Bottom Up Versus Top Down

Approaches Towards Low Energy Neighbourhoods in Austria

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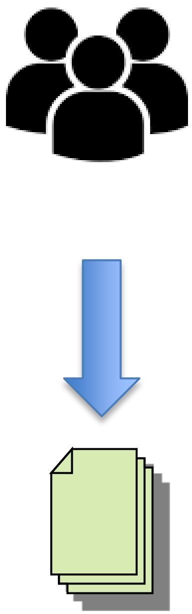
Bottom Up



Demand for

Building and Energy

Energy concept

Detailed Plans

Bottom Up

check

- Existing infrastructure
- Data
- Potentials
- Targets

Demand for

Building and Energy

Energy concept

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Top Down

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Municipality:
Develop Strategies

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Builder / planner / investor

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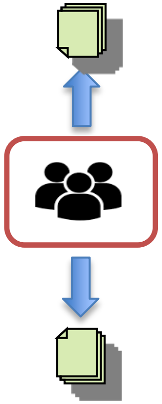
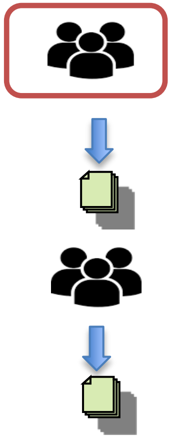
Bottom Up <> Top Down



Bottom Up:

- Starting point is the single building or building group
- Role of energy provider
- Integration into local grids
- Main motivation: building owner



Top Down:

- Starting from community / town
- Energy provider is a main stakeholder
- Buildings are seen as end-consumers
- Main motivation: community, energy provider

Focus

- Who drove the process?
- What was the demand?
- Sucessful integration of buildings / energy system of community?

Dieselweg: Renovation of a neighbourhood of multi family houses in Graz

Starting point:

- Suburban residential area in Graz
- 14038 m², 204 appartments
- Heated by single devices (fossil fuel or electric devices)
- low envelope quality

Driving Forces:

- Low income due to vacancies (high energy consumption, poor comfort)
- Need for good publicity and investment return

Aim: Show the way towards a solar-autarkic neighbourhood

Heating demand:
BEFORE: 142 - 225 kWh/m²a
AFTER: 9 - 12 kWh/m²a

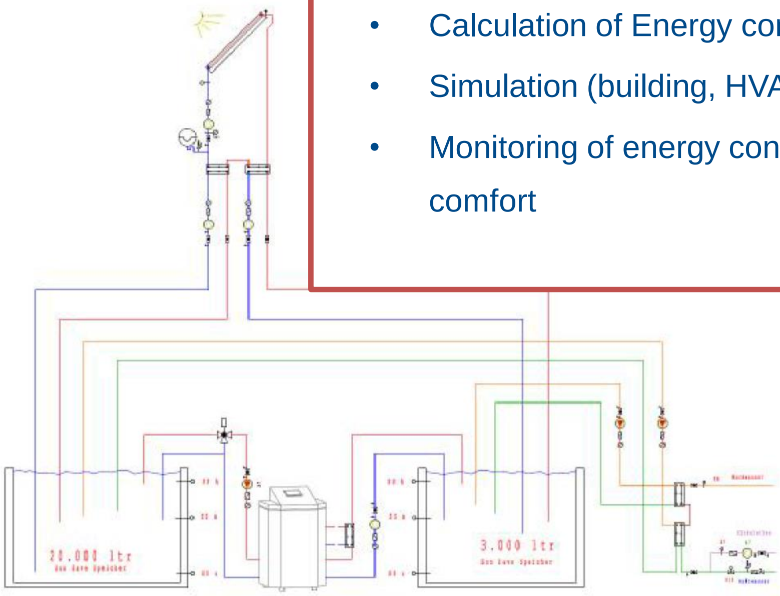
Dieselweg: Renovation of a neighbourhood of multi family houses in Graz

Innovative technical solutions:

- HVAC via facade (heating, ventilation)
- Solar thermal and PV
- Heat pump and large hot water storage for each building
- Ventilation by small units (one per appartment)

Tools:

- Baseline Study
- Calculation of Energy consumption
- Simulation (building, HVAC)
- Monitoring of energy consumption and comfort



Funding:

- via subsidies, funding for innovations, research projects
- higher income due to slightly higher rental fees and low vacancies

Dieselweg: Renovation of a neighbourhood of multi family houses in Graz

District heating and Gas grids

- DH 2010-2015
- DH 2013-2025
- DH from 2020
- Gas now
- Gas future
- Gas far future

Successful integration into existing grids?

- HEAT: No connection to district heating– ‚autarkic' island solution per building
- POWER: Connected to grid. Generated power is fed into the grid (legislative and financial reasons)

Kapfenberg: Renovation of a multi family house in Austria

Starting point:
- Residential area in the north of Styria
- 2845 m² - 36 appartments
- Heated by single devices (fossil fuel or electric devices) or small central heating systems, low envelope quality

Driving Forces:
- Low income due to vacancies (small appartments, high energy consumption, poor comfort)
- Need for good publicity and investment return

Aim: Renovation to Plus Energy Residential Building

Heat + DHW consumption
BEFORE : 108 kWh/m²a
AFTER: ~30 kWh/m²a

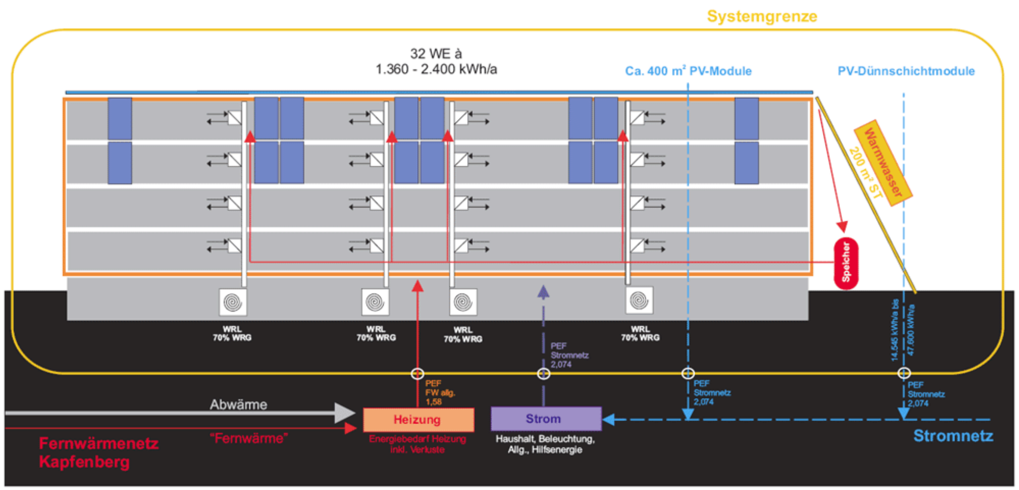
Kapfenberg: Renovation of a multi family house in Austria

Innovative technical solutions:

- HVAC via facade (heating)
- Solar thermal and PV
- Connected to district heating (backup, load peaks)
- Central ventilation with heat recovery / heat recovery by heat pump for DHW

Tools:

- Baseline Study
- Calculation of Energy consumption
- Simulation (building, HVAC)
- Monitoring of energy consumption and comfort



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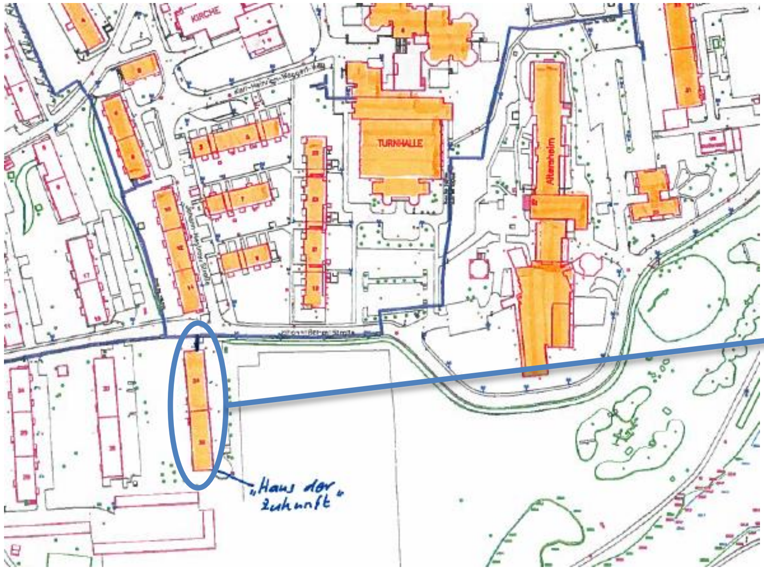
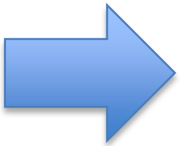


The area east of the residential building was already connected to DH ( )



Successful integration into existing grids?

- HEAT: Active energy generation (HP+ heat recovery, solar collectors). DH as backup and for load peaks
- POWER: PV energy fed into grid, grid power for HP and other requirements (legislative and economical reasons)

Energy Master Planning Processes of communities

- Main driving force:

energy strategy of communities

Status analysis

- Energy relevant data
- Energy consumption and GHG emissions
- Energy Potentials

Aim: Gather Information
Methods: use GIS and various sources
Open questions:
best way to gather data (Energy provider, community, final consumer…). Privacy

Strategy development

- Create scenarios for the future
- Spatial modelling and simulation
- Derivation of measures

Definition of measures:
Renovation of heat generation, buildings, use renewables etc.

Implementation

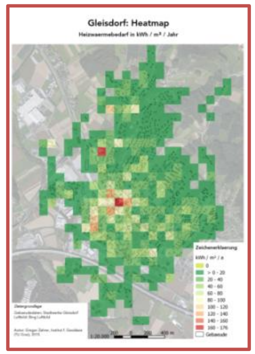
- On levels of organisation, planning, project and realisation

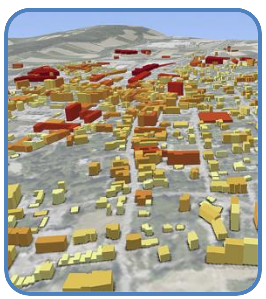
Give access to information
Open questions:
How to require implementation (eg local financial subsidies programmes, legally binding master plan ?)

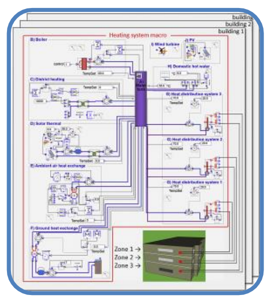
Quality assessment and monitoring

Methods - Workflow

Spatial energy and infrastructure analysis and modeling
GIS, statistics, energy balancing, roadmapping







Data acquisition, geodatabase management

Pre-processing (check, verify, extend database)

Spatial analysis / spatial modeling
- Characterization of existing infrastructures, energy demands and local resources

Renovation and modernization roadmap
- Building renovation roadmap based on hourly HWB* calculation (acc. to EN ISO 13790)
- Scenarios for increased share of renewables in heating sector and DH extension

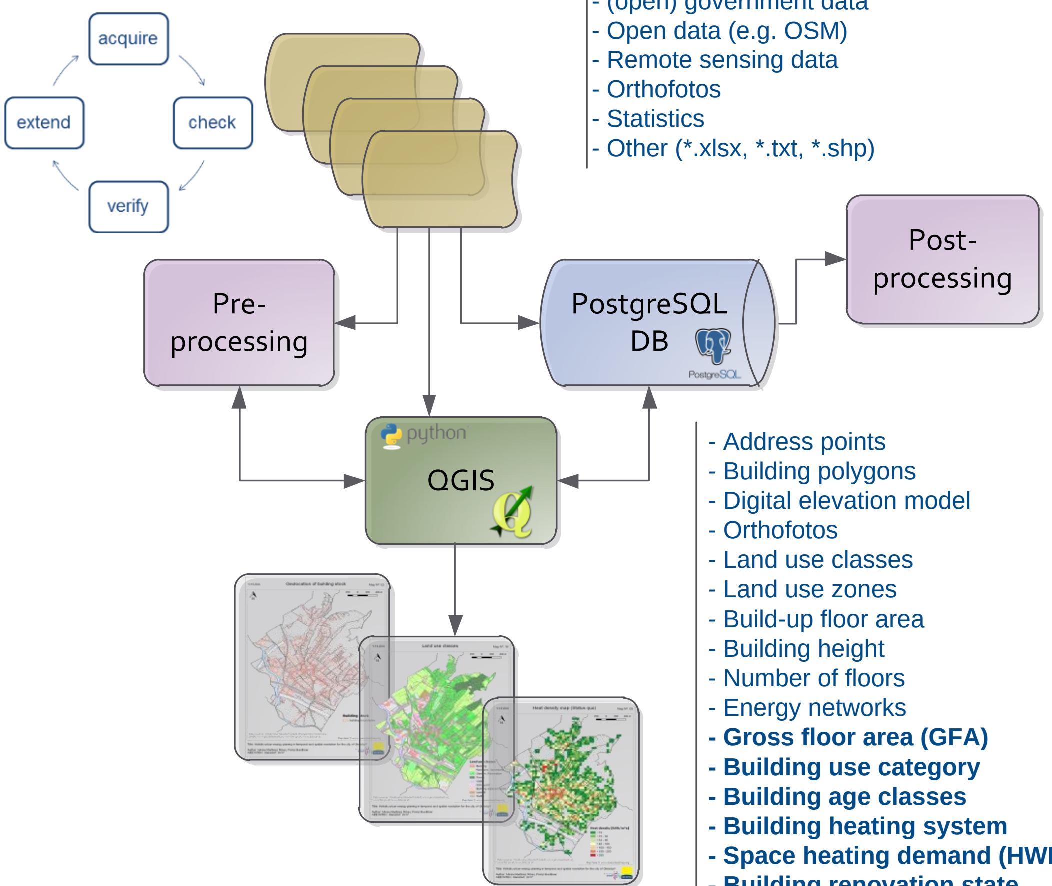
Dynamic building and utility network **simulation**
- Automated workflow coupling geodatabase with IDA ICE building simulation framework

In-depth analysis / simulations in high temporal resolution
physical models, (dynamic) simulation

Spatial analysis and modeling

▪ Setting-up geodatabase

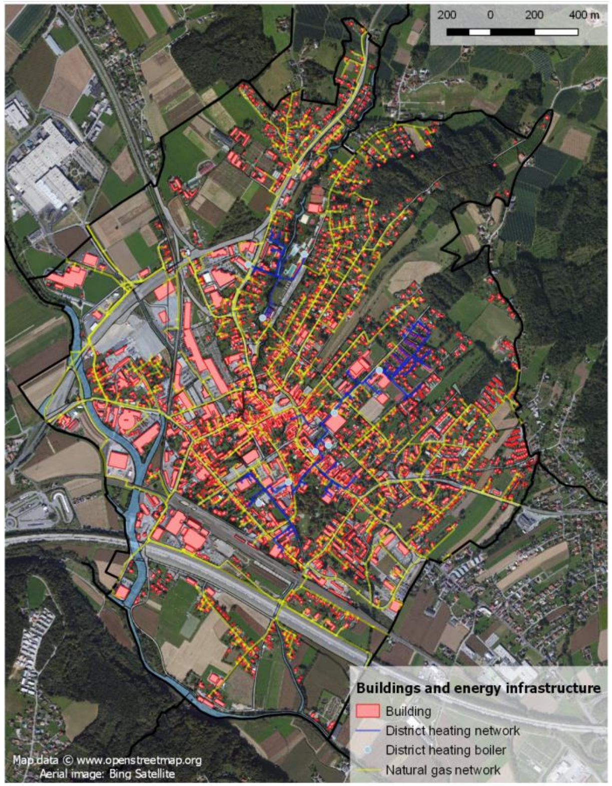
- CAD (e.g. network plans)
- (open) government data
- Open data (e.g. OSM)
- Remote sensing data
- Orthofotos
- Statistics
- Other (*.xlsx, *.txt, *.shp)



- Address points
- Building polygons
- Digital elevation model
- Orthofotos
- Land use classes
- Land use zones
- Build-up floor area
- Building height
- Number of floors
- Energy networks
- **Gross floor area (GFA)**
- **Building use category**
- **Building age classes**
- **Building heating system**
- **Space heating demand (HWB)**
- **Building renovation state**

Final geodatabase

- Geolocation of all buildings and energy supply networks
- **Full characterisation of residential sector** for basic energetic analysis
- *Only partial characterisation of industry, commercial and public sector*
- Land use / zoning



Salzburg Schallmoos:
EMP for a quarter in Salzburg

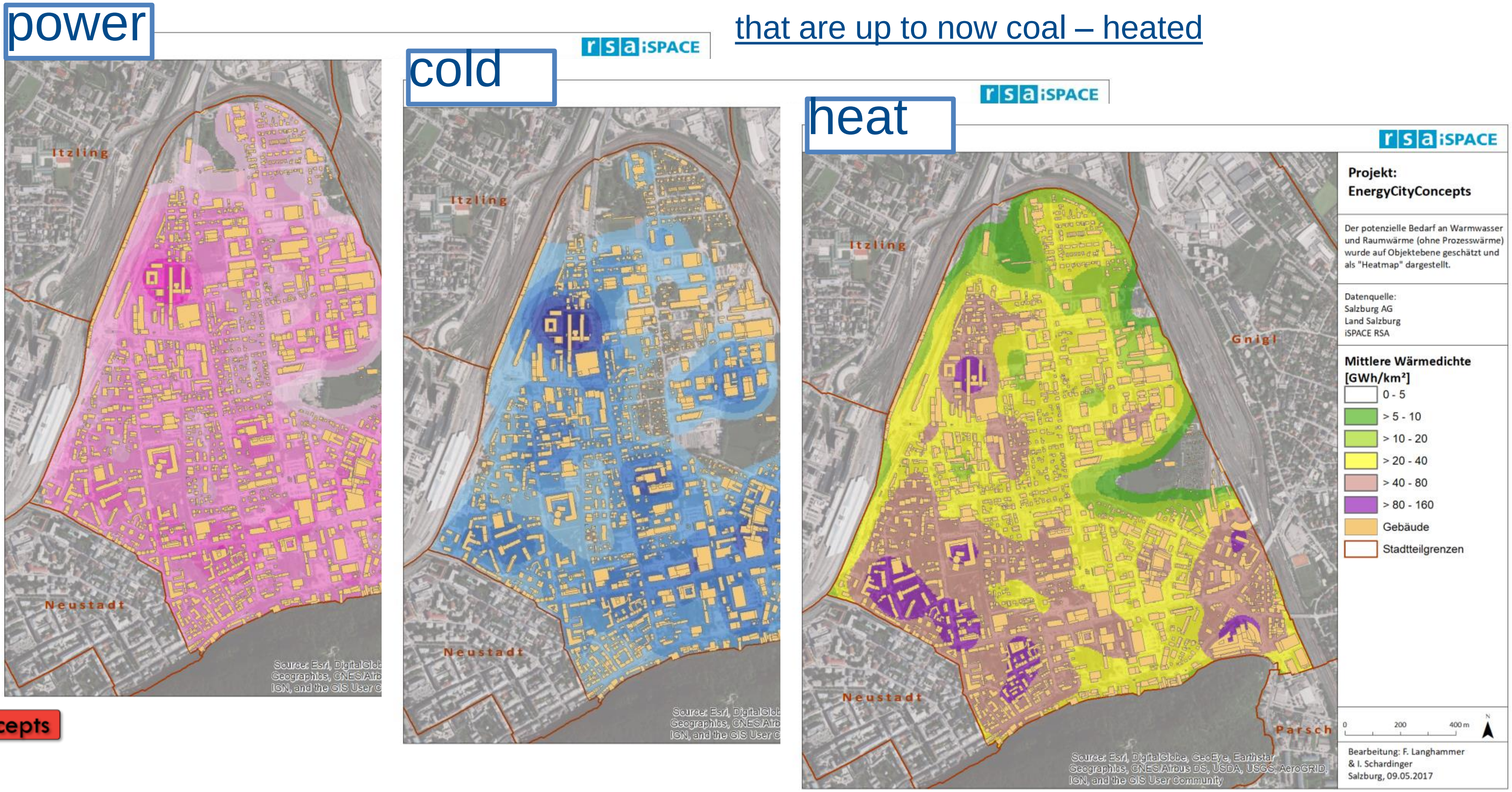
Main driving force:

Energy and climate strategy of Salzburg

Data aquisition and analysis ☺

Definition of high priority areas ☺

Plan: Start with high priority: renovate neighbourhoods that are up to now coal – heated



Demonstration project + ERS
Towards Plus Energy Neighbourhoods

Starting point:
- Industrial wasteland, in Graz
- Need of new residential space in a growing town
- Investors have taken over the area

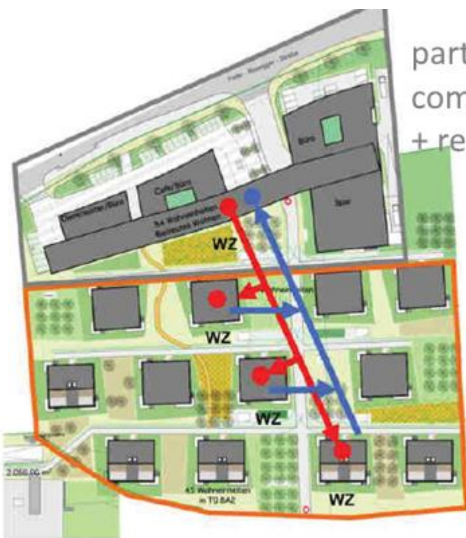
Driving Forces:
- Investor: Need for investment return
- Town and Neighbours: Upgrade of the area
- Town: Need for appartments
- Town: No further emissions due to already bad air quality

Aim: Plan and build a new urban district. Reach Plus energy and realize energy exchange between residential and commercial areas

Demonstration project + ERS
Towards Plus Energy Neighbourhoods

Innovative technical solutions:

- Solar thermal collectors
- Foundation: Ground heat collector
- Heat pumps
- Energy exchange between commercial and residential area. (Summer heat is stored for heating in winter)



part 1:
commercial / office
+ residential

part 2:
residential

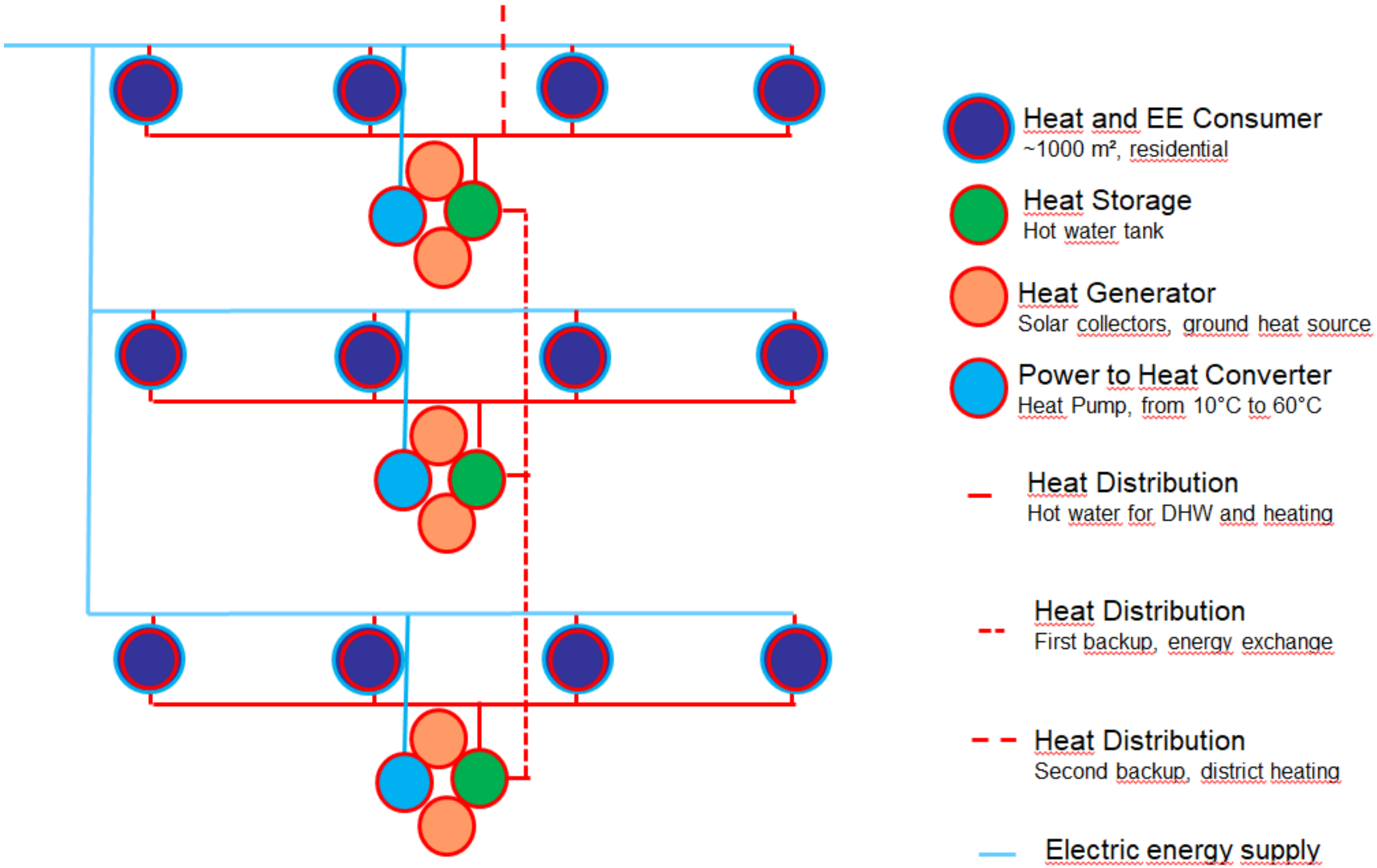
Results:

Consumption (residential): 35 kWh/m²a

Plus Energy **NOT REACHED**

- PV was not realized
- no energy exchange for cooling of supermarket
- less energy demand for cooling

Demonstration project + ERS
Towards Plus Energy Neighbourhoods



Demonstration project + ERS
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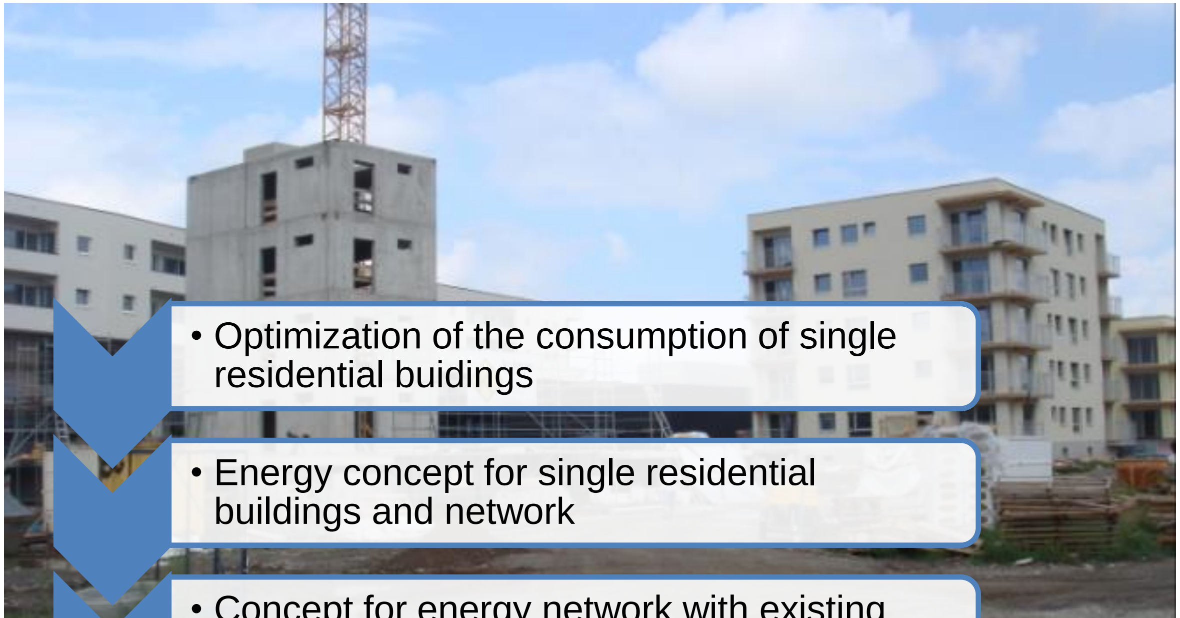


- Optimization of the consumption of single residential buildings
- Energy concept for single residential buildings and network
- Concept for energy network with existing (commercial) buildings
- Load profiles for residential areas
- Simulation of the model with TRNSYS, Calculation of Variants and Optimization with SIMPLEX (simulation tool for heat networks)

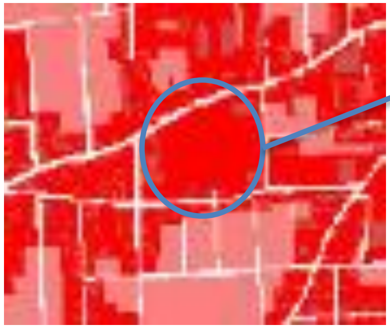
Tools:

- Baseline Study
- Calculation of Energy consumption
- Simulation (building, HVAC)
  TRNSYS, PHPP, simplex (heat network)
- Monitoring of energy consumption and comfort

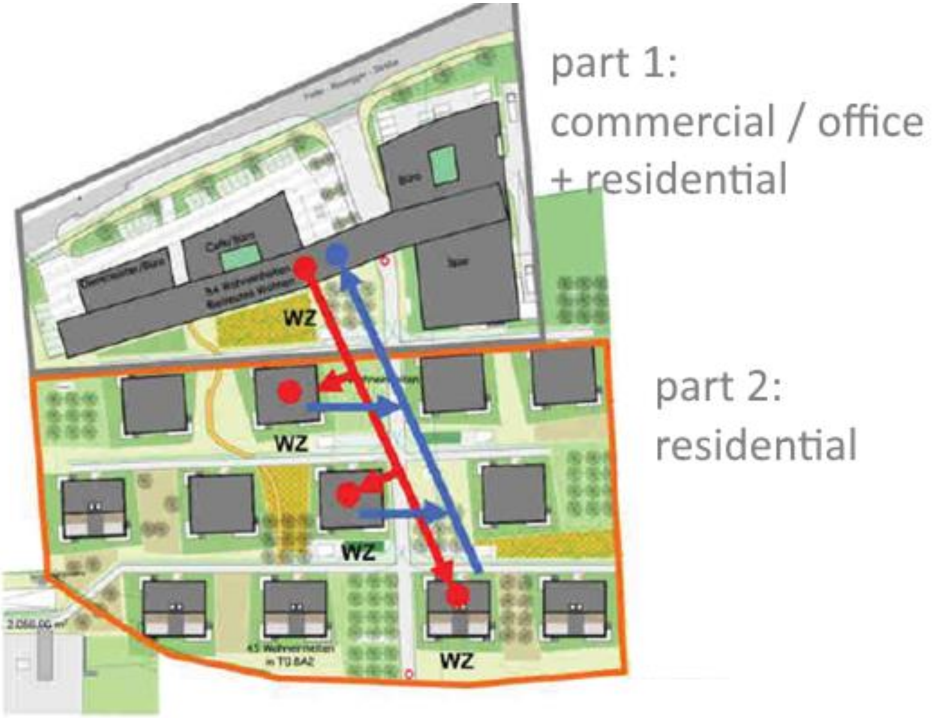
Funding:

- via subsidies, funding for innovations, research projects
- Contracting for cooling energy

Demonstration project + ERS
Towards Plus Energy Neighbourhoods



DH was planned for this area already before 2010



Successful integration into existing energy system?

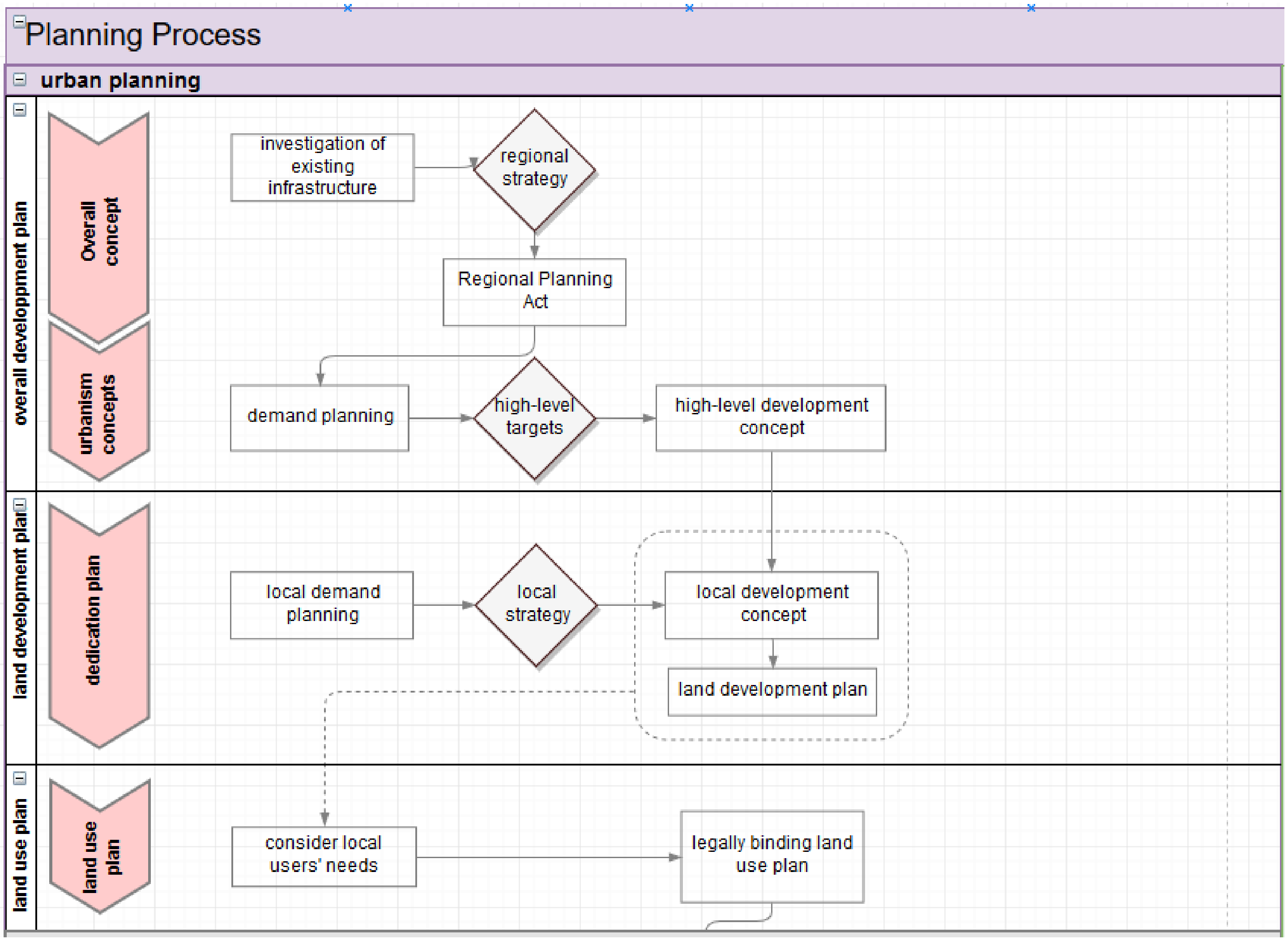
HEAT:

- Neighbouring buildings as first backup, district heat as second backup
- Heat/cooling exchange with neighbouring building is technically possible. Organisationally not

POWER:

- Connected to power grid

Process Design of Energy Master Planning in Austria

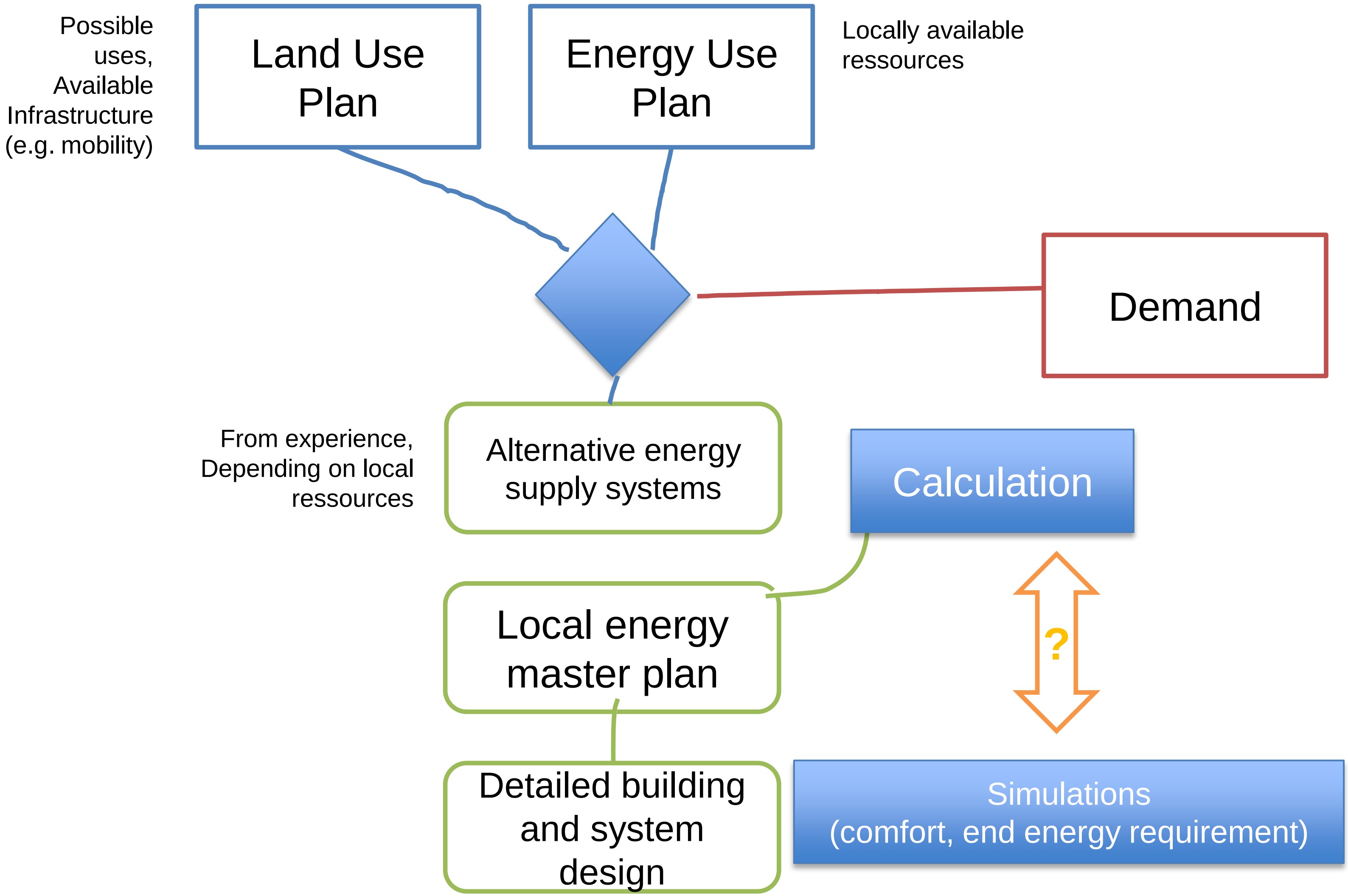


Source: CraveZero

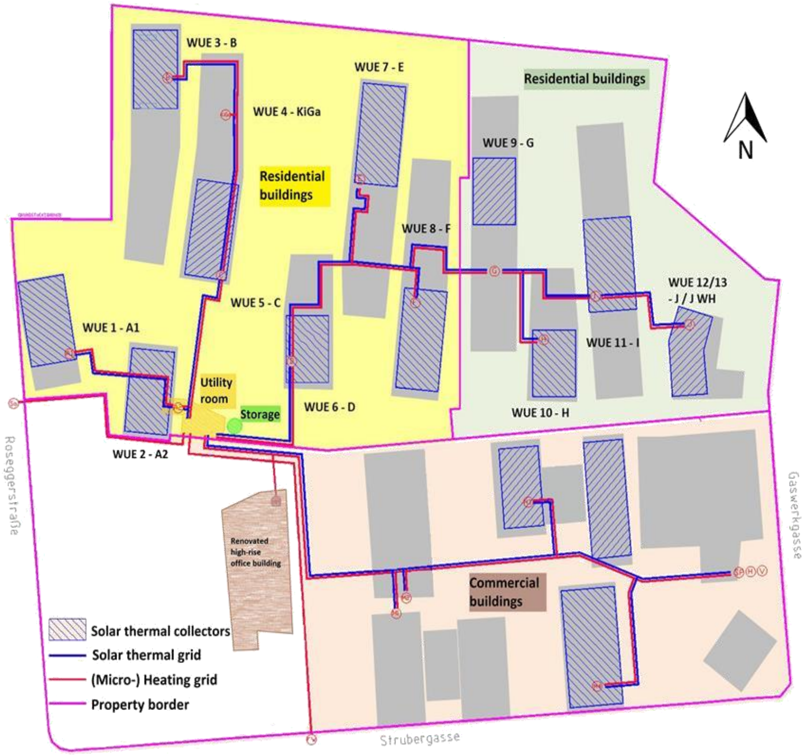
Energy Use Planning

- Priority areas
- Priority energy supply system

Process design



Example: Salzburg Lehen



Example Salzburg-Lehen: Low-temperature SDH grid

Solar thermal system connected to a low-temperature heating network supplying around 68,000m² of heated floor area

2,048m²$_{gross}$ flat plate collector field (mounted on 13 separate roofs)

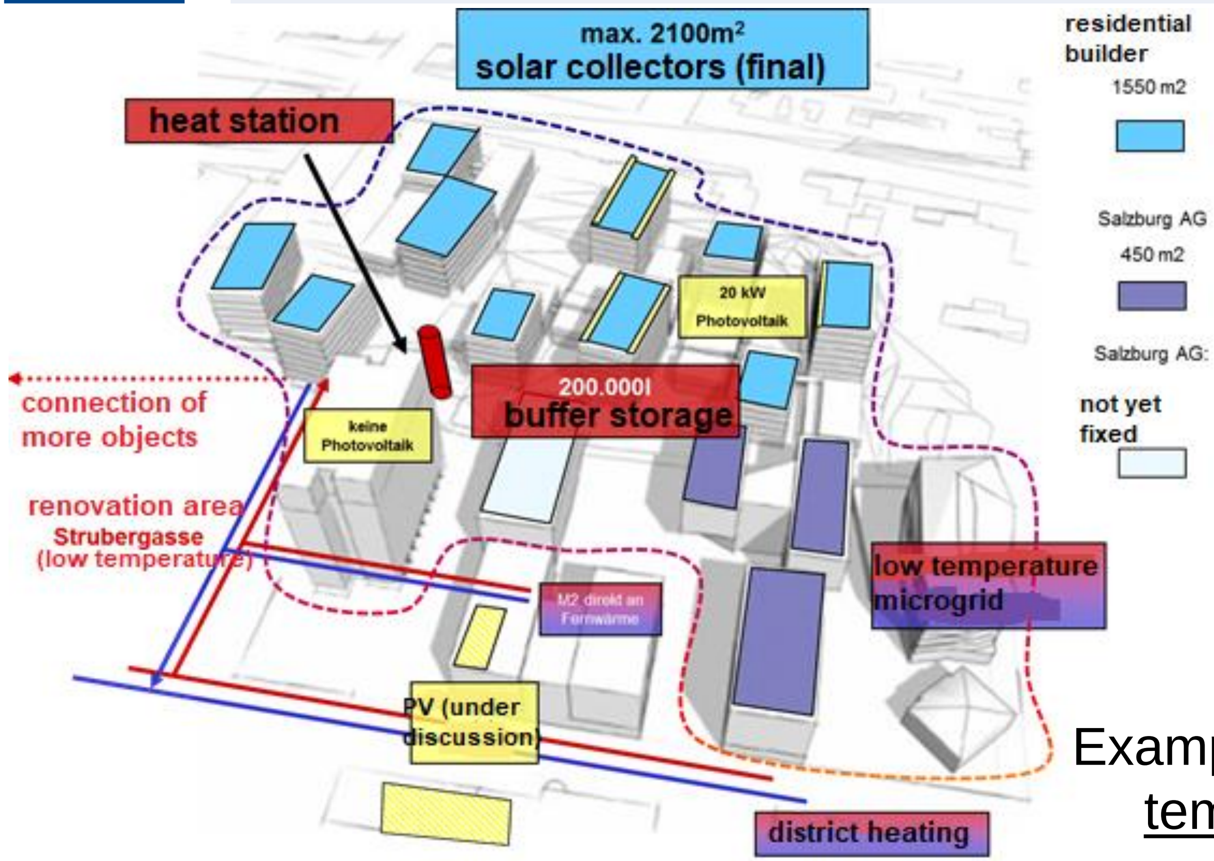
200 m³ energy storage

Auxiliary heating: storage integrated HP (160 kW$_{th}$) + district heating

DH supply temperatures: 65/35

Monitoring: 07/2013 – 06/2014

Example: Salzburg Lehen



Example Salzburg-Lehen: <u>Low-temperature SDH grid</u>

Solar thermal system connected to a low-temperature heating network supplying around 68,000m² of heated floor area

Conclusion and Outlook

TOP DOWN:

- Communities define energy and emission strategies
- Development of a common procedure for land use and energy planning
- Energy planning to accompany land use planning

BOTTOM UP:

- Provide information on local energy supply system
- Potential for renewable energies
- Cooperation with neighbours

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- Cooperation with neighbours

+

Data aquisition (consumption, return temperature)

Data exchange (GIS, BIM, …)

System optimisation (buildings and energy systems)

Steering measures

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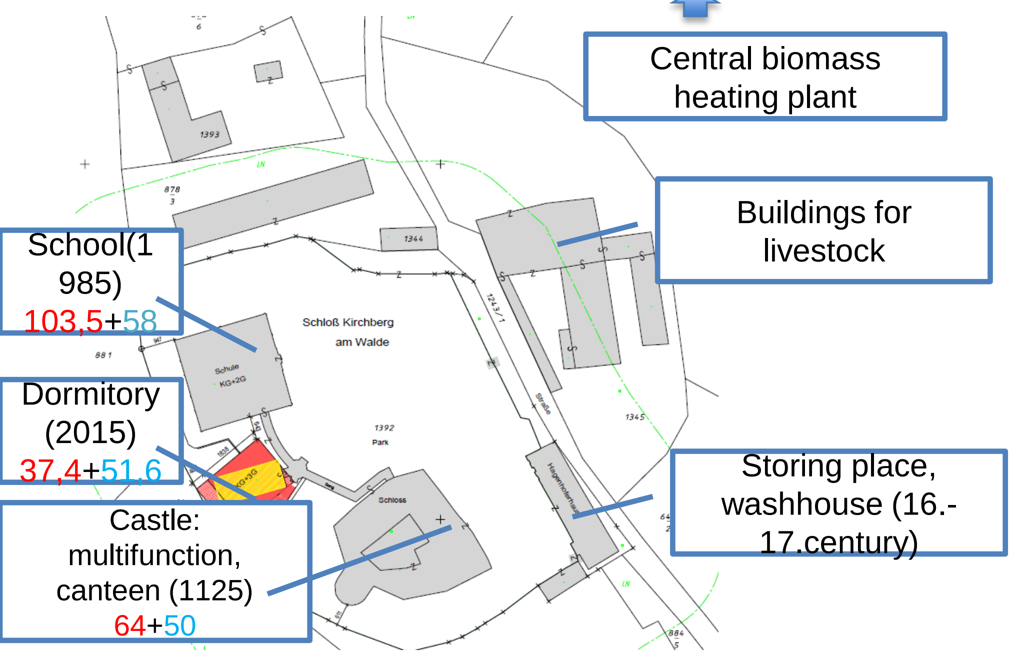
IDEA TO ACTION

Thank you
for your Attention

Kirchberg am Walde: Partial Renovation of a rural school

Starting point:
- Agricultural and forestry school in Upper Styria
- >7680 m² - 36 appartments
- Dormitory, canteen, school building

Driving Forces:
- Bad comfort and need for more space
- Need for good publicity (to have enough pupils)



Aim: Rebuilding of the dormitory house, thermal renovation of all buildings, where possible

Heat + DHW consumption

BEFORE : xxx kWh/m²a

AFTER: 14,4 kWh/m²a

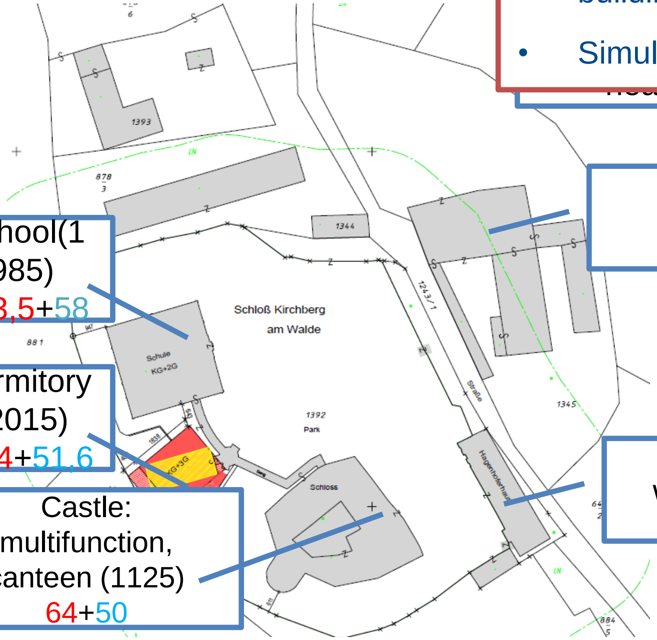
Kirchberg am Walde: Partial Renovation of a rural school

Innovative technical solutions:

- Rebuilding the dormitory
- Careful renovation of historic monuments

Tools:

- Baseline Study
- Calculation/Measurement of Energy consumption of single buildings
- Simulation (building, HVAC)



School(1985)
103,5+58

Dormitory (2015)
37,4+51,6

Castle: multifunction, canteen (1125)
64+50

Buildings for livestock

Storing place, washhouse (16.-17.century)

Funding:

- Public funding
- Income via PV feed in

- No optimization of heat network
- Single building approach