Rural Intelligent GRID

RIGRID - from Vision to Realization

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ERA-NET SMART GRIDS PLUS | FROM LOCAL TRIALS TOWARDS A EUROPEAN KNOWLEDGE COMMUNITY

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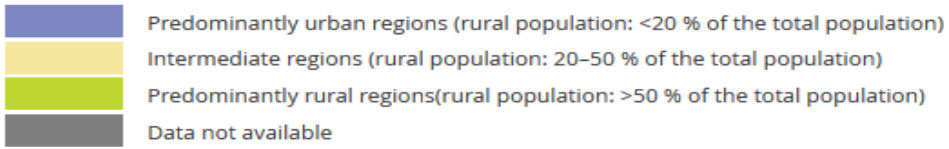
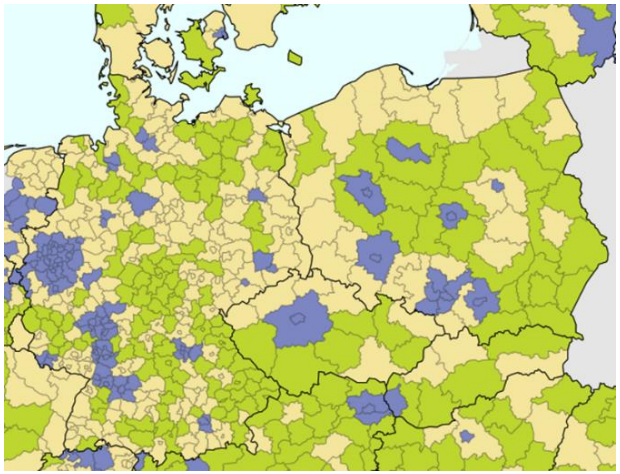
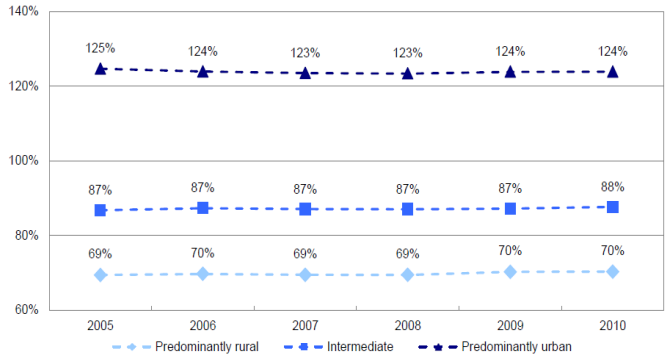
Rural Intelligent Grid – Motivation

- The dominant role of Renewable Energy Sources (RES)
  - Aim of European Union: up to 80 % of the total electric demand by RES by 2050
- Opposition from the local population regarding installing new power plants
  - Non-engagement in the planning and decision-making processes
- Most of the European areas are rural
  - The development of smart grid rural areas represents a good test field to realize and test new energy projects

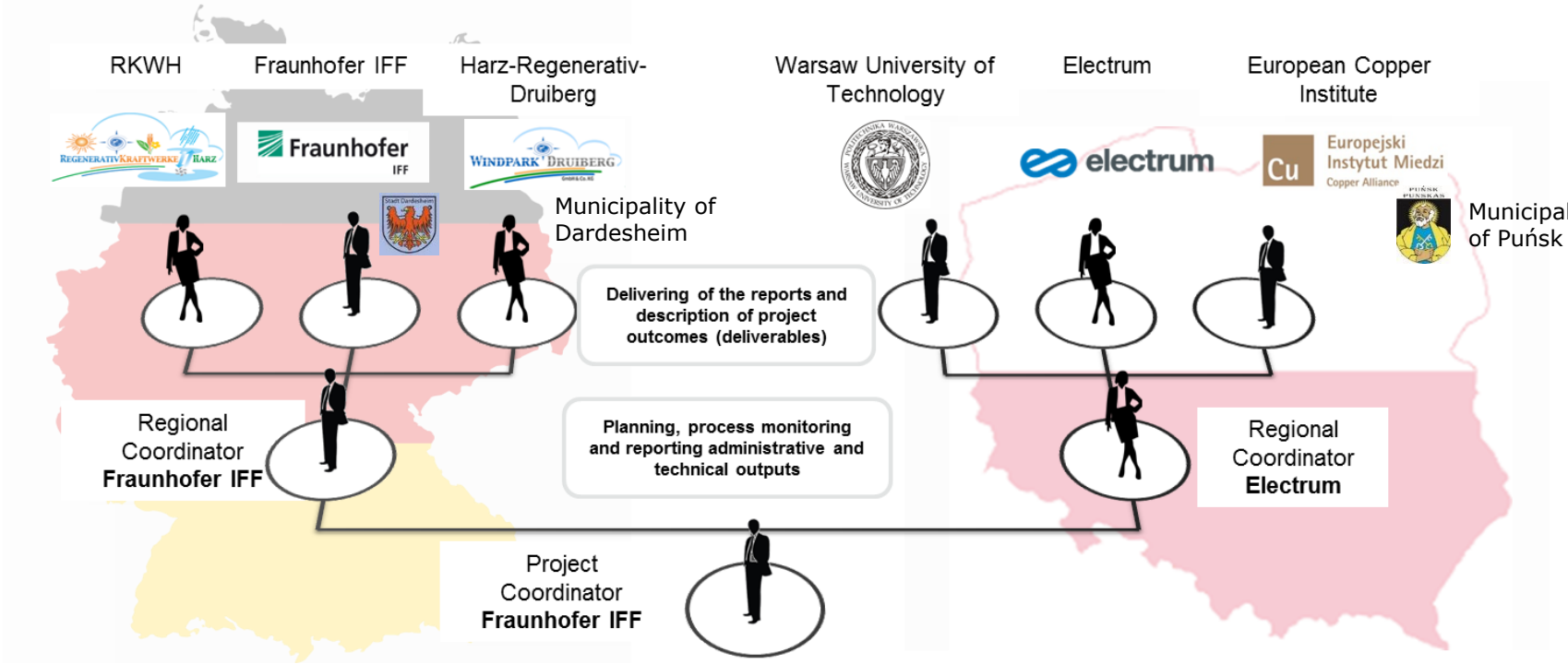






GDP per capita in different types of region in relation to the EU average, 2005-2010

Project Consortium



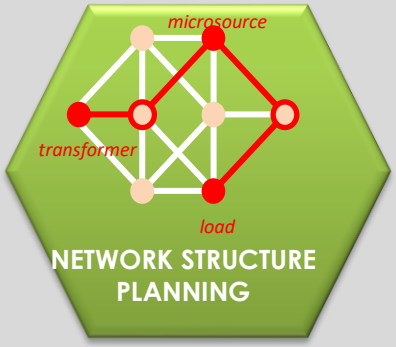
Three Layers of ERA-Net Smart Grid Plus

RURAL INTELLIGENT RIgrid

Technical layer

Local generation from RES

- to improve reliability and security of supply
- to reduce CO_2 emission



Social layer

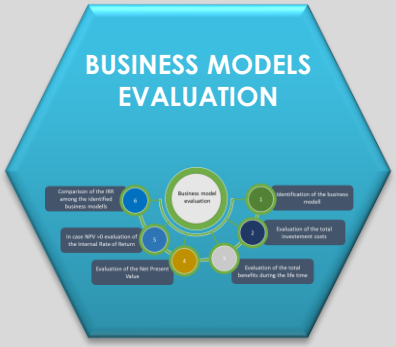
Active participation of inhabitants

- acceptance of new investments
- new jobs, contract for local companies
- attract new residents

Economic layer

Involvement of the inhabitants into the clean energy idea

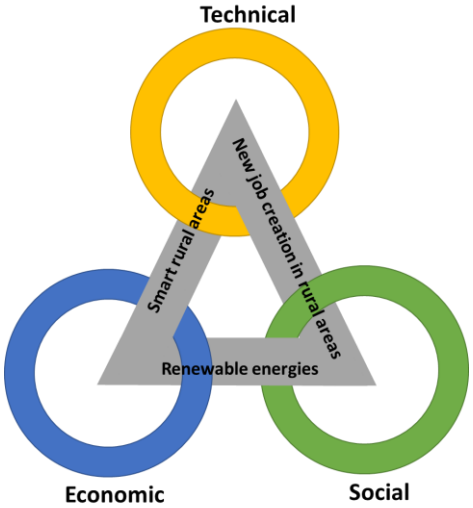
- income from the energy sale
- new career opportunities
- increased visibility of the region
- „energy" tourism development



Rural Intelligent Grid – aims and innovation

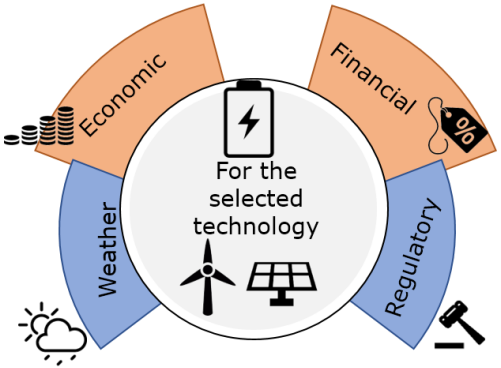
RURAL INTELLIGENT RIgrid

Aims



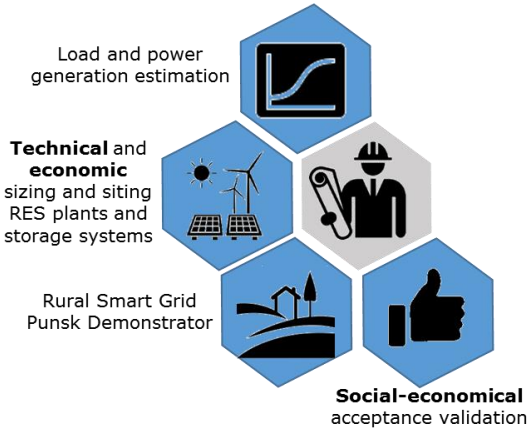
- Design tool for the planning and operation of smart grids in rural infrastructures
- Multiple-criteria approach that considers technical, economic and social aspects

Methodology



- **Technical**: realization of smart rural area based on the use of RES
- **Social**: acceptance analysis for installation new infrastructures
- **Economic**: developing new business models and attractiveness analysis

Results

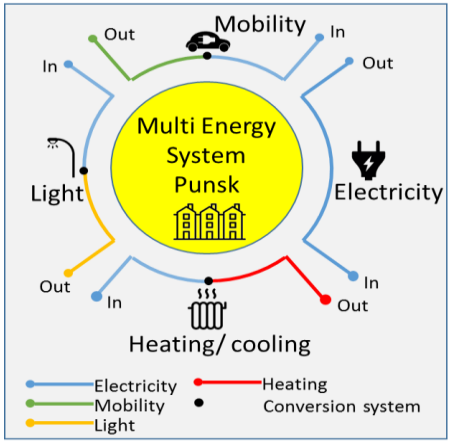


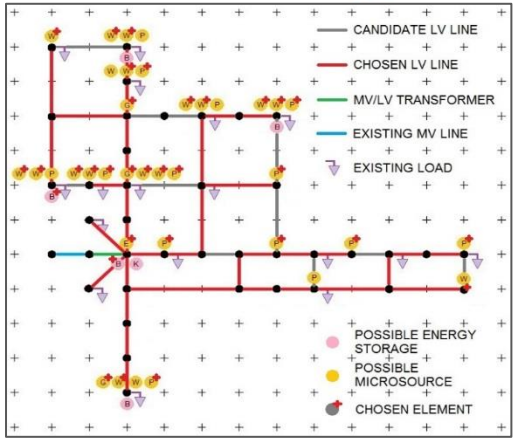
- Software tool based on VRS Platform® and on Microsoft Office®
- 3D visualization of scenarios
- Business model analysis

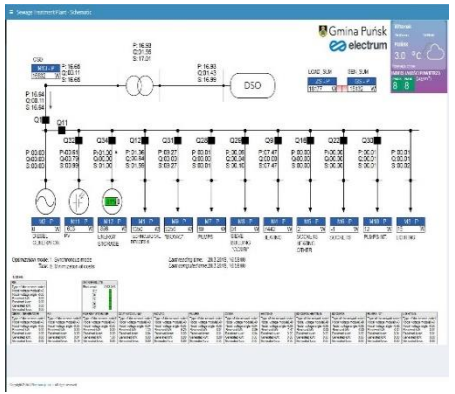
Areas of implementation

Technical layer – selected results

- Concepts, models and algorithms for optimal planning and operation of microgrids in rural areas
  - Software for planning optimal structures of LV microgrid
  - Softwar for optimal microgrid operation
  - Multi-energy model of Punsk
- Demontrator in Punsk
  - wastewater treatment plant (30 kW), PV (40 kWp), diesel generator (25 kW), battery storage (18 kW/ 25 kWh), controllable load, metering, control, protection and communication
- EMACS for monitoting and controling microgrid
- Laboratory stand for protection system testing

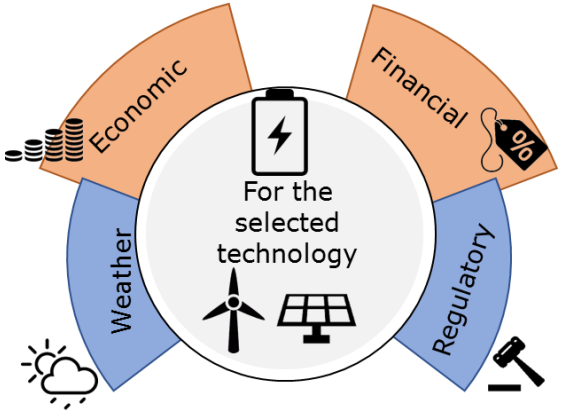


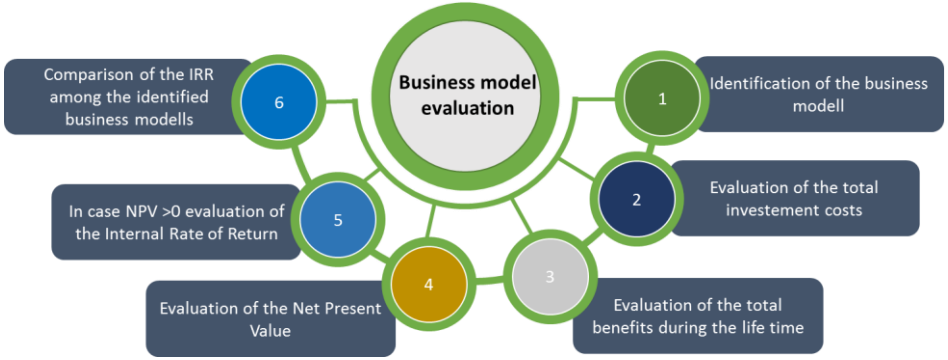


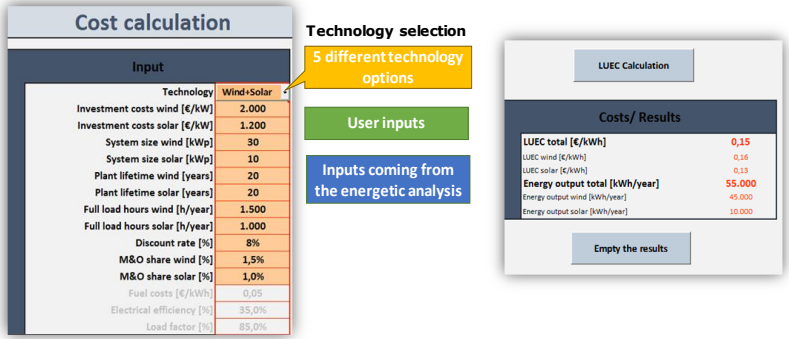


Economic layer – selected results

- Investment and operation cost calculation tool for electrical infrastructure planning and operation
  - Economic sizing of power plants and energy storage systems
  - Under condition: economic, finacial, regulatory, weather
  - Total Investment
  - Electricity Generation Costs
  - Business Model
  - Environmental impact/ Avoided CO2 emissions
  - Potential job creation

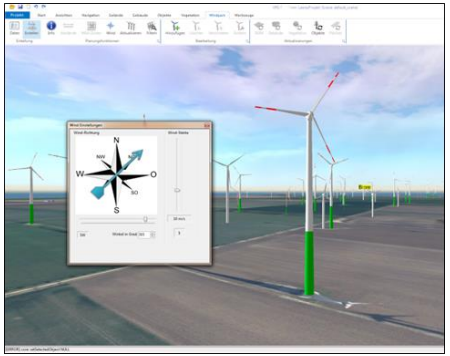


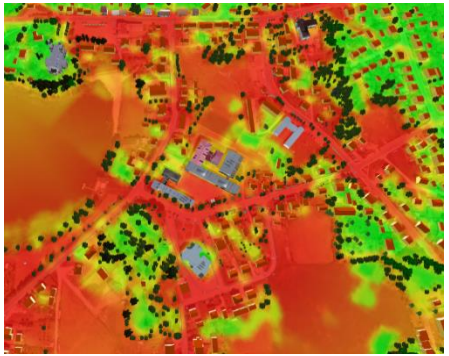


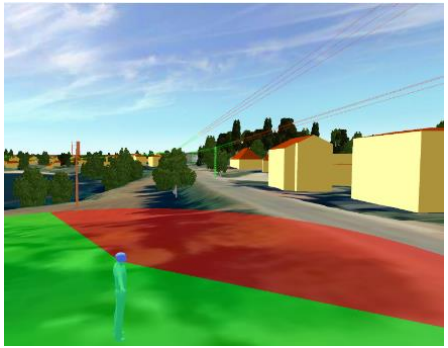


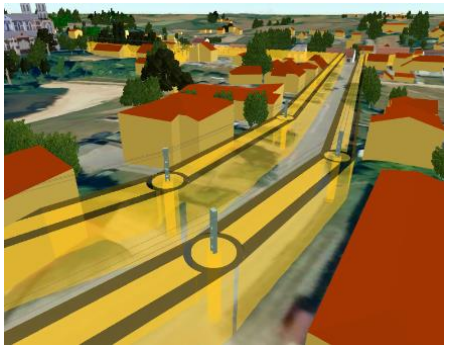
Social layer – selected results

- Virtual Reality tool for spatial planning and acceptance analysis of electrical infrastructure
  - Simulation and communication of planning with decision makers, planners and residents
  - Creation of acceptance among the population
  - Presentation of actual situations and planning alternatives
  - Customized object catalog
  - Interactive functionalities for planning and presentation

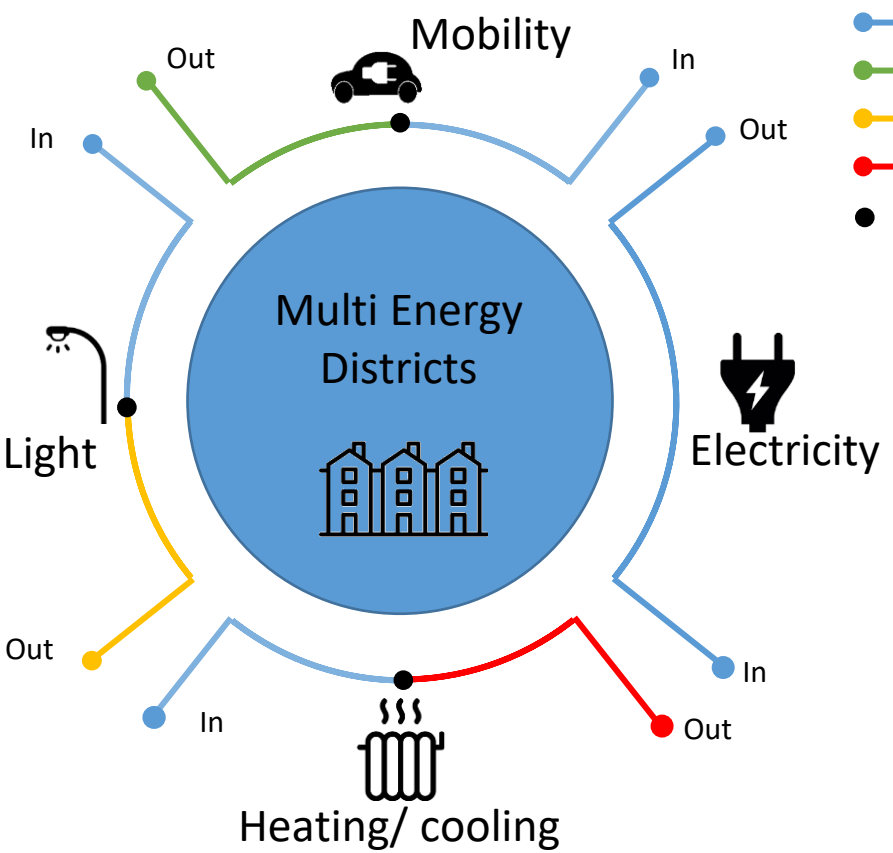








RIGRID Tool: Planning Net Zero Energy Cities- Holistic approach



- Electricity
- Mobility
- Light
- Heating
- Conversion system

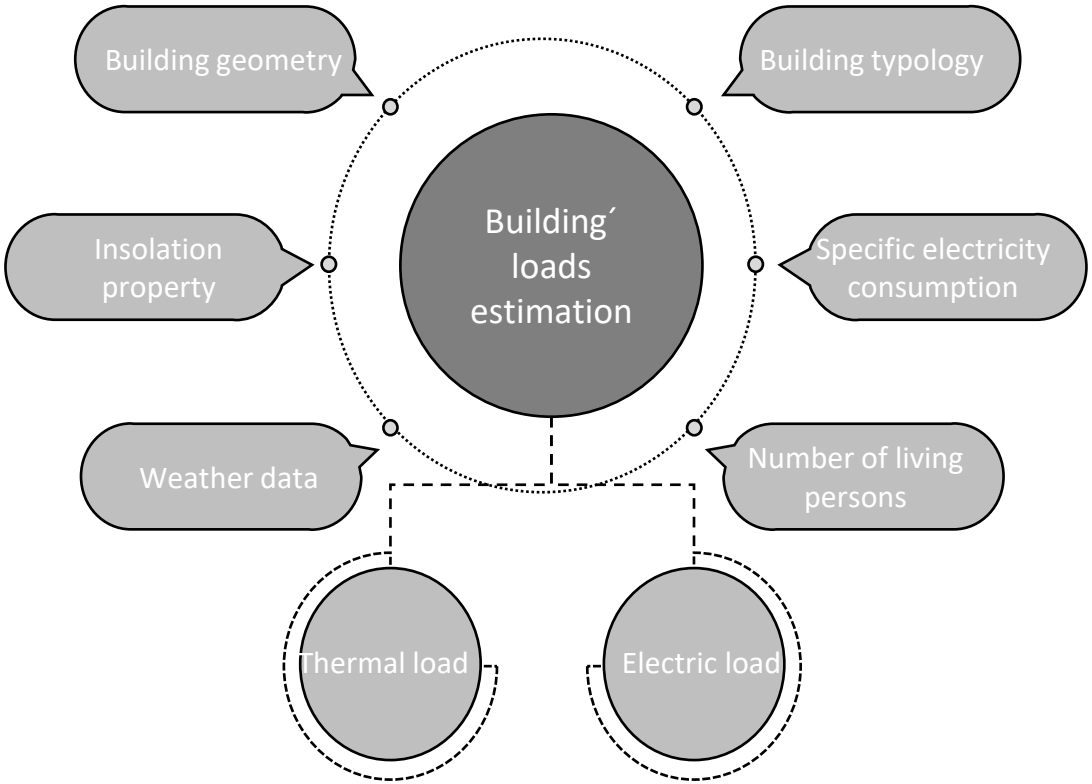
Electrification of all energy uses:

- mobility, light and heating-cooling

Multi energy systems: holistic approach of the whole energy system

- Improvement of relisience and security of the urban energy system
- Improvement of reliability
- Microgrids as solutions (i.e. 2011 tsunami in Japan)

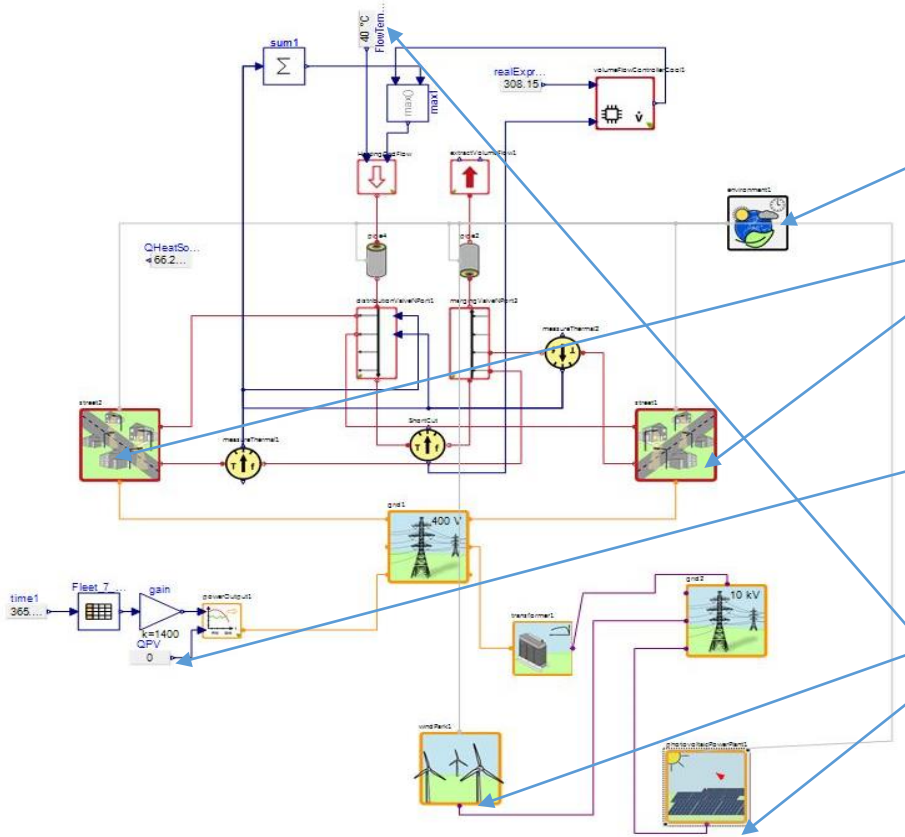
RIGRID Tool: Planning Net Zero Energy Cities- Modelling tools for energy use in buildings



Insolation property and building geometry: Thermal load
Building typology and number of living persons : Electric load

RIGRID Tool: Planning Net Zero Energy Cities- Evaluation of consumption and generation potential

Source: GreenCity Library-SimulationX



Weather data

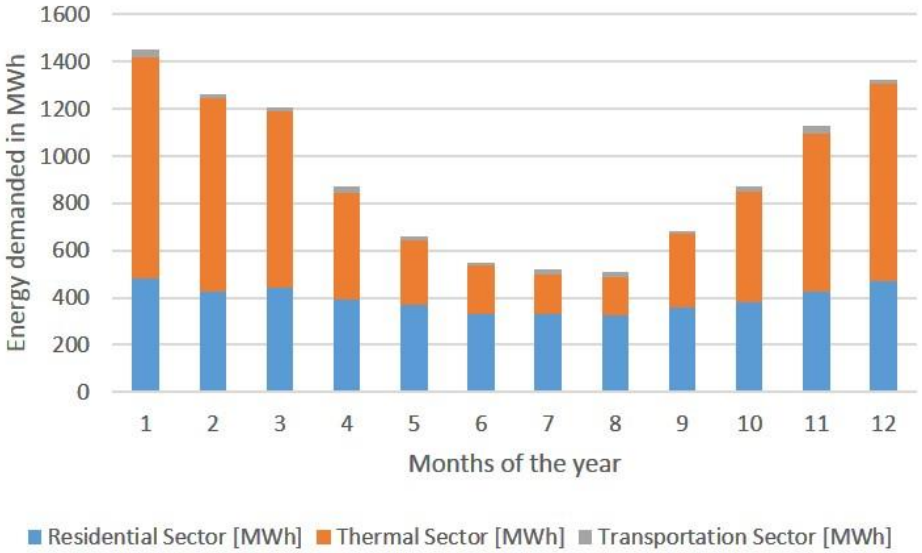
Electric-thermal loads for districts

Load profile for the mobility

Electricity generation by RES

Heat supply

Study case: Punks 2050- Net Zero Energy System- Energy consumption

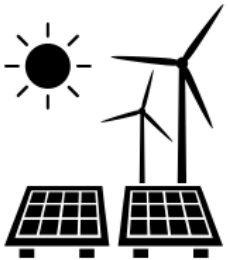


	Residential sector	Thermal sector	Transportation sector
Max demanded electric power [kW]	1221	2874	460
Yearly demanded electricity [MWh]	4718	6029	240

Study case: Punks 2050- Net Zero Energy System- Energy and economi indexes

$$SSCI = \frac{\int_{t=t_1}^{t_2} \min\left\{Load(t), RES_{gen}(t)\right\}}{\int_{t_1}^{t_2} RES_{gen}(t)}$$

System Self Consumption Index



$$NPV = \sum_{t=0}^{N} \frac{CF_t}{(1+i)^t}$$

$$IRR = \sum_{t=0}^{N} \frac{CF_i}{(1+r)^t} = 0$$

$$SSSI = \frac{\int_{t=t_1}^{t_2} \min\left\{Load(t), RES_{gen}(t)\right\}}{\int_{t=t_1}^{t_2} Load(t)}$$

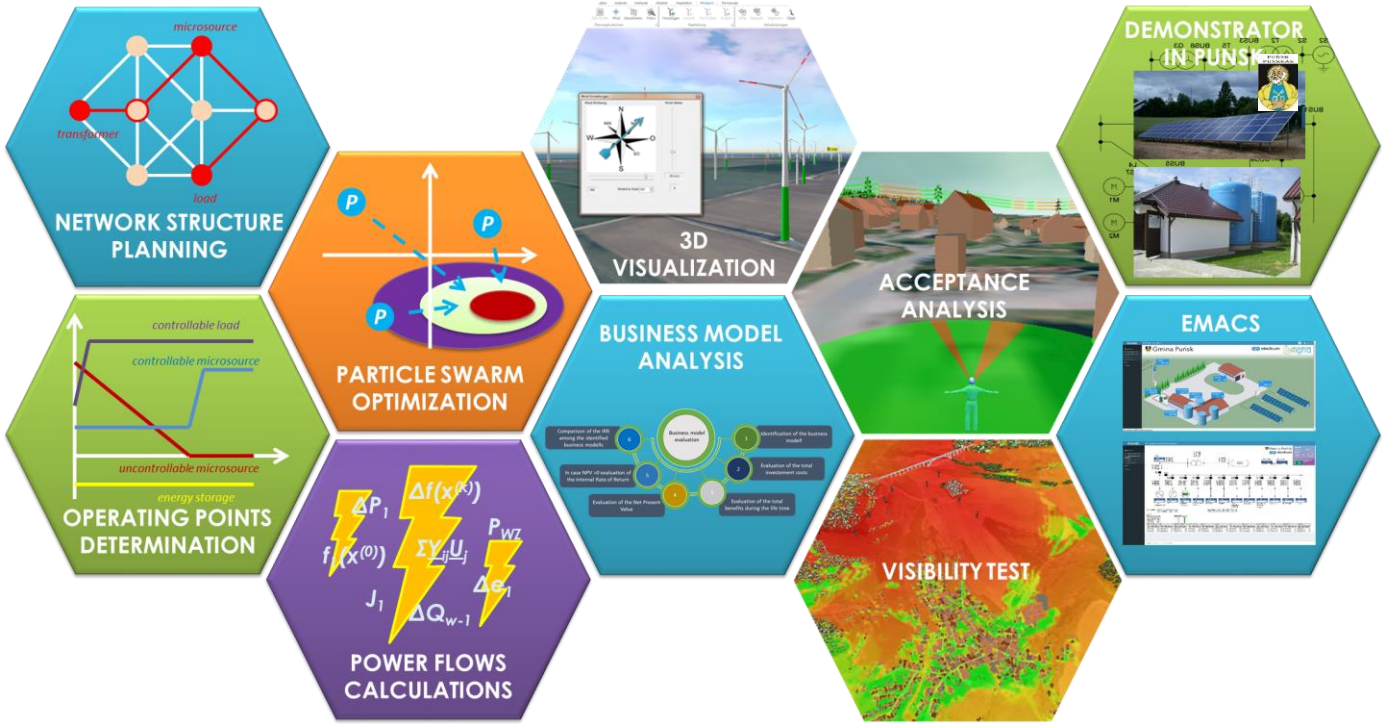
System Self Sufficiency Index

$$LUEC = \frac{\gamma \cdot i}{h \cdot \left[1-(1+i)^{-y}\right]} + \frac{M\,\&\,O}{E_{el}}$$

Study case: Punks 2050- Net Zero Energy System- Economic evaluation-Electricity generation costs

PV (kW)	Wind (kW)	$LUEC_{NZES}$ (€/MWh)	NPV (k€)	IRR (%)
10850	0	128	640	5,34
9000	1100	127	3056	6,7
8000	1621	118	2850	6,7
7000	2282	108	2663	6,78
6000	2873	98	2839	7,06
5000	3464	89	2643	7,1
4000	4055	79	2572	7,25
3000	4646	70	2625	7,55
2000	5237	61	2678	7,93
1000	5828	51	2607	8,28
0	6420	46	2591	8,50

RIGIRD Realization



ISGAN Award of Excellence 2019

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Thank you for your attention!

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Smart Grids Plus ERA-Net

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