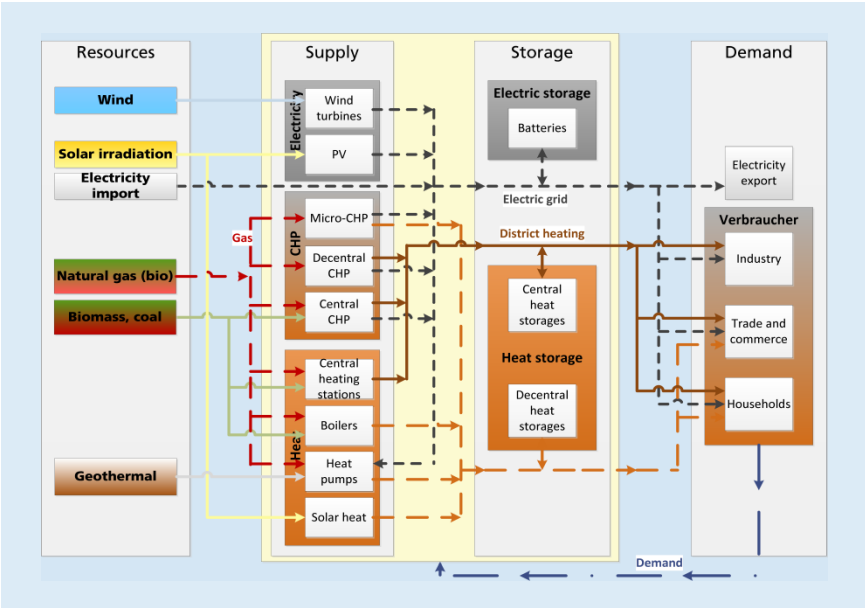
KOMMOD AS A TOOL TO SUPPORT MUNICIPALITIES ON THEIR WAY TO BECOMING SMART ENERGY CITIES



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SB13 Graz conference

Graz, 26 September 2013

Fraunhofer ISE

AGENDA

- Municipalities in the process of energy system transformation
- Scheme of a municipal energy system based on renewables
- Introduction of the energy system model KomMod
- First results and reflection of the requirements assumed
- Summary and outlook

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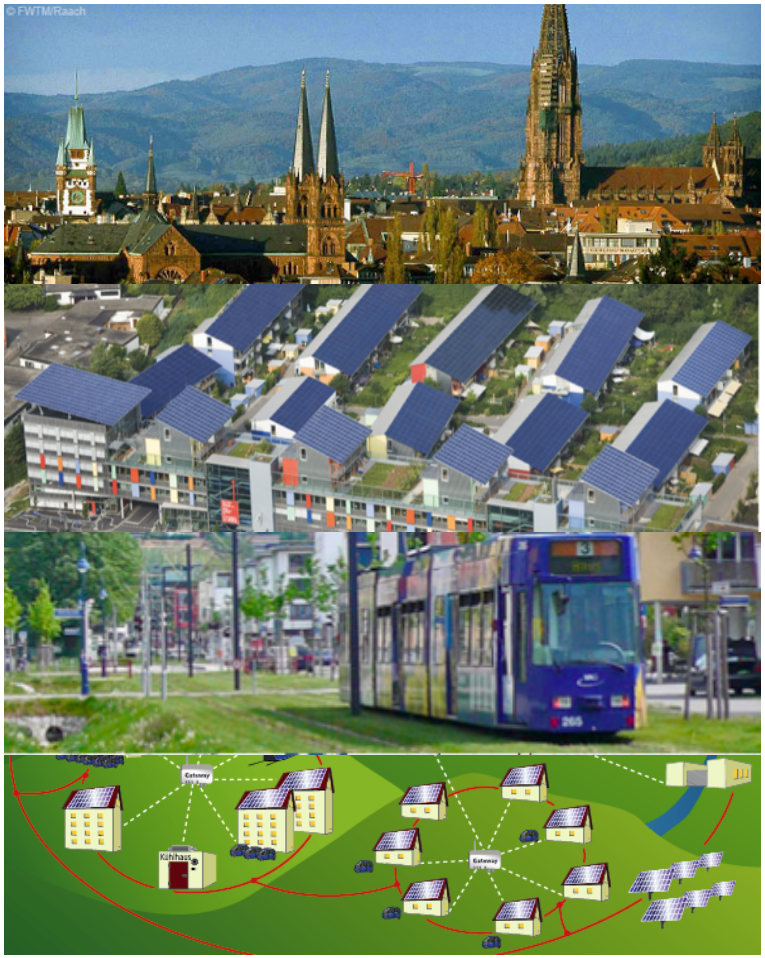
Municipalities – key role and unique challenge

- 75% of greenhouse gas emissions are produced in cities & municipalities
- Many of the transformation measures must be realised on a local level
- Active contribution of the citizens, industry, public sector etc. is needed

BUT

- The city administration is not designing the energy system
- Planning periods are 5 to 15 years - energy transformation will need 30 to 40 years
- Usually only a limited number of stakeholders and citizens is involved



Source: SMA / ISE / FWTM Freiburg

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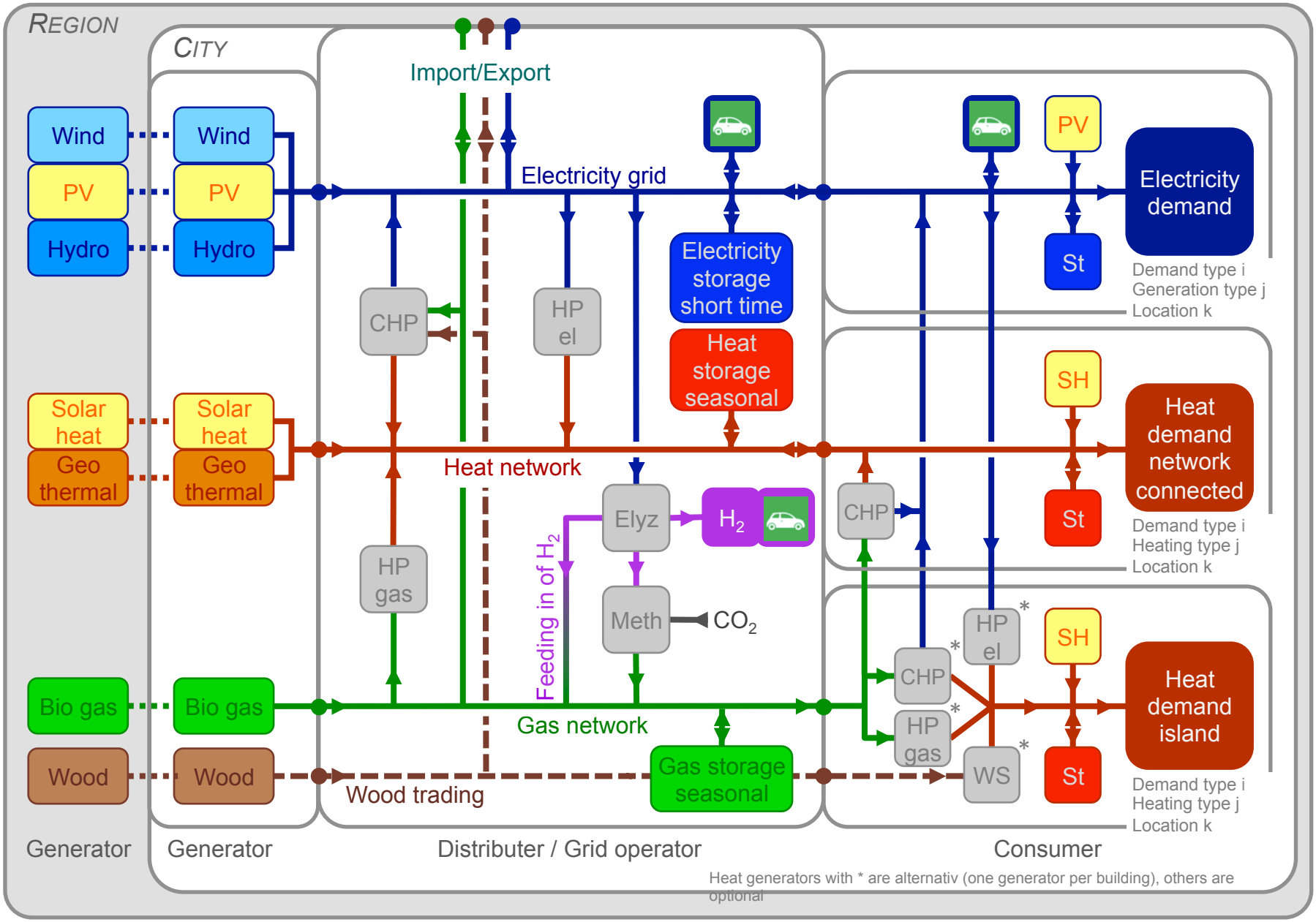
Possible contribution of energy system models

- Energy system models can support municipalities and utility companies with **strategic decisions** answering questions like
  - What does a possible future energy supply look like? (Technology mix, costs, emissions, import dependencies, …)
  - How is security of supply assured with an increased share of fluctuating renewables?
  - Energetic building refurbishment vs. optimised supply
  - District heating vs. solar thermal applications and heat pumps
  - Required amount of energy storage

Local / Regional Energy System based on 100% Renewable Energies



Source: Fraunhofer ISE

HP el/gas = Heat pump electric / gas driven, CHP = Combined heat and power, WS = Wood stove, St = storage, SH = Solar heat, Elyz = Elektrolyzer, Meth = Methanation

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Model characteristics

- Deterministic, techno-economic model
- Simultaneous optimisation of structure and design
- Consideration of different kinds of interdependencies
- Objective functions
  - Minimal total costs
  - Maximum self-sufficiency
  - (Minimal ghg emissions)
- Demand sectors
  - Electricity, gas
  - Heat (& cold)

  } incl. storage (and networks)
- High temporal and spatial resolution ($\Delta t \leq 60\text{min}$, $\Delta x \approx 100\text{m}$)

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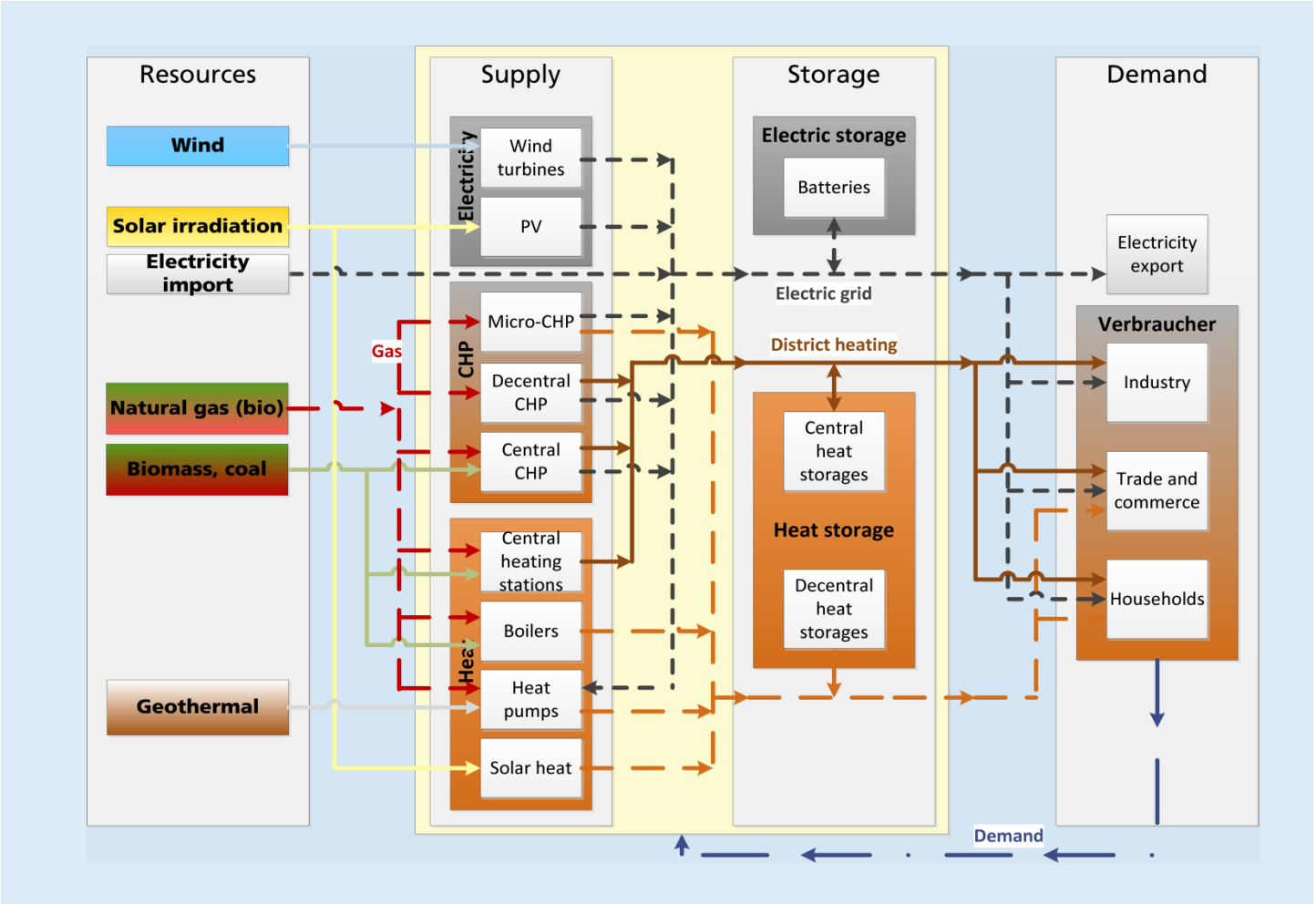
Implementation of the energy system structure



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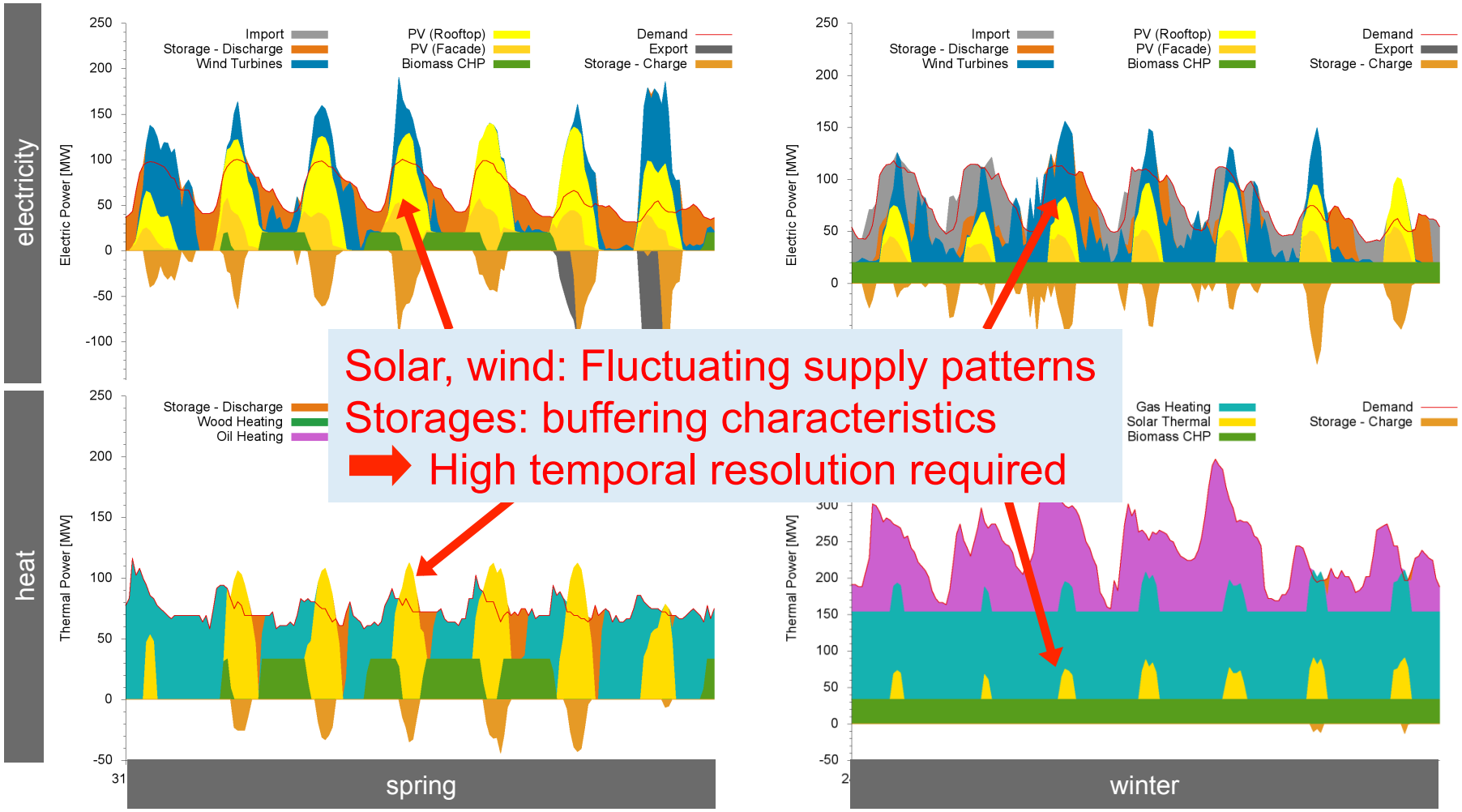
Exemplary results for spring and winter



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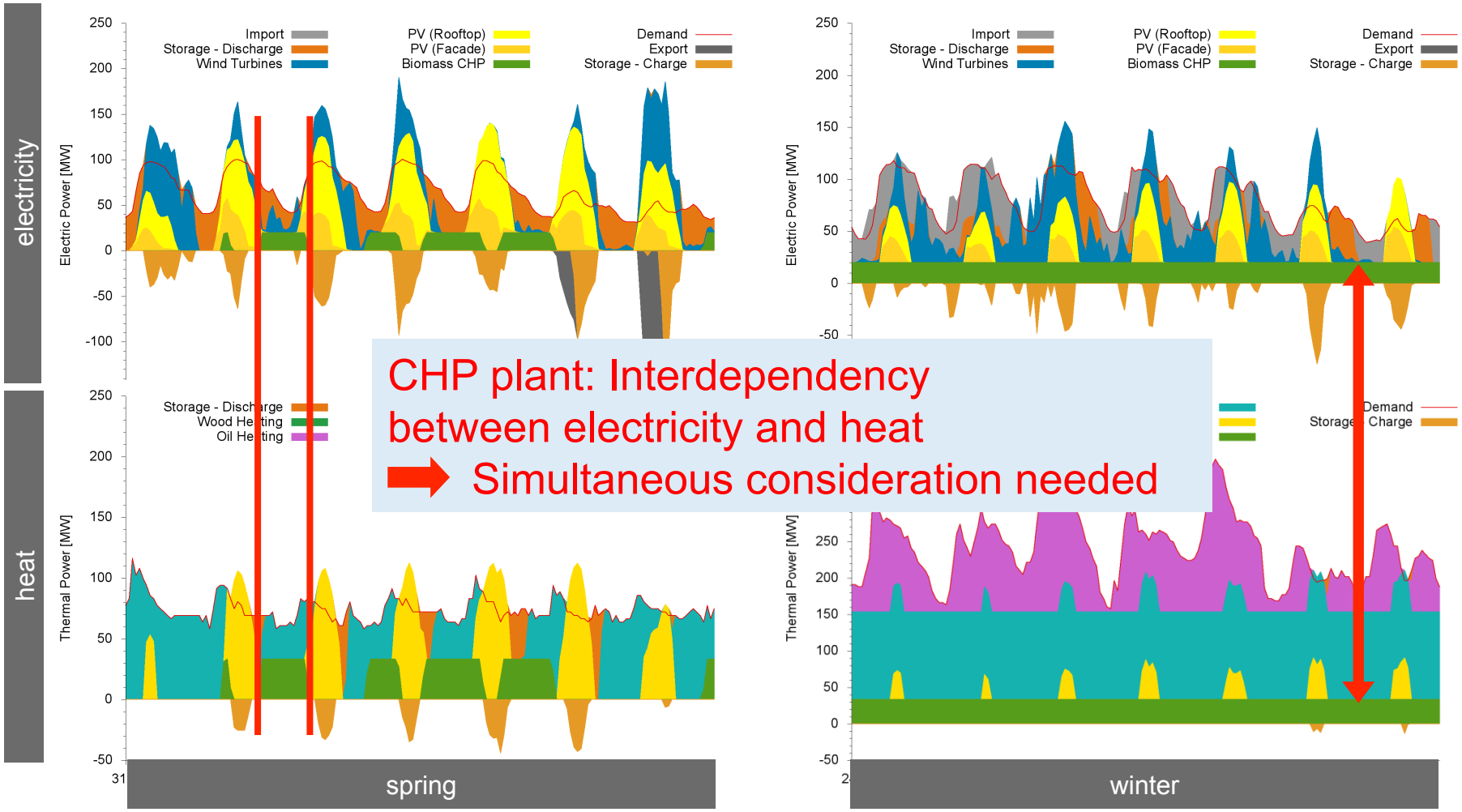
Exemplary results for spring and winter



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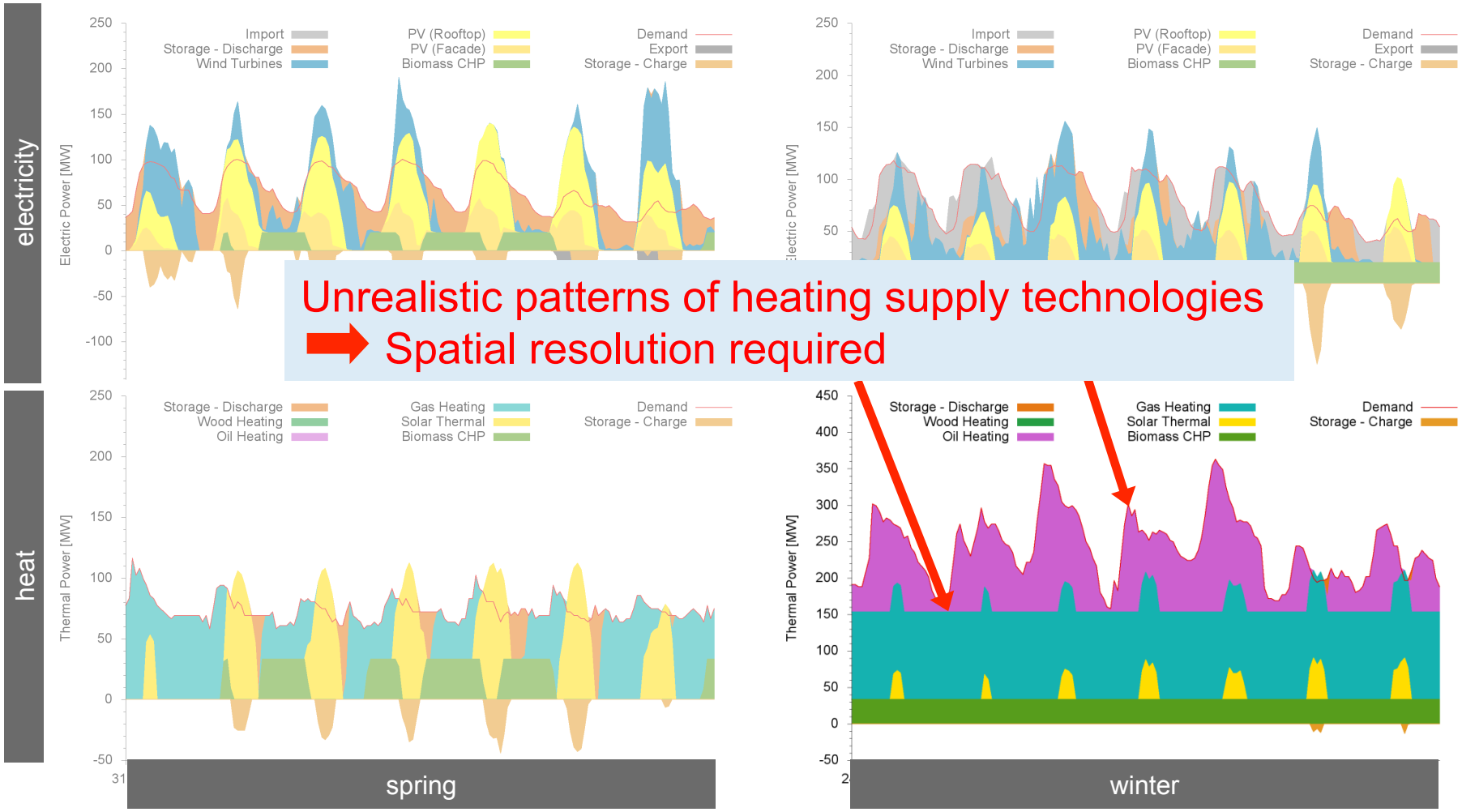
Exemplary results for spring and winter



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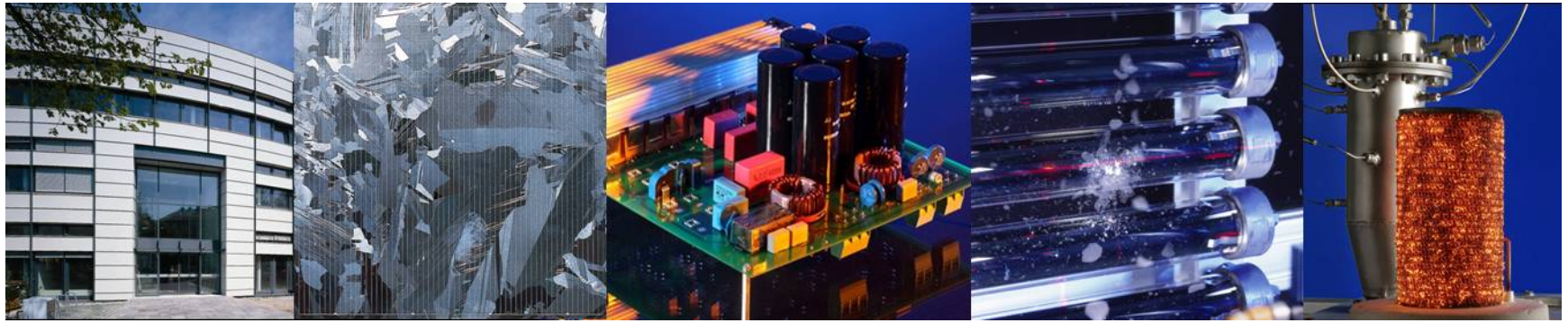
Summary & outlook

- Municipalities are in need of scientific support on their way to becoming (energetically) smart
- Energy system models like KomMod can help with strategic decisions delivering a sound technical and economical basis
- KomMod can be specifically adapted to the situation of the municipality
- High level of detail – technically, temporally, and spatially – helps to achieve realistic results
- Several objective functions allow for different focusses (costs, autonomy, …)

- Implementation of spatial resolution has to be tested in more detail
- Missing components have to be added
- Integration of the transport sector

Thank you for your attention!



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European and German energy policy targets

	Basic year	2020	2050
EUROPEAN UNION			
Reduction of Greenhouse Gas	1990	20%	at least 80%
Increase of Energy Efficiency	1990	20%	
Share of Renewable Energies	2009: 11.6%	20%	
GERMANY			
Reduction of Greenhouse Gas	1990	40%	80-95%
Increase of Energy Efficiency	2008	20%	50%
Share of RES total	2011: 12,2%	18%	60%
Share of RES on electricity	2011: 20,0%	35%	80%

➡ **The energy system must be transformed fundamentally**

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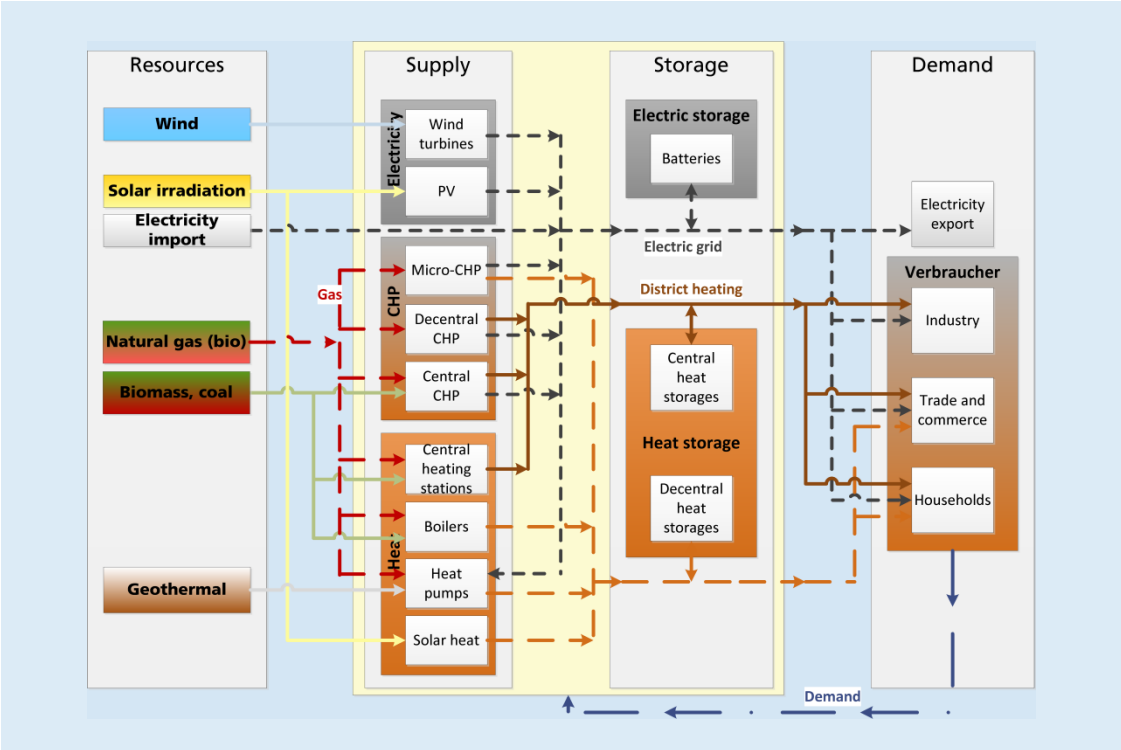
Energy system transformation is a unique challenge for cities and their administration

- **TOPIC:** The city administration is usually not designing the energy system - transferring the responsibility to external companies
- **TIMELINE:** Planning periods are usually 5 to 15 years - energy transformation will need 30 to 40 years
- **GOVERNANCE:** In most city processes only a limited number of representatives of stakeholders and citizens is involved - the energy transformation needs the involvement of the majority of the citizens and new kinds of participation processes

Source: Green City Cluster Freiburg / FWTM

KomMod – supporting Smart Energy Cities
Required input data I



- Energy sources
  - Potentials (roof-top areas, …)
  - Supply patterns (sun, wind, water, …)
- Demand
  - Building stock (type, age, usage, state of refurbishment, ..)
  - **Demand patterns** (electricity, heat)

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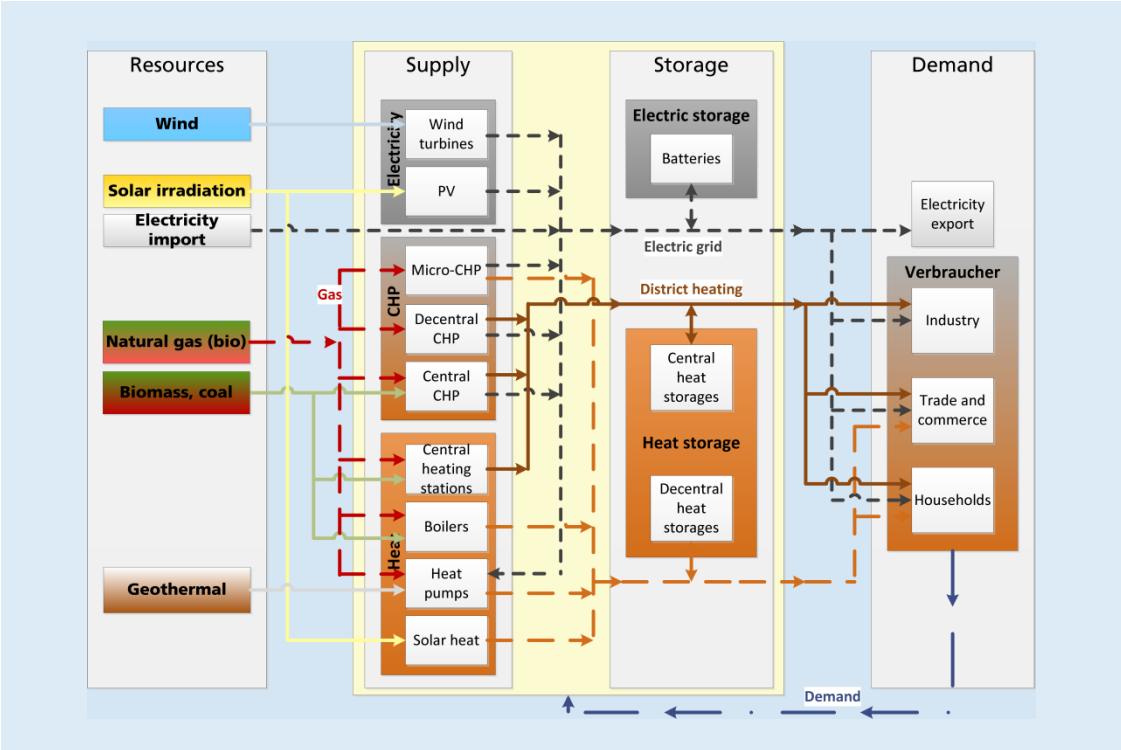
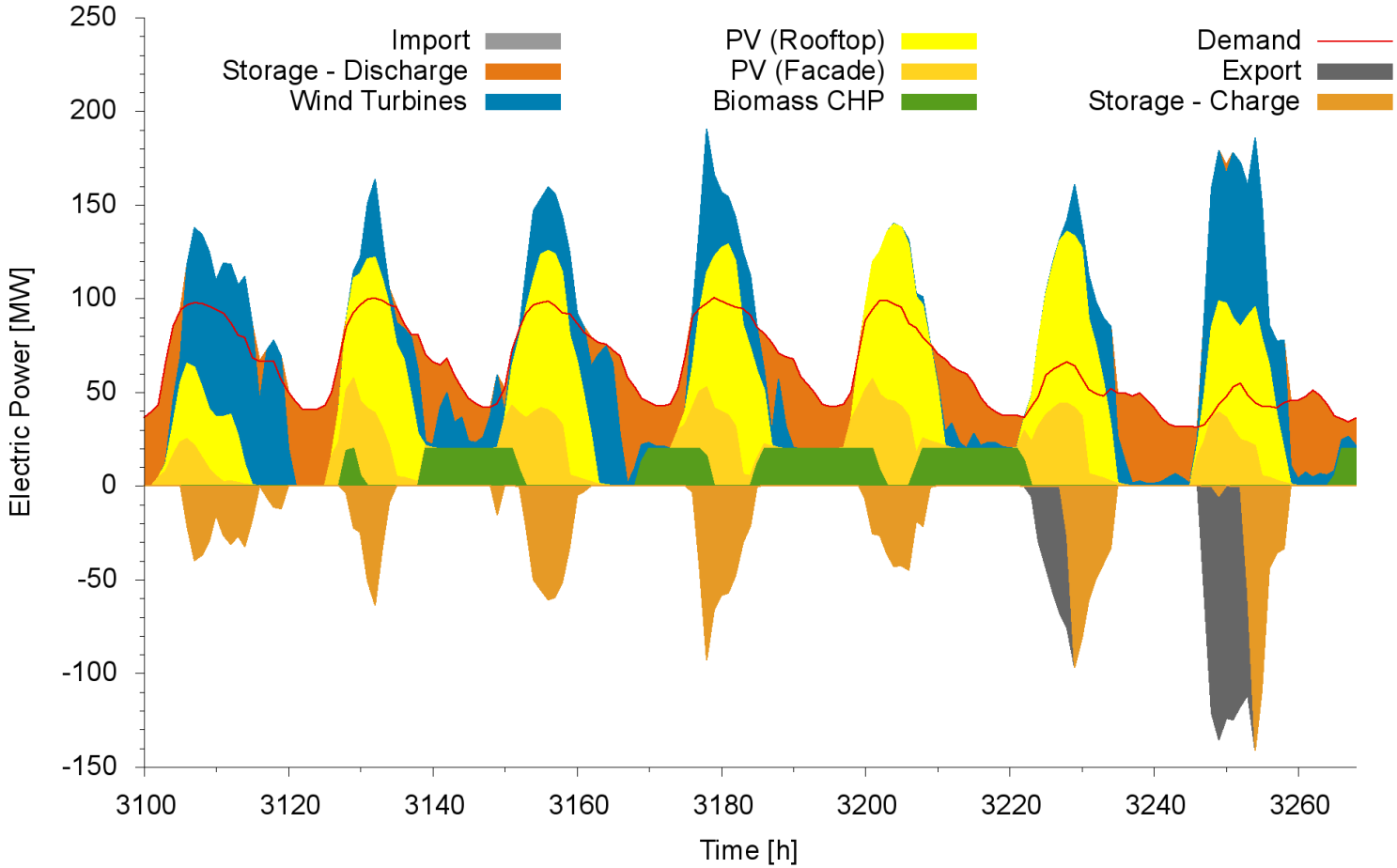
Required input data II



- Converter & Storage
  - Existing Power plants
  - Existing heating systems
  - Roof-top areas
  - Existing storage
- Energy networks
  - Existing networks / grids (heat, gas)
  - Planned / possible extension

Smart Energy Cities

KomMod – Electricity: One week in spring



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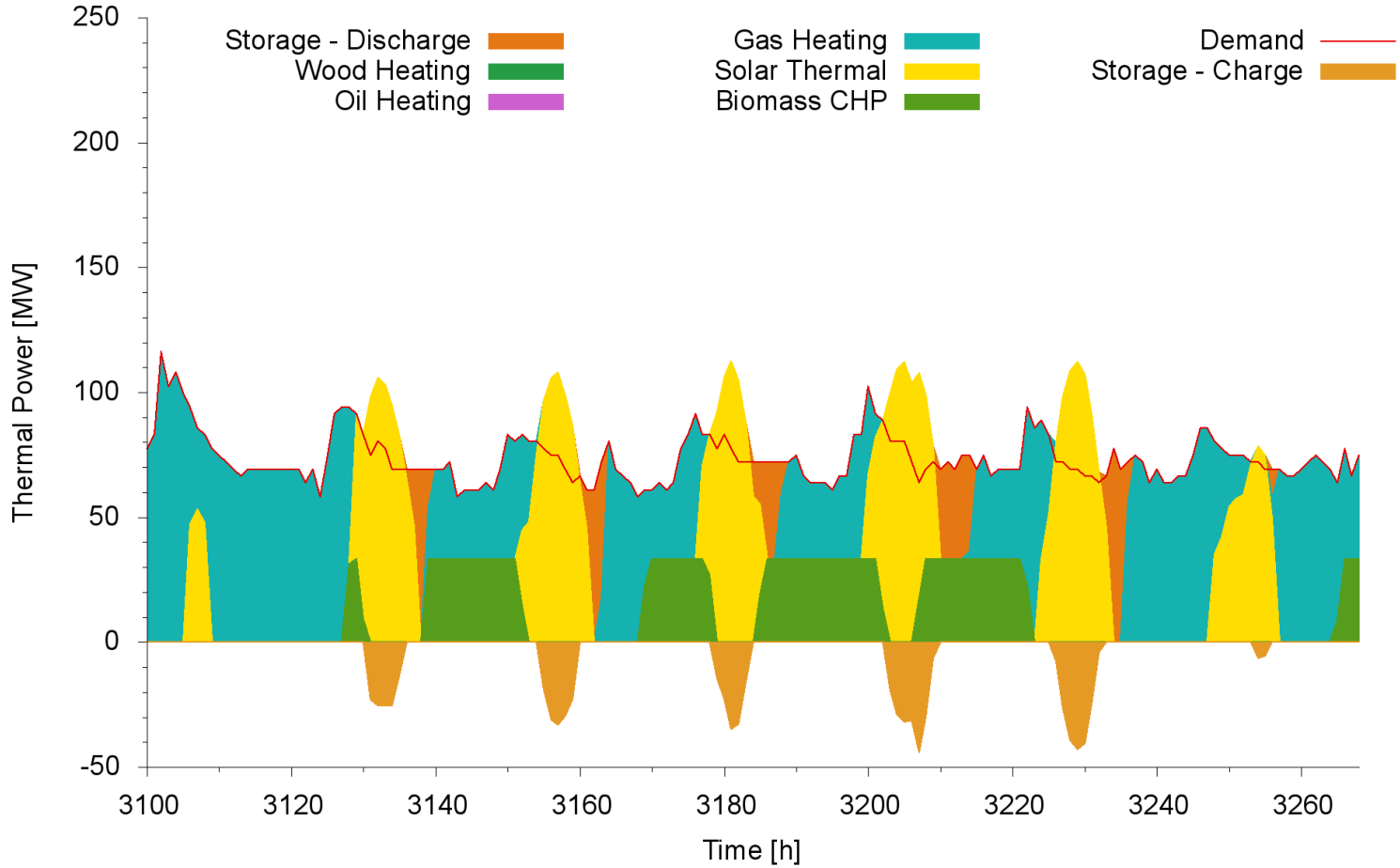
KomMod – Heat: One week in spring



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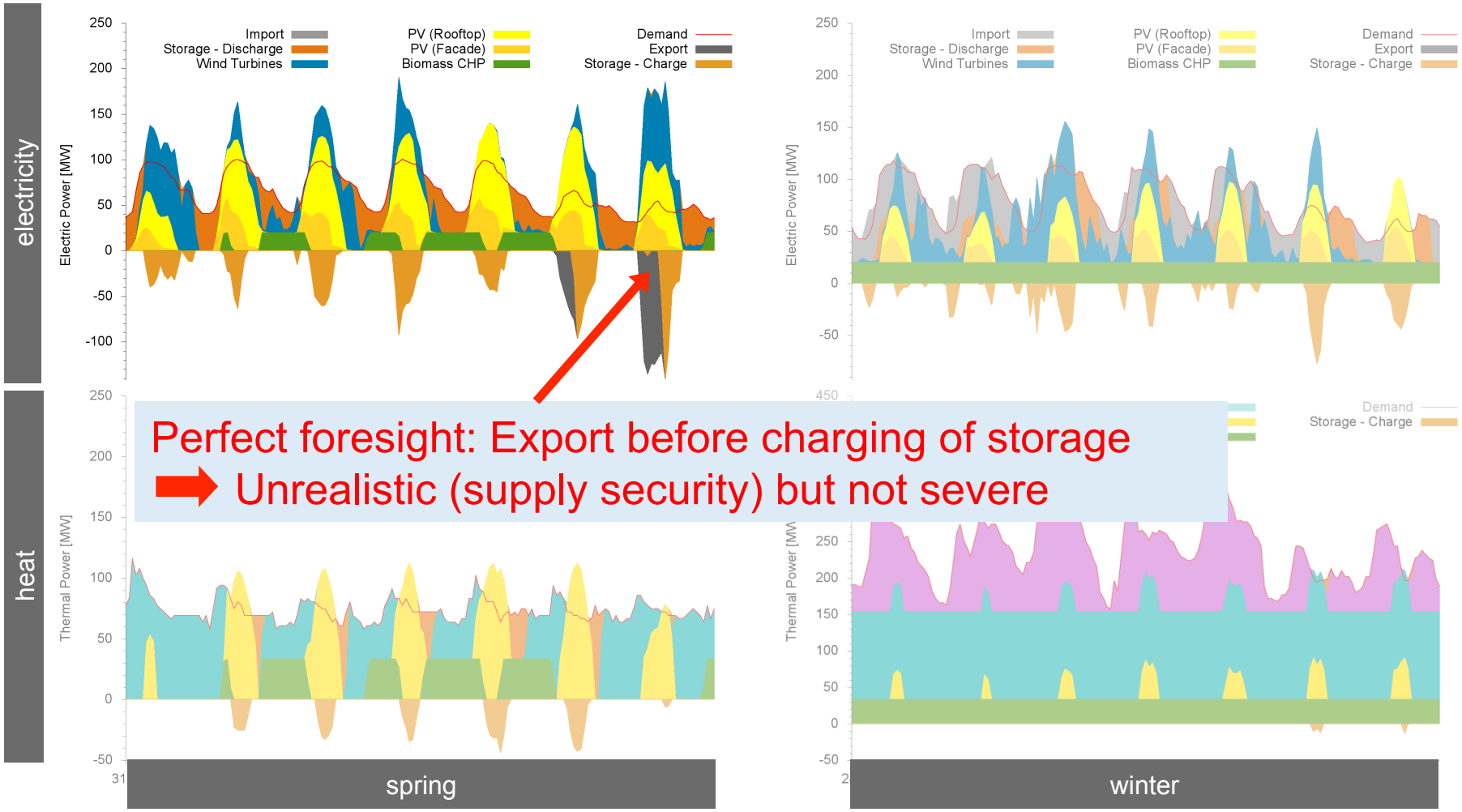
Exemplary results for spring and winter



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