## Urban energy models with TIMES

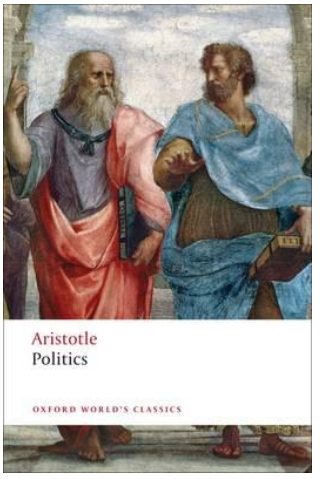
1.0 City planning and energy: a new nexus

2.0 Three Austrian examples:

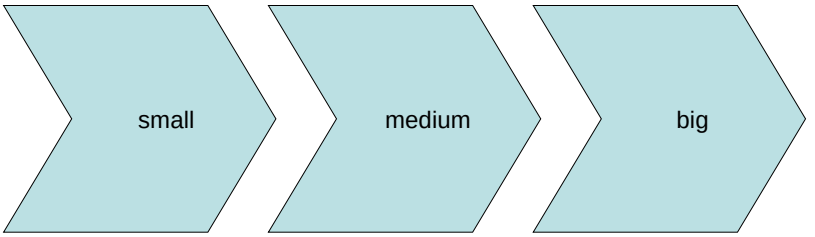
+ small sized
+ medium sized
+ large sized

3.0 But what is still missing?

## 1.0 City planning and energy: a new nexus




## 2.0 Three Austrian cities



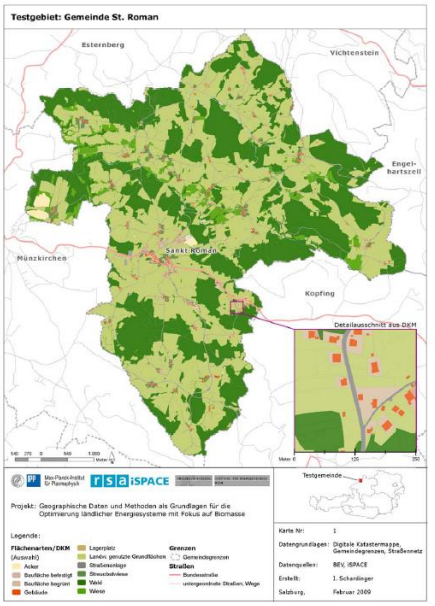

## 2.1 Small rural city

Central question: to which extend can biomass and agricultural residues be used to substitute commercial energy carriers without challenging food production?

- High spatial sprawl of settlements
- High availability of biomass and environmental heat
- But competition with traditional food production
- less spatial restriction for wind and solar technologies
- Still high fraction of agricultural activity

## 2.1 Small rural city

Model needs to cover land use and agricultural product flows.

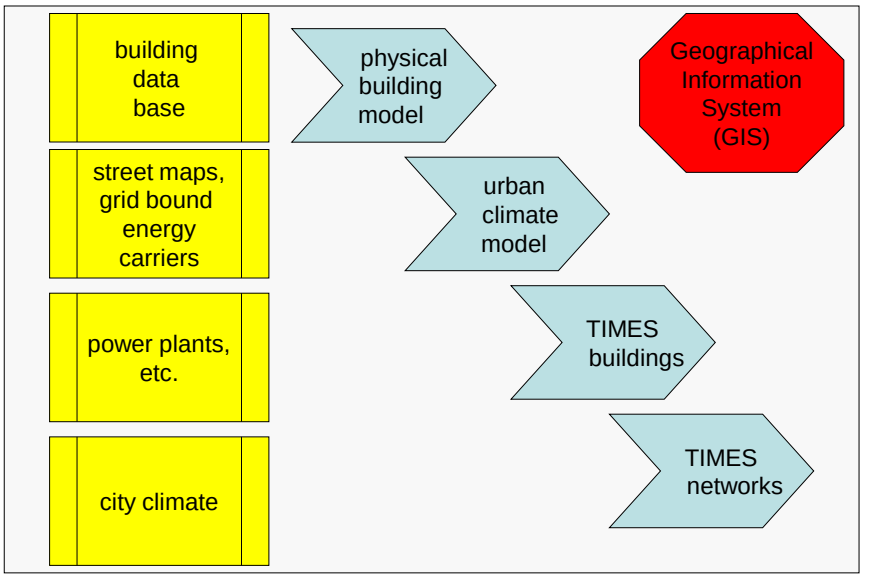



## 2.2 Medium sized city

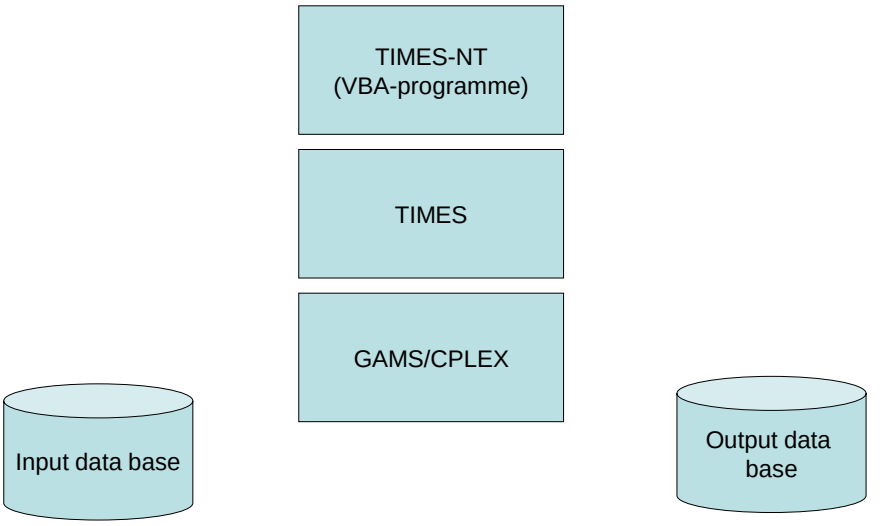
Central question: what is the optimal space heat supply technology? How can a good balance between refurbishment and sustainable supply technologies be found?

- very different densities in the settlements
- high requirement on local air quality
- sometimes availability of waste heat
- solar technologies are limited by roof space

## Medium sized city




## TIMES interface



## TIMES buildings

The city is subdivided in 250*250 m² raster.

Each building is classified following a more or less self made building typology.

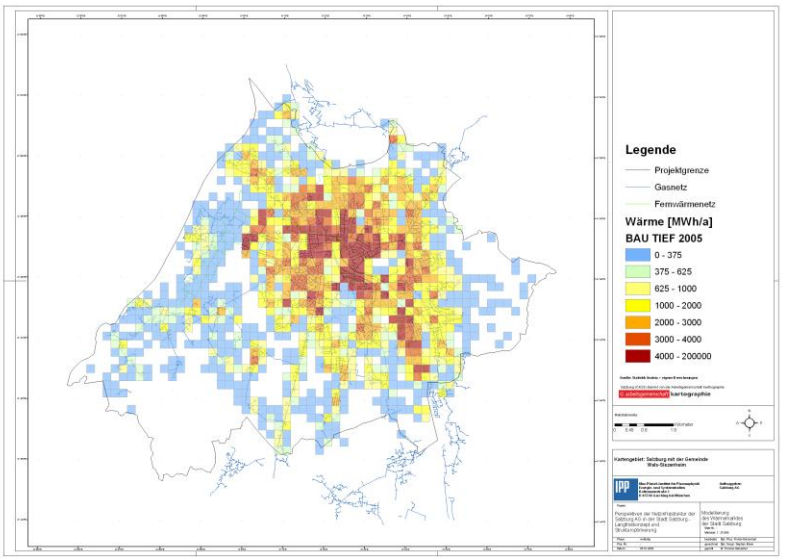
Each type is a process in the model so are refurbishment options.

Building construction and demolishment is done “by hand”.

Limits on refurbishment rates are major constraints.

The development of the heat price is give exogenously.

## Times Buildings (Medium sized city)



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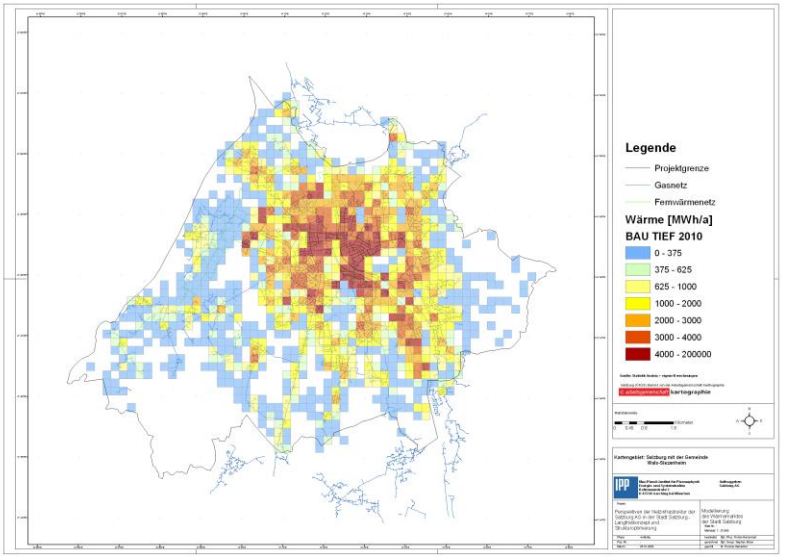


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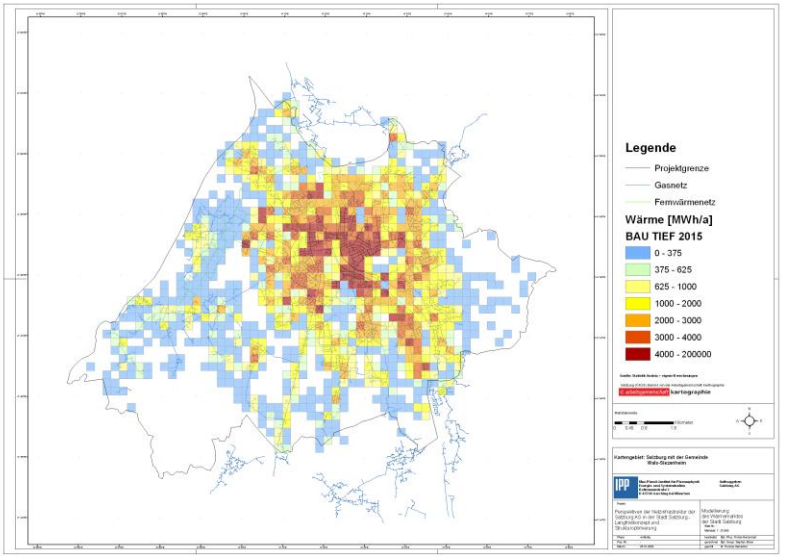

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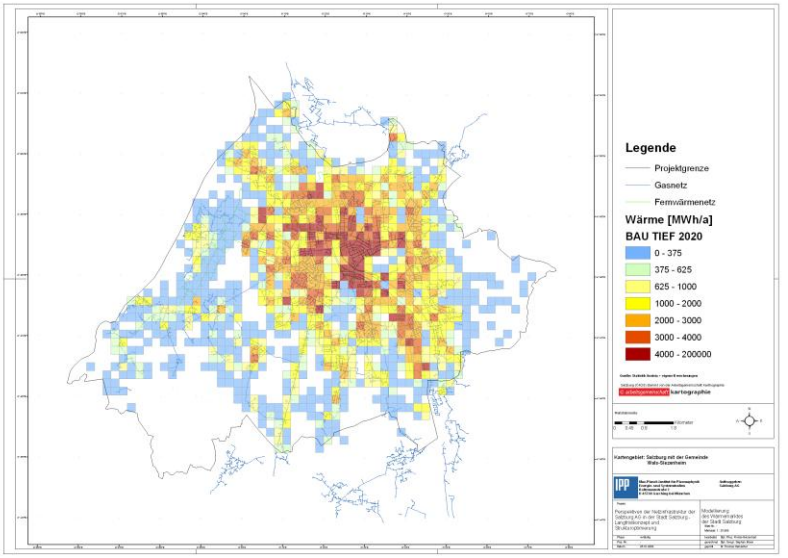


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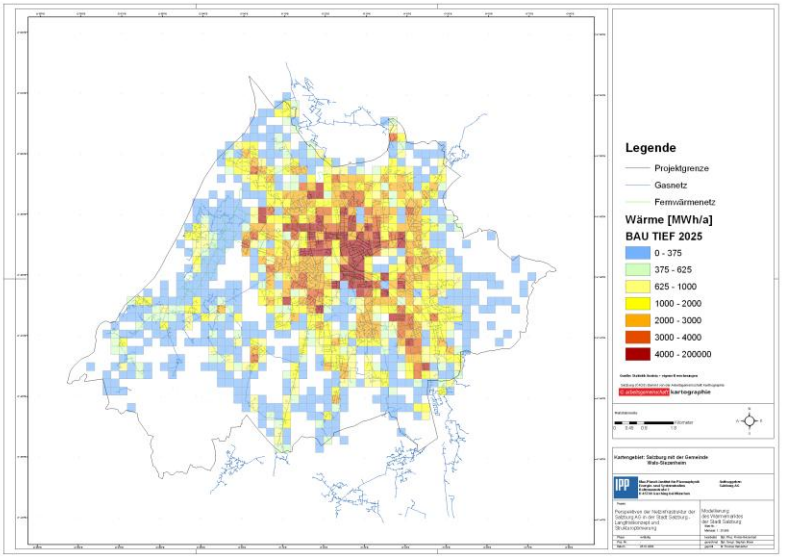

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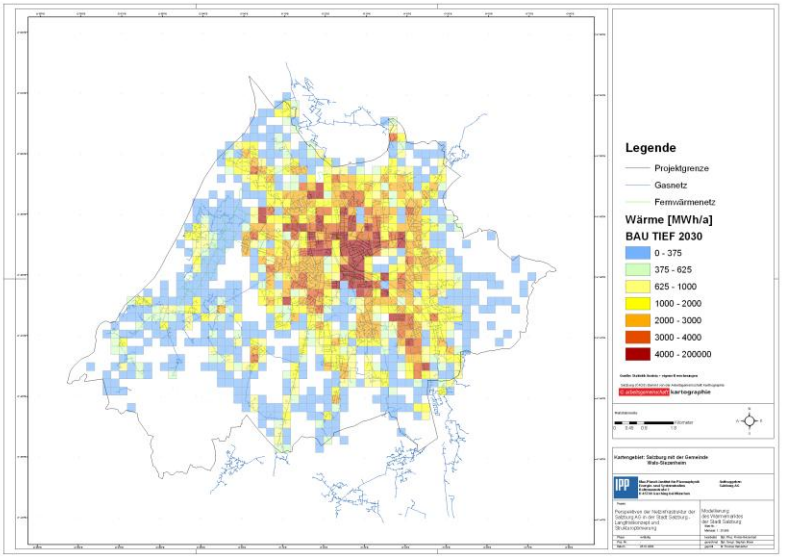



## Times networks (Medium sized city)

+ the existing district heating network is described by the exchange power between adjacent networks

+ power plants are individually modelled

## Times Networks (Medium sized city)

The city is subdivided in 250*250 m² raster.

In each raster the heat demand is taken from TIMES building.

Local heating technologies are described individually in each raster.

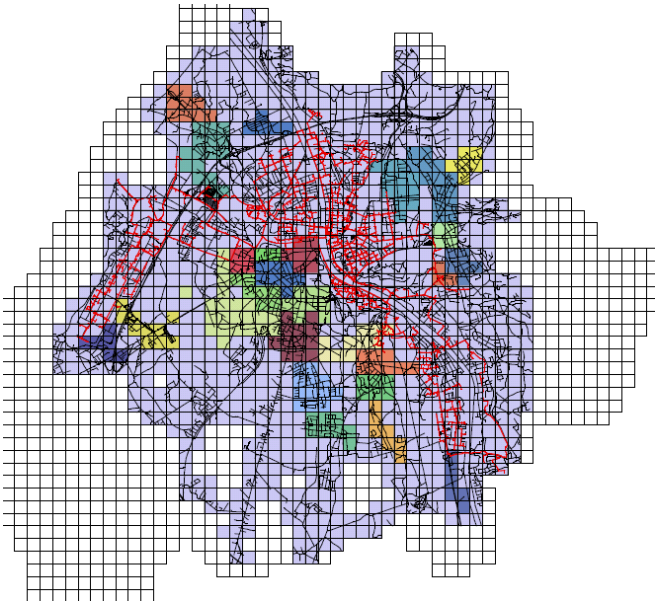
The district heating network is described by the exchange power between Raster and the individual power plants.

Constraints are put on CO2-emissions and local air emissions like NOx and dust.

Renewable heat needs to supply certain fractions.

New networks are described by “projects”, which can be constructed or rejected by the optimisation.

## Times Networks (Medium sized city)



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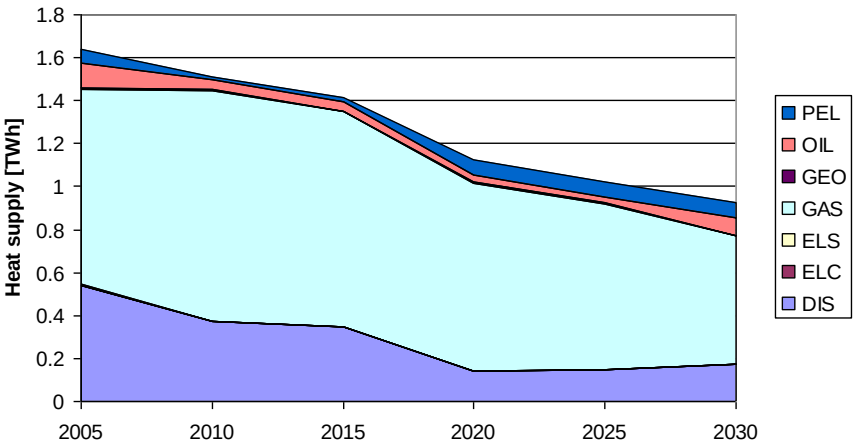
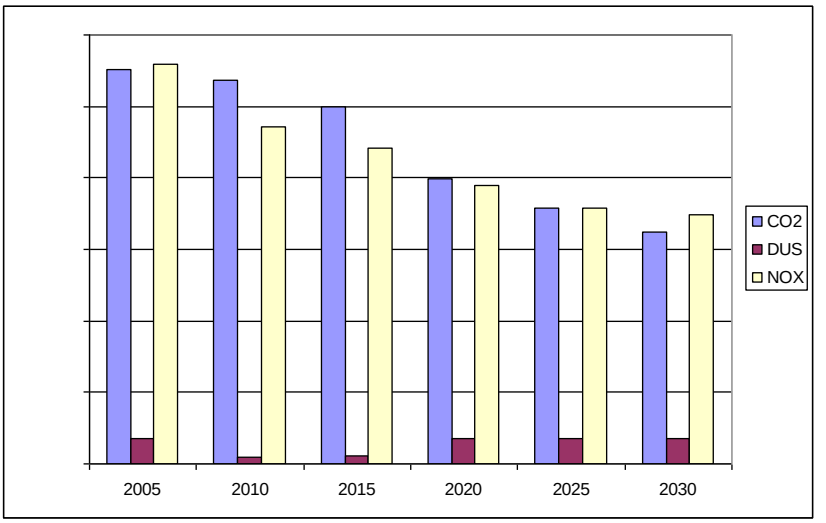


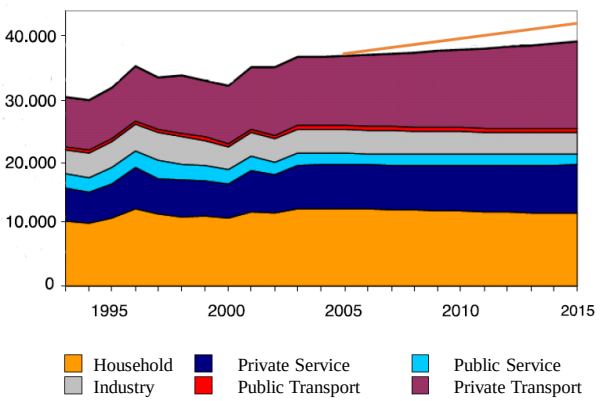

## Times Networks (Medium sized city) Emissions



## Times Buildings (Big city)

Central question: Can European legislations be fulfilled?

## Times Buildings (Big city)



## But what is still missing?

+ better models of “end users” and their behaviour

+ new approaches in quantitative urban development are under discussion like
  - cellular automata
  - multi agent model
  - …

  ways need to be found to combine these models with energy models

+ tools need to be supplied to introduce energy in the daily city planning processes