the WEM scenario required.

Thank you for your attention!

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The project was founded by the Austrian Climate and Energy Fund

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Orig. Photo: Patrick Stargardt