RE_SYS+ PNS

Die Toolbox für die Energiewende vor Ort

RESYS-TOOL

A CALCULATOR FOR THE ENERGY TURNAROUND IN MUNICIPALITIES AND REGIONS

CONTENT

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akaryon WEBTOOLS • UMWELT • FÖRDERUNGEN

Mit Wind zur Sonne

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TU WIEN

Technische Universität Wien Institut für Raumplanung Regionalplanung und Regionalentwicklung

raum region

STRATEGO

STUDIA INTELLIGENT ANALYSIS

Borovsky & Duschek GmbH KLIMATISCHE GUTACHTEN | MODELLIERUNG | MESSTECHNIK | WISSENSCHAFTLICHE AUSWERTUNG

BOKU

IRUB Institut für Raumplanung, Umweltplanung und Bodenordnung

gefördert im Rahmen der FFG-Programmlinie COIN

FFG Forschung wirkt.

RESYS-TOOL

RESYS is a **web-based tool** for the **development of a regional energy strategy** with a focus on renewable energies. Resys helps to quickly estimate

- a **municipality's energy demand** and **its development over time** (temporal resolution of one hour) for the following demand sectors: residential, industry, infrastructure and mobility
- the **potential for the energy supply** from renewables (achievable yields, time curve, investment cost)
- in **how far supply matches demand** taking account any available buffers (energy storage)
- a good **energy strategy** for the examined region relying on a smart benchmarking system

Resys provides answers to the following questions (relying on scenario analysis where appropriate):

- How does the energy demand develop over time in my municipality/region in different sectors (residential, industry, infrastructure, mobility)? Refuting the common argument "Renewables are fine but the energy is not available at times when needed."
- What is the region's potential in renewables in terms of "technically available potential"?
- Which part of this technical potential may be realistically tapped? What are the related investment costs?
- Which renewables are to be preferably used? (interactions between the sectors are considered)
- What are the consequences of trends and actions in energy efficiency and municipality development regarding the various demand sectors?
- In how far do curves resulting from the energy demand simulation match the supply curve? Can the system cope with demand peaks, for instance during the morning and evening hours?
- When would excess energy be available? What is the effect of buffers on the rate of energy use from local renewable sources and on required grid extension?

Examples for the **application of the tool**: Development of regional energy concepts, regional projects, and research

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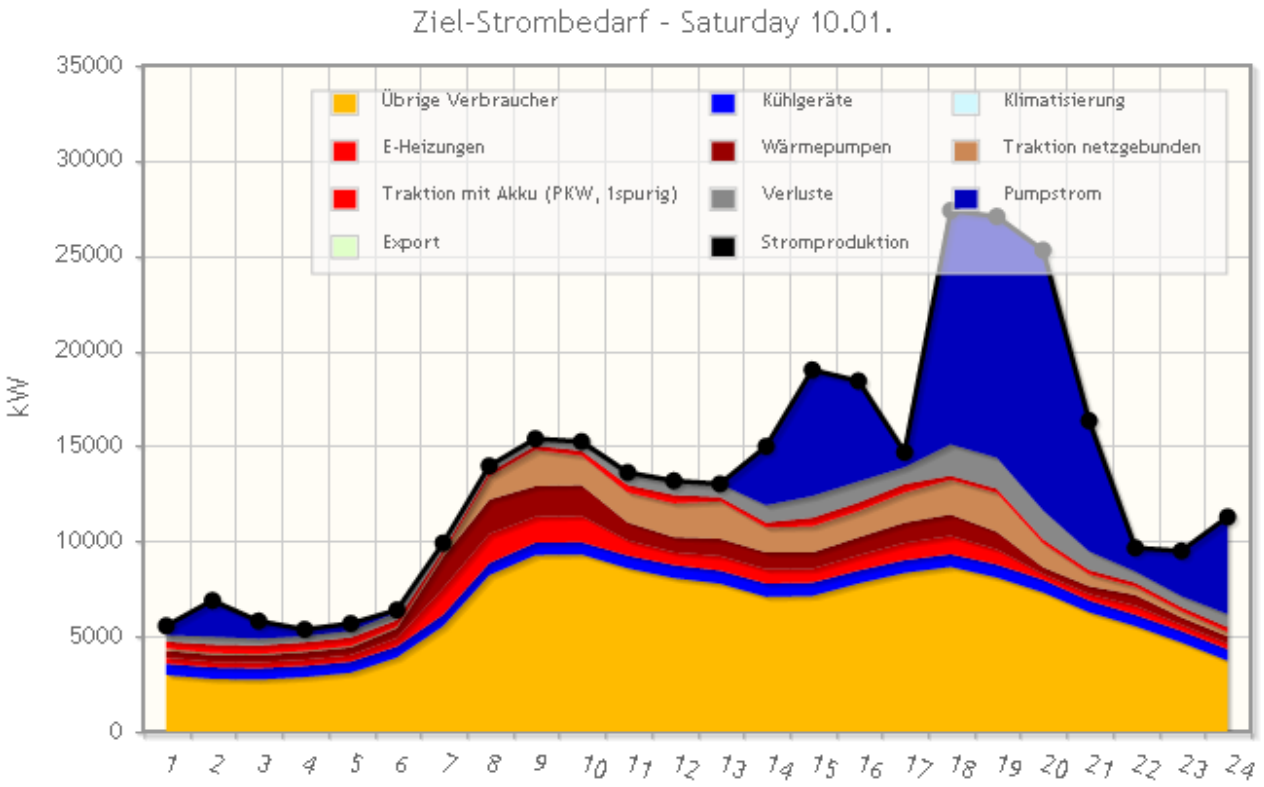
USAGE AND APPROACH

Resys relies on benchmark figures linked to municipality categories, and on databases on target energy potentials and climate. Thereby the need for primary data in your project is minimised!

1. Energy demand simulation
2. Estimate renewable energy potentials
3. Match demand and supply & work out future developments and targets
4. Substantial targets: Across energy sources and with steps down to one hour
5. Monitoring, Controlling

Results: A simulation of demand and supply curves including the auxiliary electricity demand



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OVERVIEW

The tool consists of the following 6 steps:

1 Assessment of the category of your municipality
Based on few figures the category of your municipality is assessed. Assigning a category allows for a quick and sound assessment of the municipality's figures of demand and supply in the following steps:

2 Current energy demand
Based on the category of your municipality and on benchmark data a few further inputs lead to a first estimate of the total energy demand of the sectors residential, industry, mobility and infrastructure of your municipality. The parameters may be readjusted once more fine-grained data is available. This assessment partly relies on internal calculations of heat and cooling demand which are based on regional climate data.

3 Current energy production
The current supply situation based on renewable energies is assessed as well as the theoretical potential of renewables from local resources.

4 GHG – greenhouse gases
In this section greenhouse gas settings and emission factors can be defined or overwritten. The default emission factors are based on well-established emission factor sets (e.g., SEAP-LCA, UBA, Joanneum Research).

5 Analysis
Regional climate data is used for the simulation of climate-dependent supply and demand data, the latter being broken down by sector and type of useful energy. The comparison of supply and demand shows potential deficits in covering the demand with renewable energies.

6 Services
Input and output data as well as the SECAP-report can be exported and downloaded.

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RESYS-TOOL – SELECTED INSIGHTS

Step 1: Assessment of the municipality category

The model in the background:
Basic structural data (e.g., inhabitants and employees, land usage) on the municipality leads to assigning the municipality one of the predefined categories by an internal algorithm. Each municipality type uses benchmark data on specific energy demand and supply curves (based on the energy balance data of 168 Austrian municipalities and 15 large European cities).

	City
	City with industry
	Tourism destination
	Agrarian municipality, focus on agriculture

	Agrarian municipality, focus on livestock
	Small city with infrastructure
	Municipality with a high percentage of commuters

How this translates for the use of the tool:
First, only basic structural data on the municipality is entered. This allows for the classification into a municipality type.

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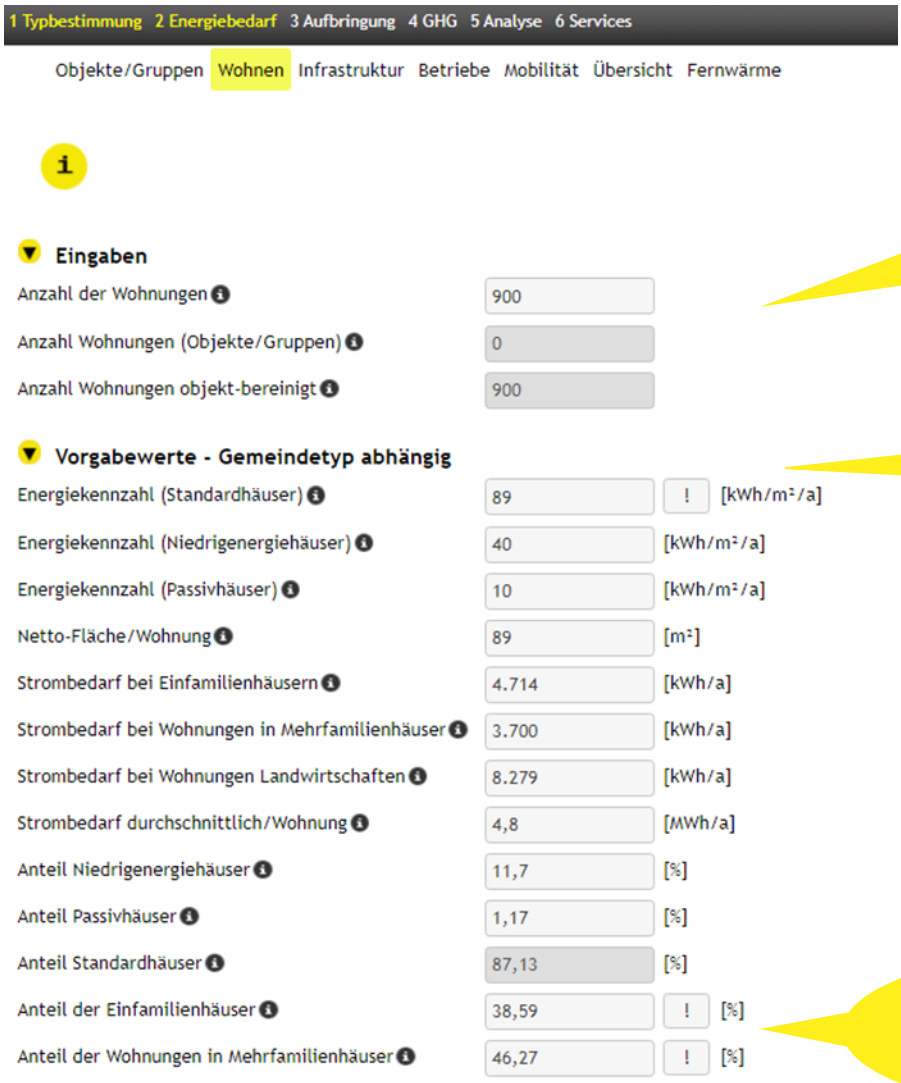
Step 2: Current energy demand

Once the user has access to more accurate data at a later stage, the new data may be added to increase the accuracy of the results ("auto refining systems").



The only obligatory input data for the identification of housing energy demand

Default values based on the municipality type

Precise value – if needed, click on the exclamation mark to reload the default value

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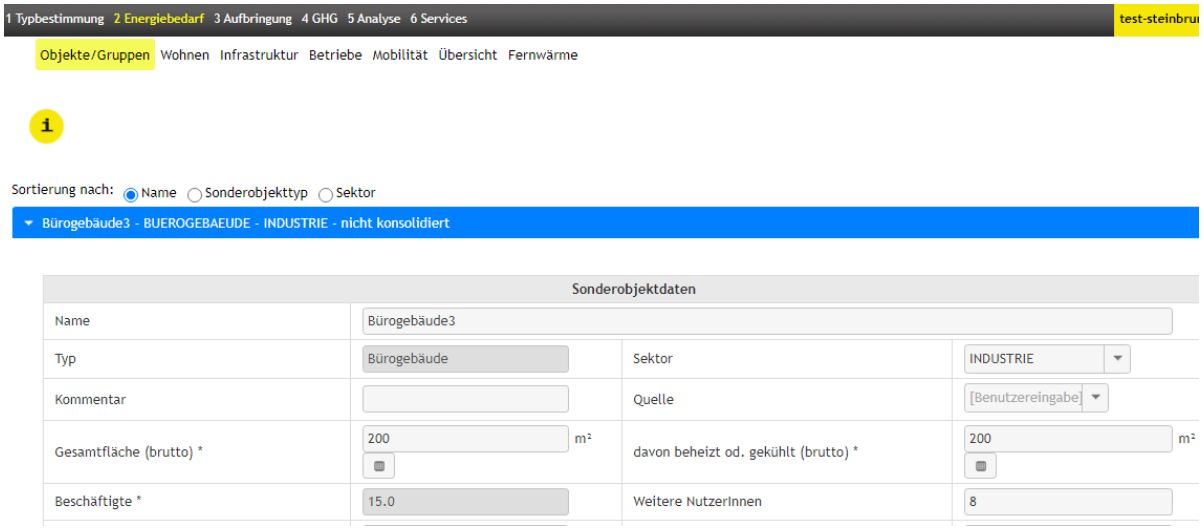
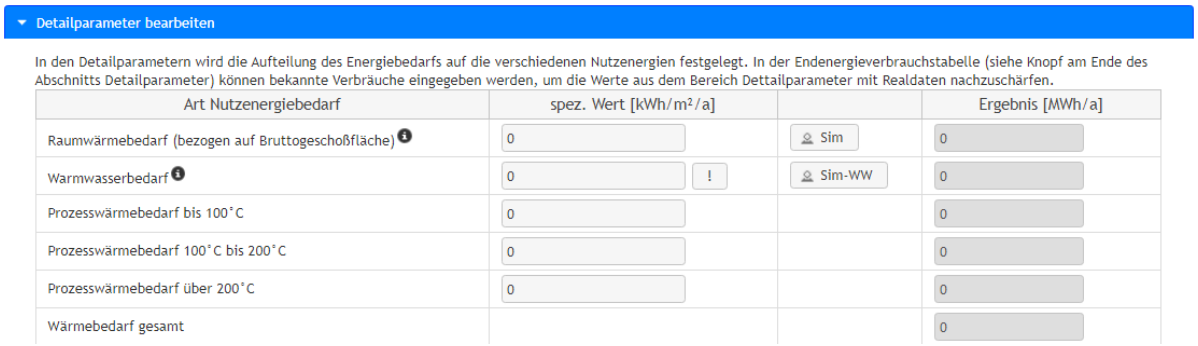
Acquisition of single objects

Objects whose data is known, such as schools, offices or residential buildings, can be recorded. For a first simulation, only the input of total area and number of employees is needed. If further details (see Detailed parameters and input of energy carriers) are known, the precision of the output data increases.

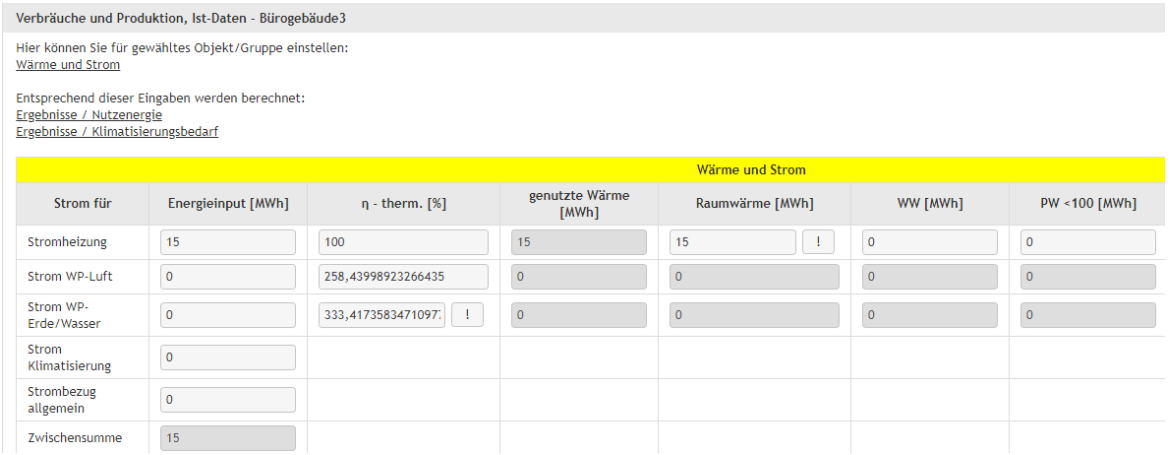
Basis data:



Detailed parameters:



Input of energy carriers:



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Step 3: Current energy production

The current use of renewable energy is assessed by energy carrier and by plant type:

- Solar energy (photovoltaics and solar thermal energy)
- Geothermal energy (converted to heat and electricity)
- Biomass
  - Plants with a CHP*:* biogas CHP (centralised and decentralised), biogas plant feeding into the gas network and producing fuel, large and small CHPs, BTL (biomass to liquid) plants, biofuel CHPs, methane/bio methane CHPs
  - Plants without a CHP: biomass boiler, biofuel boiler, natural gas/bio methane boiler, heat pumps (heat sources: air, soil or groundwater)
- Wind power
- Hydropower
- District heating networks

Example biomass plants

Parameters of the plant largely come with the software as pre-sets but may be overwritten by more specific data by the user.

Basis data:

Name	El. Leistung bzw. Treibstoff-Leistung in kW	Inputleistung in kW	Wärmeleistung in kW	Anteil Sommerbetrieb 0 ...1	Anteil wärmegeführt 0...1
Biogas mit BHKW1 (zentral)	1 !	2,5 !	1 !	0	1

Performance data:

Name	Heizlast-abdeckung wärmegeführter Anteil	Heizlast-abdeckung strom/BTL-geführter Anteil	eta-elektrisch	eta thermisch	eta-Produkt (BTL, Biogas)	rel. Hilfsstrombedarf	Biogas-Netzeinspeisung 0...1
Biogas mit BHKW1 (zentral)	1	1	0,4	0,4	0,97	0,02	0

Detailed parameters:

Name	Energieinput MWh/a	Ertrag Strom MWh/a	Ertrag genutzte Wärme MWh/a	Ertrag flüssige Brennstoffe MWh/a	Ertrag Biomethan (Gaseinspeisung, Verwertung in externe Kessel)	Bedarf Hilfsstrom MWh/a	Abwärme ungenützt MWh/a
Biogas mit BHKW1 (zentral)	3,83	1,532	1,532 FW-Einspeisung	0	0	0,077	0

Based on these parameters the yields of electricity, heat, fuel and excess heat as well as fuel demand and auxiliary electricity are calculated:

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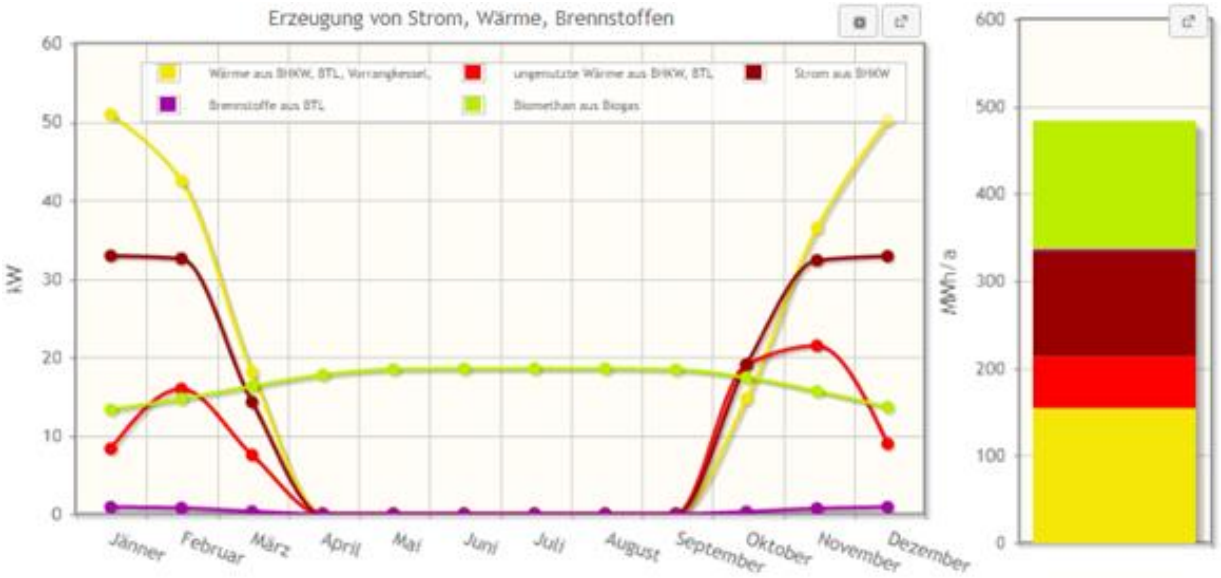

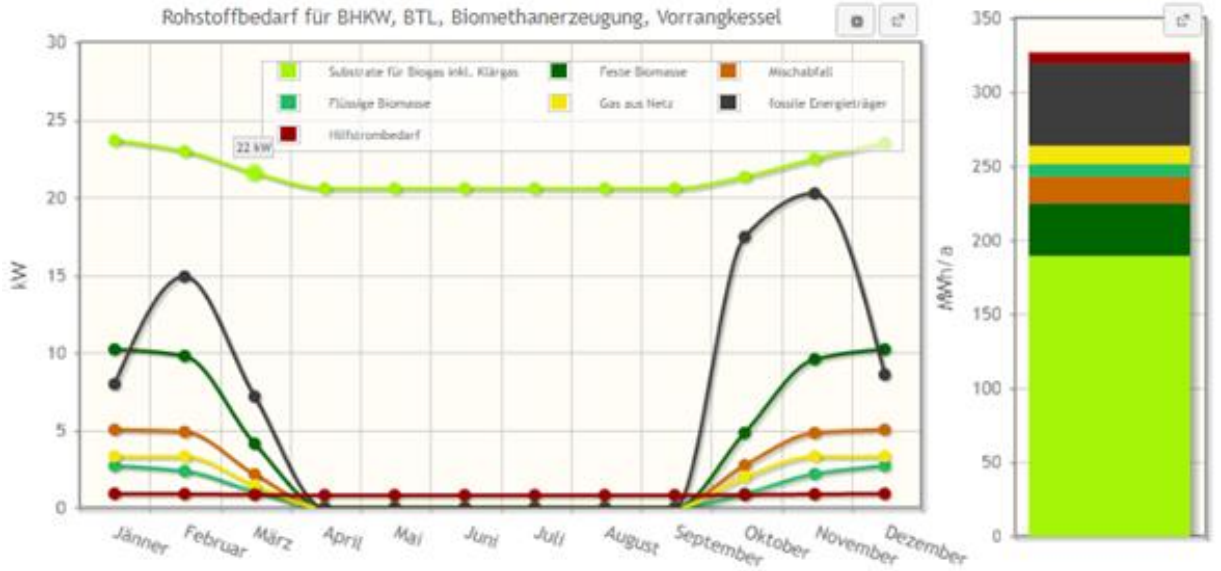

Example photovoltaics

In addition to assessing the yields, the use of the entire electricity of the municipality is compared to the locally available potentials for photovoltaic production.

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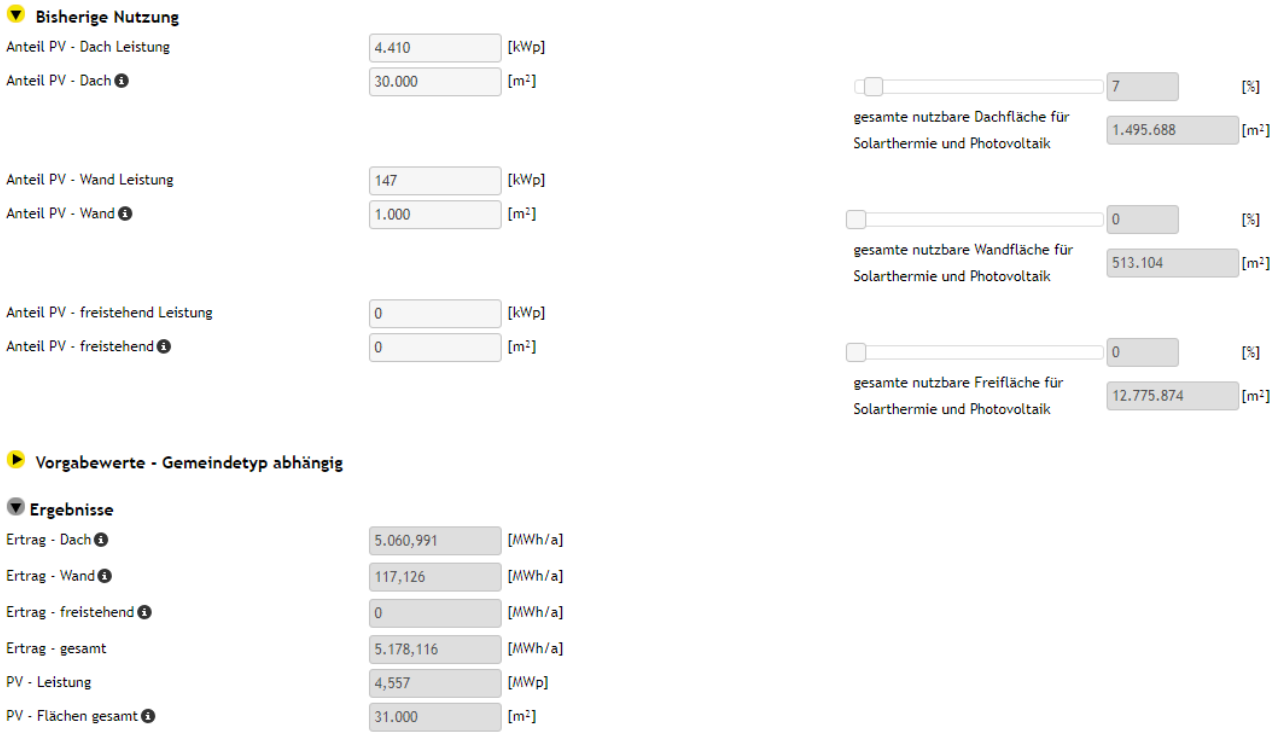
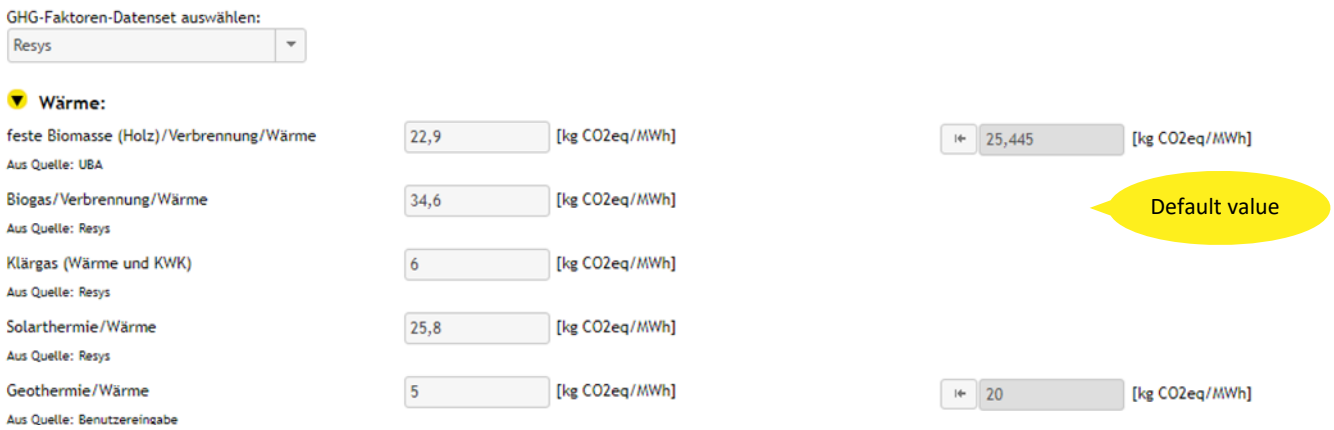


Step 4: GHG

In the module GHG, basic data for the calculation of greenhouse gas emissions is defined. The default values can be overwritten if needed.



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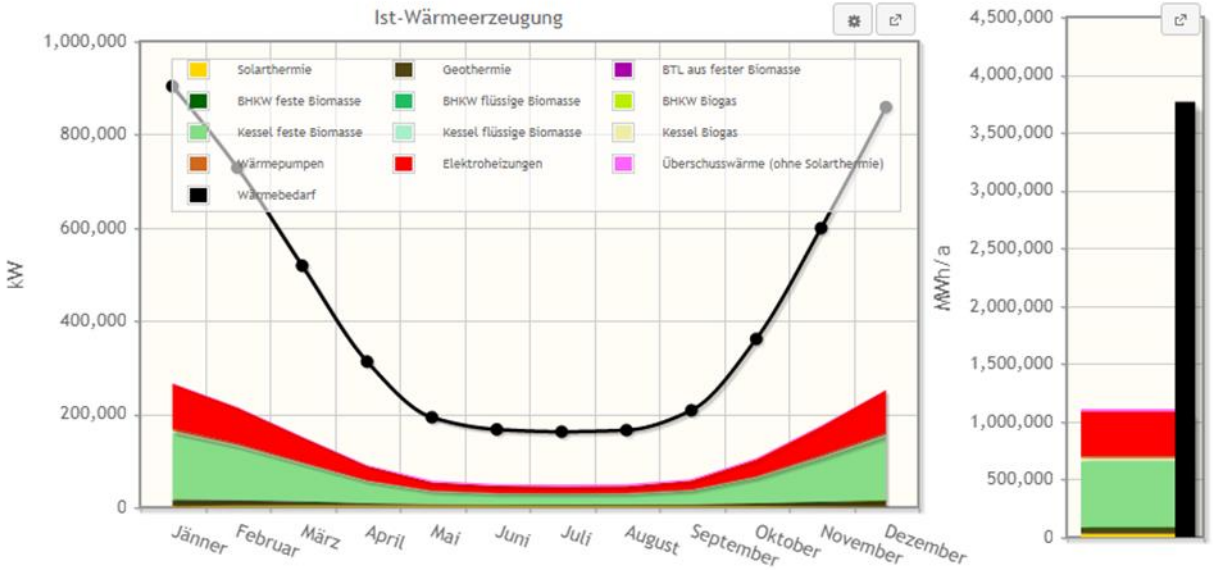
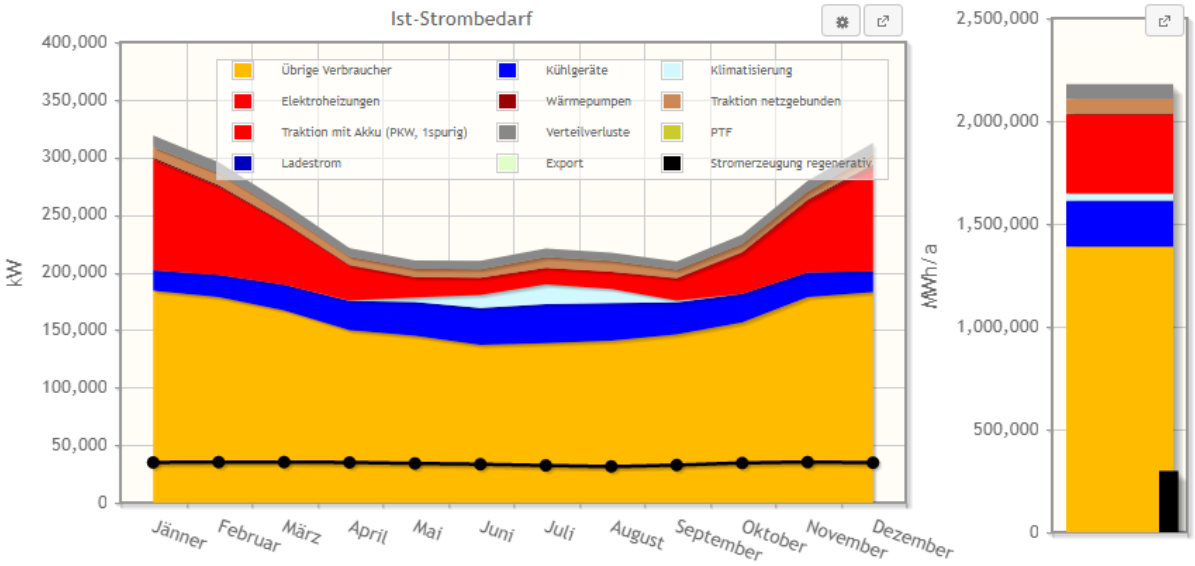
Step 5: Analysis

The comparison of the energy demand and the current use of energy shows the deficiencies when covering the demand with renewables (the more the local demand is covered by locally produced energy, the less must energy be imported) This, for instance, results in fewer required investment into the electricity grid capacity:



The analysis furthers shows the energy demand by sector to visualize potential approaches for energy saving actions:



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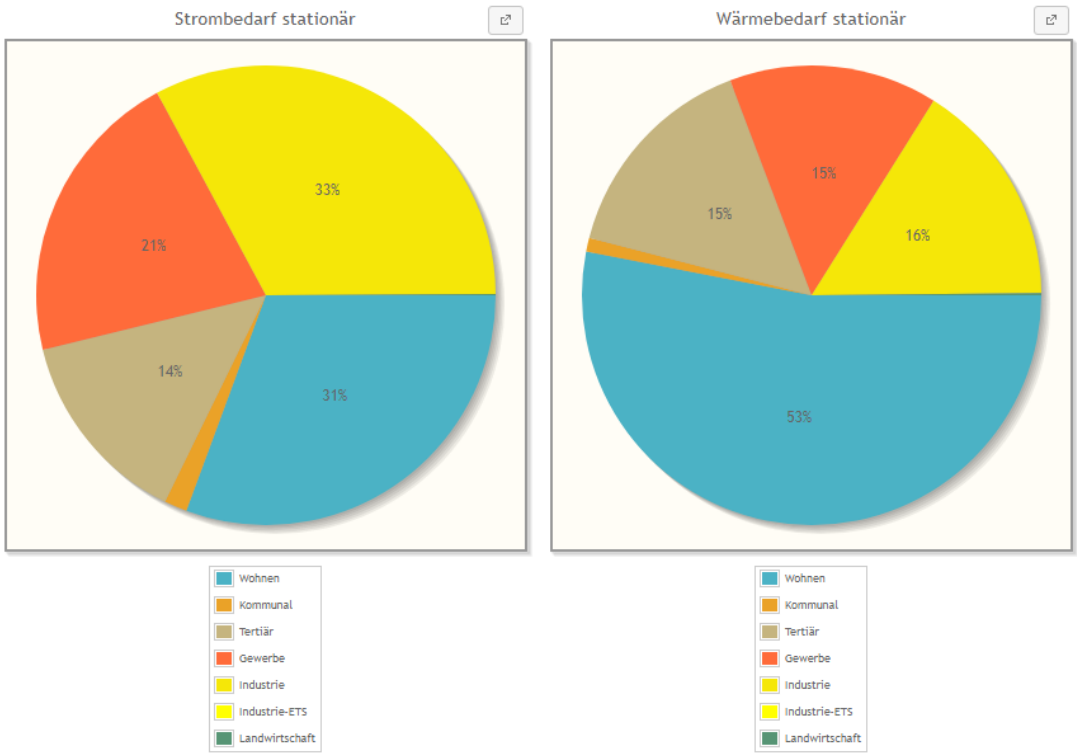

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Step 6: Services

Comparison of scenarios and municipalities, and forming of regions:

The tool enables a copying of municipalities and scenarios. Energy production, demand and greenhouse gas emissions of different scenarios of a certain municipality as well as of several different municipalities can be compared.

Data exchange:

The following data interfaces are available:

- Export into Excel-format (from Version 2007 onwards): all input data, output data and charts.
- All graphics can be saved in png-format (readable and displayable by all Office-programmes).
- The SECAP-export assists the completion of the BEI of the Covenant of Mayors.

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BACKGROUND OF THE MODEL

Simulation of the energy demand: To provide estimates for missing demand figures, functional relations between framing parameters/input data are established based on empirical data. Further, demand figures of the analysed municipality and typical key figures are established.

Potentials of using renewables: Potentials are assessed along a path of staggered refinement starting out from the theoretical potential (determined exclusively by principles of natural science, particularly of physics) to the technical potential (assessed by principles relating to currently available technology) to the economic potential, considering the social acceptance (specified via user input), resulting in a realistic potential.

Time curves for supply: The chart of a function (comprising yields and further key data such as excess energy or auxiliary electricity demand) is calculated for each technology according to the technical-physical framing condition of each plant (efficiency, operation parameters, etc.)

Example for the use of solar energy: The solar irradiation onto a plane of arbitrary orientation and inclination is assessed by resorting to the global irradiation as it reaches a horizontal plane relying on the radiation models by Klucher (1979) and Reindl (1989). Thereby passive solar gains achieved via glass facades and active solar gains from photovoltaics (Quaschning, 2011) and from solar thermal plants may be assessed. Plants with various orientations and inclinations (pitch), various user profiles and temperatures for the useful heat (solar thermal plants) are simulated and evaluated.

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About REsys

Resys has been developed by a research cooperation, coordinated by akaryon GmbH, a company specialised on model-based tools for sustainability.

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Tool: www.resys-tool.at

As part of the project **Energiewende konkret**, the tool is currently upgraded with new functionalities for climate modelling, value added and optimization.

Project website: : www.energiewenderechner.at

akaryon – coordinates the project, contributes to the development of mathematical models, is responsible for the shared data structures, and develops features for the toolbox. These features are based on the tool Resys, designed and implemented together with **Dr. Günter Wind** and **Dr. Horst Lunzer**.
Strateco OG – contributes the optimization-tool PNS and manages the cooperation with the users.
Engineering Office Borovsky & Duschek GmbH / IBBD – contributes climate models and data.
STUDIA – provides cost-, benefit and value added-analyses.
Technical University of Vienna, Institute of Spatial Planning, Research Area Regional Planning and Regional Development – brings know-how of space requirement and competition for land in the production of renewable energies in the project.
University of Natural Resources and Life Sciences Vienna, Department of Landscape, Spatial and Infrastructure Sciences – provides experience and tools in the area of modelling energy demand and CO_2 on a municipal and non-municipal level.

This project is supported by FFG Coin.

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