ONLINE Help: ELAS-Calculator

1 Introduction

The ELAS-calculator was created in order to make it possible for not only communities and corporations but also for individual persons to analyse the energy consumption of a specific residential area. The ELAS-calculator offers following possibilities:

- Calculation and illustration of the "AS-IS – state"
- Simulation of reconstructive plans (restoration, alteration, expansion, demolishment and relocation of a residential area)
- Simulation of future scenarios in regards to alterations of boundary conditions
- The ELAS-calculator achieves the following intermediary results:
    - Total energy consumption of a residential area
    - Ecological footprint (SPI®)
    - CO_2–Lifecycle-Emissions
    - Added value
    - Sales
    - Workplaces
    - Imports

The following page briefly describes important buttons and functions:

START	Starts the ELAS-calculator
Submit	This button MUST be clicked, as soon as an insertion is made and a suggested value is altered, in order for the ELAS-calculator to take the suggested value.
Back (Site-specific Data)	Navigation button: if all data has been filled out, the font will be black. To move on to the desired page, click the button.
Next (Electricity)	If the data has not been completed, the font will be light-grey and you may not move on to the next desired page.
Edit	Permits the alteration of a created building-group
Delete	Deletes a created building-group
Add	Adds a building-group
Plan	The planning of a building-group in the As-Is-analysis
Print view	Print-version of calculations
Show / print input data	Makes a printable table of all inserted data
Proceed to planning	Changes to planning-mode

Changes to scenario-creation

Changes language

Restarts the ELAS-calculator and deletes all inputed data

Opens saved *.elas document

Saves inputed data

Resets inputed data of current page

Navigation-bar: As soon as a page is completely filled out, the bar turns green. If the current page is in bold print, some data is still missing. The bars of the pages that have not been filled out are white. Click directly on the navigation-bar to return to previous completed pages.

Minimizes or maximizes the view of the data in order to permit a better overview of the pages.

Resets inputed data to 0

Takes the in-putted data for the Hot-water preparation from the dispersion of the room temperature heating preparation.

Exposes and suppresses details of the outcome

Jumps to desired section of outcome page

Drop-Down Menu: This option can be clicked in case further options are available.

The selection of the building standard is only for buildings from 1991 and newer, otherwise it is shaded grey.

Selected values can be converted in desired units of measurement.

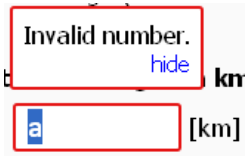
not selected

selected

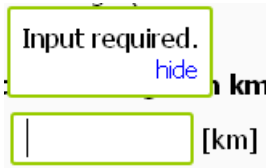
Parameters can be chosen by clicking the so called Check-Box. Multiple boxes of the same question can be selected.

Download: There are Information-pdfs in various sections to help the user.

Tool-Tip/ assistance



Warning for incorrect or invalid input



Warning for missing data input.

2 Methods to Calculate Values with the ELAS-Calculator

In the following chapter, the fundamental methods with which the ELAS-calculator achieves and illustrates it's results, will be explained:

2.1. Calculation of Energy Consumption

The energy consumption value is achieved differently according to various arithmetic methods which the ELSA-calculator uses. For calculating a residential area in the **As-is-state**, the energy consumption value for each business operation is included. This contains the energy consumption for alternating room-temperature, hot- water, electricity, businesses of communal infrastructure and mobility.

In the **planning-mode** based on the as-is-analysis and also in the planning of a residential area „from the green field", the actual construction of the buildings and infrastructure are taken into account. In this case the total grey energy for refurbishment or demolition of buildings, streets, channels is taken into account. The energy consumption value for construction is shown separately from that of the business operation. The grey energy complies with the accumulated energy expenditure (KEA) (Öko-Institut e.V., 1999) and contains the energy consumption of a product (ex: bricks for house) construction from the production chain. It was calculated with the help of the LCA data bank *ecoinvent.*

2.2. Ecological Footprint (Sustainable Process Index, SPI)

There are various types of ecological footprints, which incorporate human behaviour to different extents. *One* type of calculation method is the so called Sustainable Process Index (SPI®) (Krotscheck and Narodoslawsky, 1996). In this method, all flows of material and energy, which are necessary for a product or service, are converted into areas. Normally this applies to the production as well as the use of a product and also includes the created emissions. The conversion of the flow of material and energy occurs with two different principles:

1. Human material flows may not alternate the cycle of materials: This principle deals with the carbon cycle and means that no more fossil carbon (from coal, oil, natural gas…etc.) may be emitted into the environment than the ocean can reabsorb and sediment.
2. Human material flows may not alternate the quality of the local environment: This means, that harmful substances in the earth, air and water may not exceed the absorbance capacity of the environment.

The entire area of the footprint is made up of following partial areas:

- direct area consumption for infrastructure
- area consumption for unrenewable resources
- area consumption for renewable resources
- area consumption of fossil carbon (C)
- area consumption for the absorption of emissions into water
- area consumption for the absorption of emissions into the earth
- area consumption for the absorption of emissions into the air

The bigger the ecological footprint, the more harmful it is fort the environment!

2.3. CO_2 – Lifecycle-Emissions

The amount of CO_2 emission can be calculated from the ecological footprint. By classifying the SPI into 7 categories, it is possible to calculate the CO_2 emissions with the section of the "area consumption for the absorption of fossil carbon (C)". The consumption of fossil resources is taken into consideration for all goods and services. The basis for this is given by the natural carbon cycle. Due to the fact that the entire carbon balance of biomass is balanced (emitted CO_2 during combustion is later bonded by the rebuild of biomass), only the ocean floor shows a CO_2 dip. The amount emitted per year can be calculated based on the sedimentation rate of the ocean floor (500 m²/kg*a) (Krotscheck and Narodoslawsky, 1996).

TIP: The term "life cycle-emission" means, that the emissions are not only local in the residential area, but they are to be viewed on a global basis. This also includes CO_2-emissions of the entire lifecycle of all products (ex: benzine, insulating material). These emissions can be specifically ascribed to the residential areas. However, the entire CO_2-amount of the result is not emitted in each local residential area.

2.4. Regional Economic Analysis (REA)

Residential areas are a regional economic factor. Construction, inhibition and consumption happen in those places where humans live. People must satisfy their basic needs. These include housing, work and education, free-time and social contacts, supply of goods and services. Most of these basic needs have an economic side to them; they induce expenses in private households and bring revenue to businesses. A variety of economic entities can be affected from a residential area and they can either profit from them or carry costs which can not always be covered.

A regional economic analysis presents economic affects, with emphasis on those with relation to the energy consumption of a residential area.

The outcome parameters of the REA are revenues, added value and occupation and imports. The outcomes of the ELSAS-calculator are presented on a regional basis "Austria as a whole" („Österreich gesamt") and "own state" („eigenes Bundesland") (state in which the analysed residential area is located).

2.4.1. Methodology of the Regional Economic Analysis (REA)

The regional economic analysis (REA) of the ELSAS-calculator covers two methodical elements:

- a system of the acquisition of economically relevant impulses and
- a system of the calculation of these impulses to regional economic affects (regional economic model)

The system of the acquisition of economically relevant impulses leans on the structure of the ecological approach. The activities which lead to ecological effects (energy amount, footprint, emission), are normally also economically relevant and vice-versa. The acquisition of economic impulses abdicates on differentiations. These are nevertheless ecologically relevant, however make few cost differences. The economic impulses are divided into the construction (building, refurbishment...etc.), the function and operation of the building, communal activities (construction and operation of communal infrastructure, communal services) and mobility.

Essential for the outcome of the impulses are the calculations of amounts (ex: waste amounts, travel kilometres…etc.) and their values through prices. A regional economic model is used for the calculation of these impulses to regional economic effects.

2.4.2. Regional Economic Model

The calculation of the economic impulses created by the residential areas is done with the consideration of the sectoral integrations of political economy. These integrations are presented in so called Input-output-tables. The expenses of the main protagonists count as inputs: the architect and inhabitants of the housing, the communes and service companies. The expenses created by the residential area cause revenue in those businesses, where goods and services are purchased. These businesses create added value and employments. Furthermore, they buy goods and survices from other businesses. This creates an economic cycle, which can be calculated with the help of input-output-tables. The effects are assigned to the respective state, Austria or foreign country.

<u>The Principle of the Input-Output-Method</u>

The Input-Output-model is the basis for the analysis of numerous political economic questions. Input-output-tables show the intermediate consumption of goods, which were necessary for the emergence of a specific good. The goods are separated into native and imported goods in the input-output-tables. The tables show, of which parts the production

value is made of: on the one hand of added values and on the other hand of intermediate inputs.

The input-output-mode creates an analysis of the entire chain of intermediate inputs. Not only can the steps of an individual production be determined but also the steps before that and before that, so that all the impacts of an economic transaction can be determined.

With the so called Inversen of the Leontieff-Matrix, which is achieved through the input-output-table, the entire chain of intermediate inputs can be represented.

The most important outcomes of the input-output-models are those which affect the revenues, the added values and the work. *Revenues and their multiplicators*: multiplicators show, how many follow-up sales are created through Euro revenue, which has been put into the system: Multiplicators show, how often a Euro which has been thrown into the system is used again. *Value added:* not only the revenues are important results of the input-output-analysis, but also the domestic values added: these permit winnings to be earned and to compensate for work and production factories (earnings for work, business earnings, interest on capital…). *Work*: transformers make the connection between the inputted euro and the work effect. The work affects are represented in the full-time equivalent. The transformers differentiate themselves through their branch (ex: high in agriculture), however they sink though production advances with time.

Used Data Origin for the Regional Economic Alnalysis

STATISTIK AUSTRIA exhibits an updated system of input-output-tables, the most recent update is for the year 2007 (STATISTIK AUSTRIA). The ELSA-REA uses input-output-data from EUROSTAT, which is, according to ÖNACE 2000, made up of an input-output-table for Austria with 15 sectors. The input-output-tables show which sector produces which goods (appearance table) and how the goods are produces (utilization table), in other words, which inputs a sector needs to produce a certain good in the first place.

Sectoral and Regional Differences of the Input-Output-Commitments

The model within the ELAS projects was differentiated both sectorally and regionally:

Sectoral differentiation: the sector energy and water supply was subdivided into three categories: supply with renewable energy sources, supply with un-renewable energy sources and water supply.

A 17-sector-model is created from this.

Regional differentiation: The input-output-links were adjusted to Austrian states. An input-output-table was created for each state. The basis for these was the regionalisation approaches for input-output-tables; the regionalisation operations were done by a beneficiray of a subcontract.

Long-term Predictions of Input-Output-Links

In order to represent the long-term regional economic effects, predictions of the future input-output-links had to be made. Basis for these are predictions of efficiency progressions and the structure of the sectoral links. The regional economic analysis calculates, according to current data and existing input-output-tables for the year 2000, the input-output-tables for 2010, 2020, 2030 and 2040. The predictions for the years 2010-2040 occurred under certain presumptions:

TREND-Scenario: Trend expansion tied together with regionalisation and moderate energy price progressions.

GREEN-Scenario: Energy efficiency and ecological adjustment of the economy tied together with an energy price rise and a global economic perspective.

Prices: The model calculations are made with current prices. Discounting of future effects is not conducted.

Taxes: The regional economic analysis is made by gross prices; afterwards the taxes are subtracted from these gross prices, so that net prices are included in the calculation and so that the results are also presented in net prices.

3 Guidline to the Operation of the ELAS-Calculator (as-is-analysis)

The inquiry method of the ELAS-calculator is represented in image 1. In the following, the individual steps for the calculation are explained in detail (with regards to image 1).

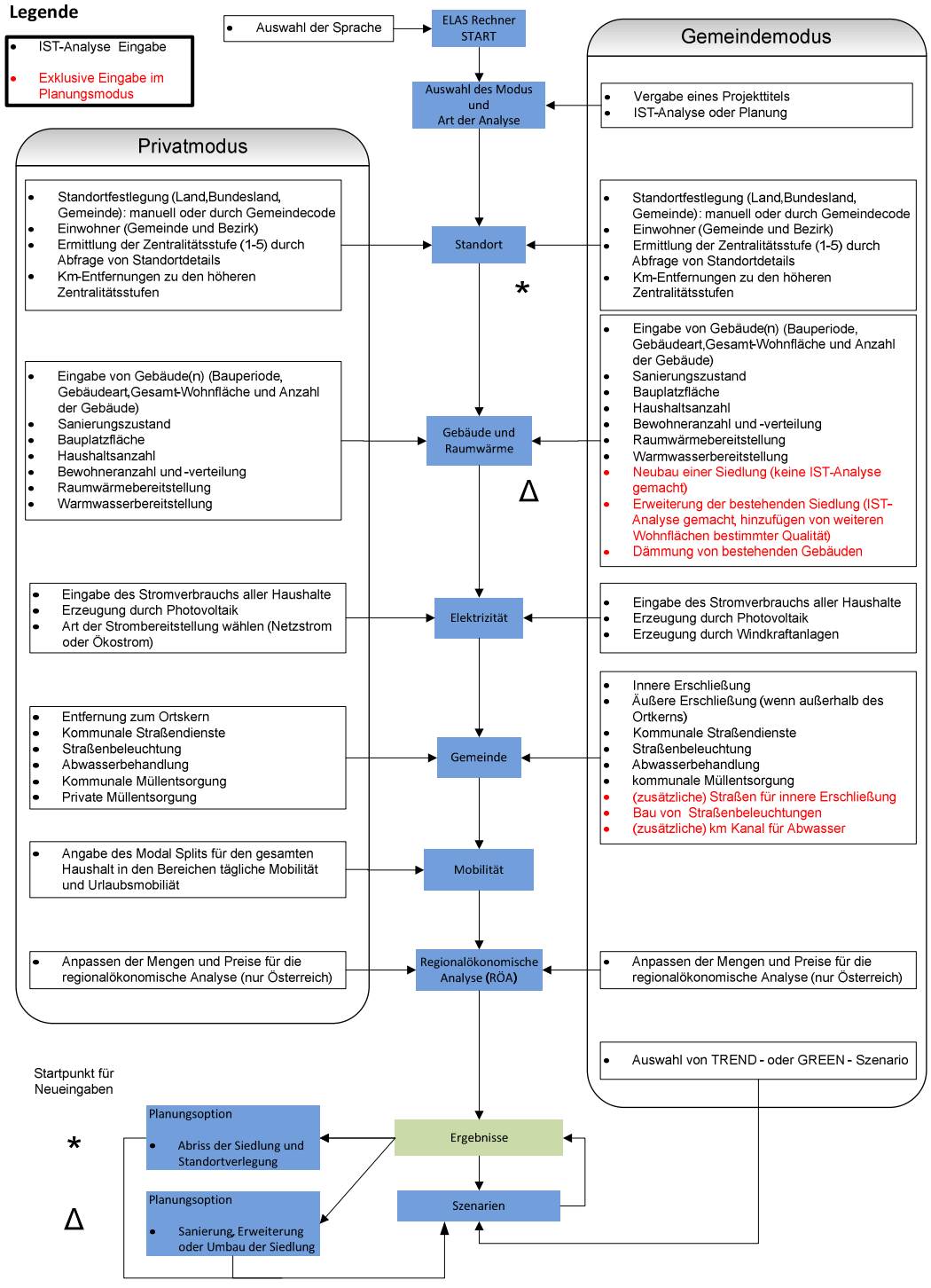


Image 1: schematic course of action of the ELAS-calculator

The following chapters will reveal, which information from the user is required, in order to use the ELAS-calculator. In addition, it is explained for which calculations the inputs of the user are used.

The calculator has two different modes (private and community mode). Tips exclusively for the private mode of the ELAS-calculator are highlighted in green.

3.1. General Information

The explanation of the buttons and their functions can be found in the chapter 1.

3.1.1. Start Page

A start page gives the user basic information about the calculator and the ELAS-project. There is also an option which allows the language of the calculator to be changed to "German". Furthermore, previously saved projects can be loaded. The legal notice can also be found on the start page and is shown on all following pages. The legal notice, as well as the disclaimer can also be found on printed pages. There is an email-address which is constantly checked by the project team members in case there are any questions regarding the program.

3.1.2. Start of the ELAS-calculator

By clicking the "Start"-button, the ELAS calculator is opened and ready for a new project. First of all, a title for the project may be given, in order to retain an overview of different calculations. The project title also corresponds to the recommended file name when saved, however it can be changed. In the following step, the user must categorize him-/herself as an individual person, a community or decision maker. This will cause the questions to be different in detail in correspondence to what the user has chosen. As a private person, the user has the option to enter an already existing building and infrastructure and receives the results. The input values can be changed in further calculations in order to illustrate planning and possible future developments. In contrast, it is possible in the community mode to change between the as-is-analysis and the planning mode in which the already given data is saved and reinserted by the user. Additionally, a "planning of a new residential area" is available. In each of these three alternatives, one can change into a scenario building, in which two pre-made scenarios of how the residential area will look like in the year 2040 with the given parameters, are presented.

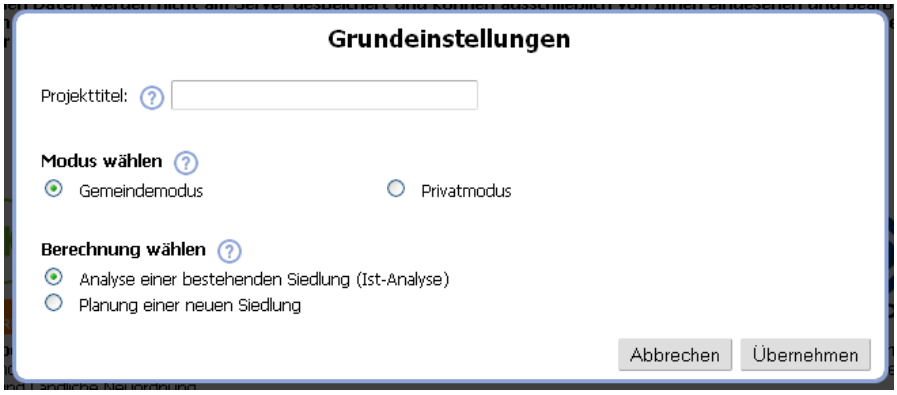


Image 2: Basic options of the ELAS-Calculator

After the start page, naming the project and a choice of the calculation mode, the questionnaire section of the ELAS-calculator begins. An intuitional assembly as well as a relatively simple operation system for the user, was essential during the development of the ELAS-calculator. For this reason, for all the input values which require certain precognition, default values are suggested. These can be assumed by the user or alternated. The default-values are based on either statistical values or outcomes of questionnaires which have been completed within the ELAS-projects.

TIP: Numerous values which have been inserted by the user **must** be accepted by clicking the button "*Submit*", in order to be used for the calculation.

3.1.3. Functions of the ELAS-Calculator

After leaving the start page, a list of functions can be found at the top of the website (image 3).

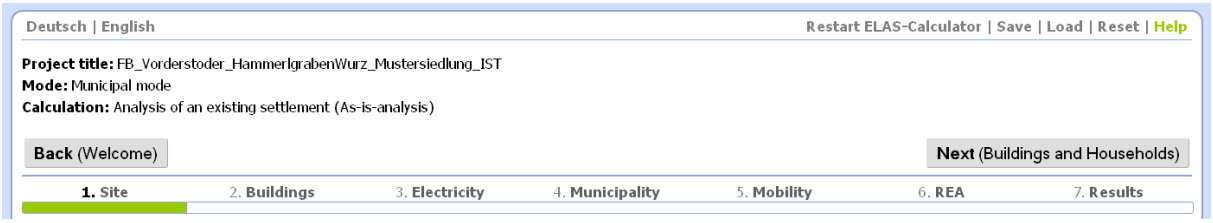


Image 3: Navigation and function bar in the ELAS-calculator

Restarting the calculator: It is possible to restart the ELAS-calculator at any time. However when choosing this function, the user will be asked again if a restart is desired and alluded that if the data is not saved, the current project will be lost. The user is relocated to the start page.

Saving data: This option can also be found in the function bar, which is available during the entire utilisation of the ELAS-calculator. When saving a project, a file with the project title name and the ending **.elas* is created. The file is saved only locally on the PC and can be recalled into the calculator at any time. It is also only readable with the ELAS-calculator. This offers privacy of the inputted data and results for the user.

Saving the data, especially the outcomes, is very important, because the outcomes are used in further application of the calculator (scenarios and planning) provided that the data can be reused. The previous outcomes can not be recalled, unless the file was saved, in that case, all calculation steps can be reloaded.

Loading data:

Saved data can be reloaded in the ELAS-calculator. The questioning is started at the step in which the user has last saved.

Reseting data:

The user can reset all current data and input new values.

Help:

An introduction about the function and use of the calculator can be found in the Help-pdf.

In order to keep an overview, the project title, mode and calculation method is shown on each page.

Navigation:

There are different ways to navigate in the ELAS-calculator. There are grey buttons under the project information each which go a step forward or backward. The same buttons can be found at the end of each question page. When numerous question pages have been visited and data has been given, it is possible to jump directly to a desired section using the navigation bar.

3.2. Site-Specific Data

Especially in the branch of mobility for a residential area, the location of the settlement is important for the ELAS-calculator. For this reason a localisation is asked on the first question page. When the location is established, the user may choose either "Austria" or "other country". If a calculation is made in a country other than Austria, the classification to a centrality level can only be inserted manually. Moreover the calculation is conducted with a different fuel mix (EU-27 average). However one must consider that in the mobility branch, the calculation still happens in the background with the data, which is Austrian specific because the modal splits were received in reference to age groups and centrality level as an important part of the ELAS-project in a separate evaluation and analysis. However, this does not have a great affect on a different country because the user can change the proposed kilometre values. Only the proposed values can differentiate from the given values of the user. Furthermore, the calculation step is explained, in which the residential area is located in Austria. It is possible here to select a location for the residential area of one of the 2,357 communities in Austria (statistic Austria 2010). There is a step-by-step questionnaire or the user can directly enter the community identification number. The population counts for all communities can be found in the background, which are automatically suggested from the ELAS-calculator. Each population count (area and community) are then used for various calculations, not only for the regional economic analysis (REA), but for example also, to calculate the amount of street construction of a residential area.

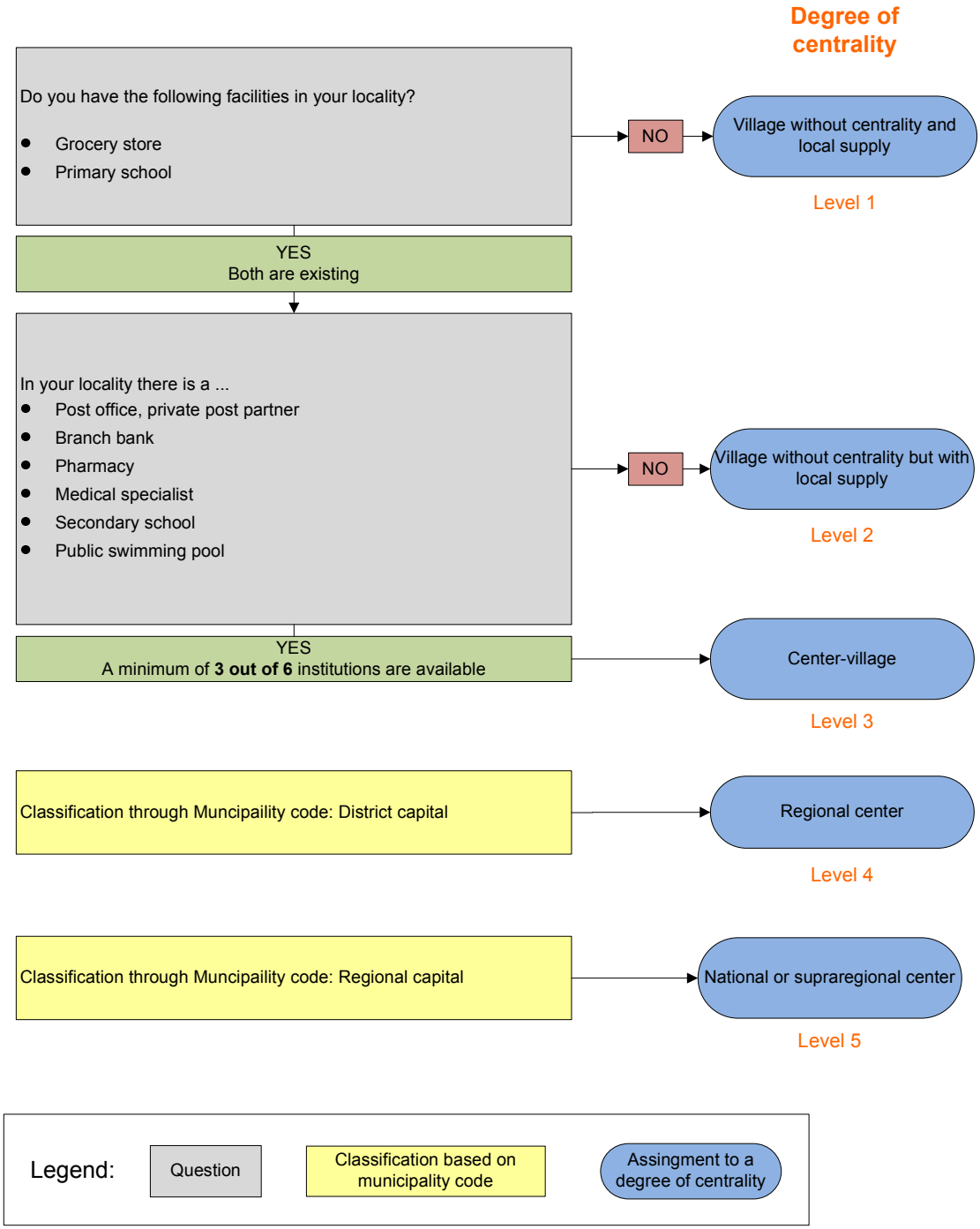


Image 4: Determination of the Centrality level with the ELAS-calculator

The location is assigned a certain centrality level in order to determine the mobility of the residents at a later point in time (see image 4). Higher levels of centrality (national central point = 5 and small centre point = 4) are already defined. The capital of a country has level 5 and state capital cities have level 4.

Specific questions are asked for the classification of a level between 1 and 3:

- Is there a supermarket in the city?
- Is there an elementary/ primary school?

If one or none of these criteria apply, a low centrality level (1) is automatically suggested. If both criteria apply, further questions about the city's facilities (post office, pharmacy, public pool, doctor) are asked to determine a level of 2 or 3. A minimum of 3 criteria are needed for a centrality level of 3, otherwise level 2 is suggested. The centrality can be alternated by the user at any time. The user can learn more about the criteria of the centrality levels in the info-pdfs.

Afterwards, the distance to the cities with higher centrality levels in kilometres is asker respectively to the chosen centrality level.

In the case of a residential area outside of Austria, the centrality levels, population count, and the distance to other centrality levels must be entered manually. Furthermore the suggestion or possibility of the direct completion of the community number is no longer an option.

3.3. Buildings and Households

In this section, the user is asked to give the state of the buildings in the residential area which is to be analysed. Following characteristics are required:

3.3.1. Structure of the Buildings

In this section, the building groups are created. Buildings which have the same construction period, building type, construction and heating systems each create one group. A new group is formed as soon as one of the four characteristics is different. There is a downloadable info-pdf which shows the evaluation of a building group of a residential area, in order to help the user; image 5 on page 14 is a graphic illustration.

An overview table appears for every building period for the building group, when a building group is evaluated. It is possible to edit the given data or to delete a building group in these tables. Following parameters are questioned:

- Building period
- Building type: One-family house (OFH), row or double house (RH), multi-story housing (MSH)
- Building standard (from building period 1991): new building, low energy house, passive house
- Number of buildings
- Habitable area

- renovation condition (multiple answers possible): not renovated, basement and/ or attic, outside walls, windows

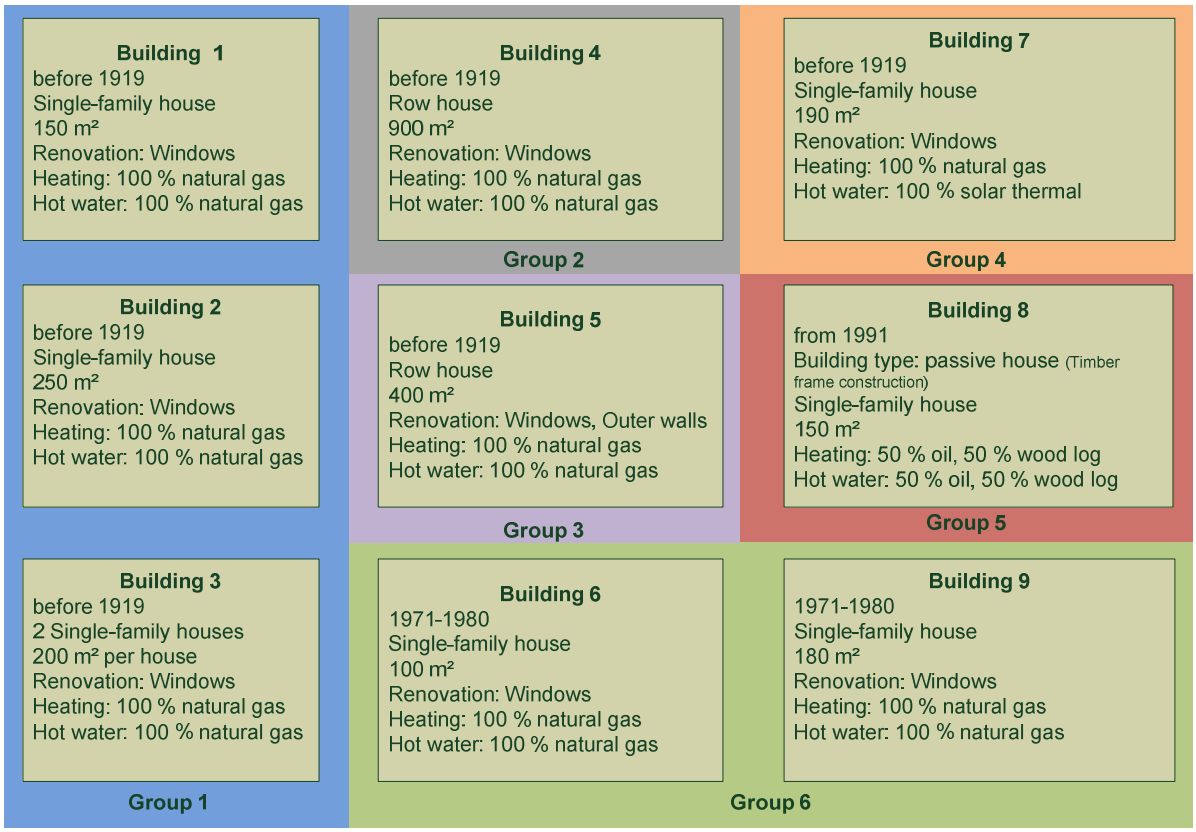


Image 5: example of the building groups in the ELAS-calculator

TIP: The more building groups that are created, the more individual become the possibilities in the planning mode. Each of the planning options can be carried out specifically to the separate building groups (ex: renovation)

Due to the fact that both the habitable area (net area of the considered building group or housing unit) as well as the area of the building plot (sum of all areas on which considered buildings were built) were asked, the floor-space index is also determined. It shows the total floor area (= net habitable surface/ 0.85) in proportion to the area of the building plot and serves as a pure informational value, which is not included in further calculations.

3.3.2. Resident Information

The suggested age group distribution corresponds to the Austrian average according to Statistic Austria 2009 and can be alternated by the user. Following data is required:

- Number of households
- Number of residents

- Age group I (0-14 years), Age group II (15-29 years), age group III (30-59 years), age group IV (60 years and over)

The number of households is used for the calculation of the electricity consumption. The mobility manner is later determined from the number of residents and age group assignment.

3.3.3. Room-Temperature and Hot-Water Preperation

The suggested values "energy conversion factor" and "hot-water demand per person" is based on the Austrian averaged values (Jungmeier et al., 1997). The data background to the suggested kWh-values can be found in the appendix. The energy conversion factor shows the amount of energy, which is used yearly per m² net habitable area for heating. The energy conversion factors distinguish from another depending on the type and age of the building/ building group and renovation. A more precise value for the considered building/ building group can also be entered by the user. The entire heating demand is determined by multiplying the energy conversion factor times the entered total habitable area. The habitable space has already been evaluated in section 3.3.2. The energy conversion factor (kWh/m²) can change through the combination of building period, building type and building standard (in case the building period is > 1991). The suggested values of the ELAS-calculator changes dynamically according to the input of the user and becomes for example smaller through possible renovation. The entire hot-water demand is calculated by multiplying the population number with the average yearly water demand (1.000 kWh/Person, Default).

TIP: The chosen renovation option(s) count for the entire building group!

Now one determines which type of heating system is used to regulate the room and water-temperature. There are a variety of different technologies which can be used, where a percent distribution is suggested. The user can reset all fields to 0 by clicking the button "*reset fields*" and insert the desired distribution. The values can also be assumed by the water-heating by clicking the option "*Adopt distribution of heating system*" in case the water is heated in the same way.

3.4. Electricity

In this section of the questionnaire, the electricity consumption as well as a possible renovation in the residential area is determined. Again a value is suggested, that is based on the average electricity consumption of an Austrian household. A one-family-house is here distinguished from a row house and a multi-story house. The entire electricity consumption of the residential area is determined by the number of households and the respective average electricity consumption per household.

The created amount of electricity can also be evaluated in kWh. This amount is subtracted from the energy consumption and calculated against with the ecological footprint, because it reduces it. The entry is carried out in reference to the yearly dezentral in the considered residential area or separate object from renewable energy sources provided electricity. Possible technologies are for example photovoltaic systems, wind power plants or biogas BHKWs. If more than one type of technologie is used, the total amount of electricity production must be determined. Furthermore the suggested compensation for electricity fed into the grid from phootovoltaic (according to the renewable energy feed-in tariff from the eco-electricity act 2011, in buildings integrated photovoltaic system, 5 kWp – 20kWp) is used on the question page of the regional economic analysis (REA). If other technologies are used for electricity production, the compensation for electricity fed into the grid in the REA must be respectively adjusted by the user.

Additionally, as a user in the private mode, one has the possibility to choose the reference source of the electricity. "Conventional electricity" corresponds to the average electricity mix of Austria. This mix is also used for calculations in the community mode, as long as the residential area is located in Austria. The "EU 27" electricity mix is used for calculations in other countries. In the private mode, one can choose "green electricity". The electricity identification of each mix with which the ELAS-calculator is evaluated, is listed in table 1.

Denotation in the ELAS-calculator	Conventional Electricity[1]	EU 27[2]	Green Energy[3]
Configuration	43,9 % water 7,5 % coal 1,3 % oil 12,1 % gas 4,6 % bio mass 0,8 % waste 0,03 % PV 2,2 % wind 0,02 % Bio-gas and others 27,55 % ENTSO-E-Mix	10,6 % water 27,9 % coal 3,1 % oil 23,4 % gas 2,3 % bio mass 0,9 % waste 27,8 % nuclear 0,2 % geo thermal energy 0,2 % PV 3,5 % wind 0,07 % Biogas and others	84,5 % water 10 % wind 3,5 % biomass 1,0 % biogas 1,0 % PV

Table 1: Electricity identification of the three varying electricity mixes in the ELAS-calculator Kommunale Dienstleistungen und Infrastruktur

In the fourth section of the ELAS-calculator, the energy consumption of the communal services as well as the needed communal infrastructure for a residential area is evaluated. The questioning is classified into five areas: road network, road services, road lighting, waste water treatment and waste disposal.

3.4.1. Road Network

Both the inner and the outer development of the road network of a residential area are questioned in order to achieve the kilometres of roads, which are decked by communal services. These have different ecological and economical effects.

The inner development is made up of those streets, which are located within the considered residential area. The differentiation is determined by a community and a national road and is entered separately in the ELAS-calculator. When entering a single housing unit, the street

[1] According to EA „Electricity/Heat in Austria in 2008“: http://www.iea.org/stats

[2] According to IEA „Electricity/Heat in European Union - 27 in 2008“: http://www.iea.org/stats

[3] Based on the electricity mix of the green electricity AG, labelling according to 2009: http://www.oekostrom.at/

which leads along the property boundaries for the inner development is meant. Private roads are to be handled as community roads.

Subsequently, the user determines, if the residential area is located in the city centre or outside the centre (ex: in the case of a splitter settlement). In the case of a residence outside the city centre, the outer road development is asked (again divided into community and national streets). The closed cultivated settlement area, in which also super markets and public facilities like a municipal office or a school are located, is seen as a centre.

3.4.2. Road Services

This section is a part of the evaluation of the communal services of the residential area. It is assumed that the services are carried out by a community vehicle and that it must cover a specific distance for each complying service. This results in an energy consumption which is added accordingly to the considered residential area. Included in the road services are all drives that are done by the community or by private service providers (ex: farmer) for the following services: road cleaning, mowing and trimming, snow clearance, gritting services and other services. With the number of drives and the determined kilometres of roads (3.5.1), the energy consumption as well as all other parameters can be calculated. The default values originate from the evaluation of the community surveys, which are given from case studies for data analysis.

3.4.3. Road Lighting

If a residential area has street lighting (yes/no question), the default values are suggested. The number of light points which a residency is permitted to have, is calculated by the determined inner road development multiplied times 0.031 light points/ street meter. The electricity demand is assumed with 268 kWh/ light point and year. Both these values also originate from the questionnaire of community case study, which served for the evaluation of the data of the communal infrastructure and services.

3.4.4. Waste Water Treatment

One value for the yearly waste water treatment of the residency is calculated and suggested from the number of residents. This is achieved from the Austrian average value of 128.48 m^3 yearly per person (as of 2006)[4].

The waste water treatment of the residential area can be centralized or decentralized (ex: through a plant purification system). The costs of operation as well as the ecological pressure differ depending on which equipment is used. One can distinguish between a two- or three-step-system in the case of a centralized plant. The data of the distance between the

[4] http://www.umweltbundesamt.at/umweltschutz/wasser/abwasser: errechnet aus der Gesamtabwassermenge von 1.064 Mio m^3/a und 8.281.295 Einwohner im Jahr 2006

residency and the waste water treatment plant is evaluated in a km laid sewage system and the energy consumption can be entered as available sewage pumps in kWh/a.

3.4.5. Waste Disposal

All fractions, which are picked up by a disposal service business or can be brought to a by collection point by foot are selectable by a checkbox. If a fraction is not selected, it is assumed that the resident disposes his/her garbage in a waste collection point. Excluded is waste, that can be decomposed (biodegradable waste and greenery). The distinction is especially important in the determination of the ecological footprint, because it is either calculated with LKW-kilometres or in the case of waste disposal through residents with PKW-kilometres. The second case is used for the basis calculation of the distance to the old substance collection centre.

The questions for the communal section are simpler in the private mode in order to comply with the knowledge of the resident. Private people usually do not have access to data about communal infrastructure, for this reason in the case of a private person, the ELAS-calculator uses statistical means for calculations. In the private mode, the user first enters how far away from the community centre the residential location is located. If the considered housing unit lies in the centre, the value 0 km is entered. Detail information such as inner and outer development is not asked in the private mode. In the street lighting section (if existing), the number of light points in the property boundaries are asked. The evaluation of the sewage data is also greatly reduced. The questioning and calculation for waste disposal are the same as in the community mode.

3.5. Mobility

The total yearly kilometres of all members of a household aged 15 an more are asked. The mobility is divided into three categories: every-day mobility, short vacation trips and main vacation trips. The suggested and individually editable km-values for every-day mobility of the ELAS-calculator are based on the case study communities, whereas the vacation mobility values are taken from a study of Statistic Austria (2009)[5]. Transportation devices which will have more impact in the future are also shown. These include bio-gas bus, electro, hybrid, natural gas, bio was and E85 cars. These boxes however, are set to a default of 0 km and can be adjusted by the user.

[5] Statistik Austria: Ergebnisse der quartalsweisen Stichprobenerhebungen zum Urlaubs- und Geschäftsreiseverkehr 2009

Additionally, the boxes for future drive technology are of importance for the private people, in case **scenarios** are to be played, which are only available in the community mode, in which for example the effect of a change to different transportation devices should be analysed.

3.6. Regional Economic Analysis

The regional economic analysis of the ELAS-calculator, calculates the regional economic effects of a residential area. The activities tied together with a residency (construction, refurbishment, operation...etc.) lead to expenses which have effect on the economy. The regional economic analysis sums up these expenses (sales) and calculates their effects (advances) and their resulting value creation, the inducted employments and imports.

The suggested prices can be adapted in this questionnaire section. Sales taxes are included in the prices. Already inputed data is used, to determine the inserted amount. All amounts refer to a year. Listed are goods and services which correlate directly to activities of the residency.

If the user calculated a residency in another country, the REA-entry is not included and no outcomes are calculated, because the data of the input-output-analysis refers to Austria and can not be transferred to other countries.

3.7. Calculation Results

The calculation results page is shown when all listed sections have been completed. In the community mode, either the desired end-result or, in the case of changing into the planning or refurbishment mode, an interim result is shown. The final results can be printed with the print preview. This opens a new window with the print preview, which also includes all graphics and tables. Furthermore, the inputed values can be opened in a window and printed separately over *show inputed values/print*. The display of the results can be minimised and maximised, the units can also be changed (ex: m², km² or ha).

The total results fort he energy consumption, SPI, CO_2-life-cycle-emissions, sales, value creation, employments and imports are represented in an overview table. All calculated values refer to a year and count for the entire analysed residency, which can be made up of various building groups.

TIP: The user should save the calculation here over *save data* at the latest.

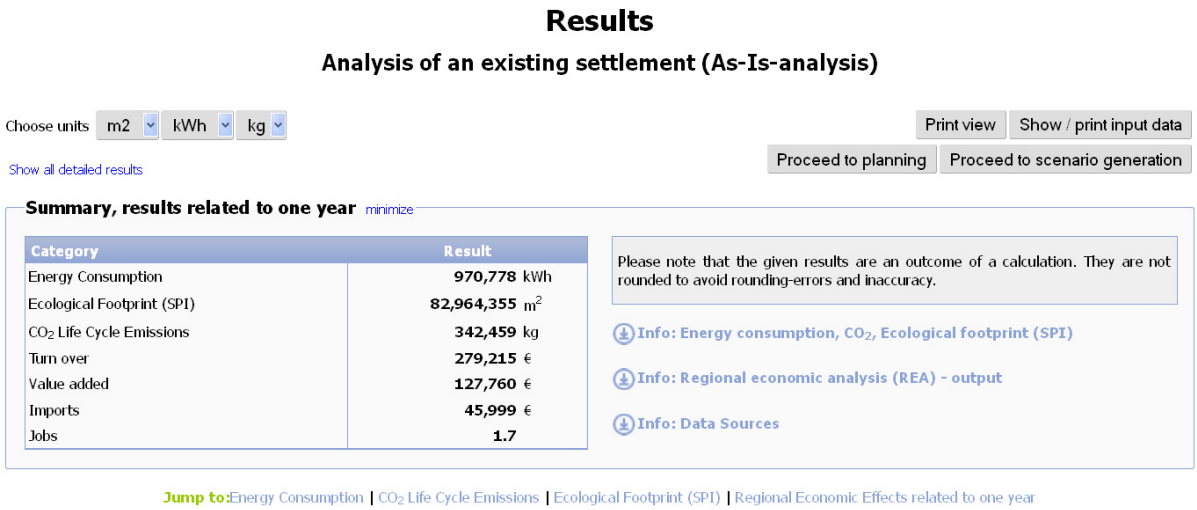


Image 6: Presentation of the total results in the ELAS-calculator

After the presentation of the total results, the individual results are shown in a table and illustrated in diagrams. For example image 7 shows a detailed display of the energy consumption.

The previously questioned sectors are graphically illustrated in the diagram of the energy consumption of a considered residency. What the separate sectors are made up of can be looked at in detail on hand of the tables. In this way, the user can keep a clear overview and can also identify the hotspots of the energy consumption.

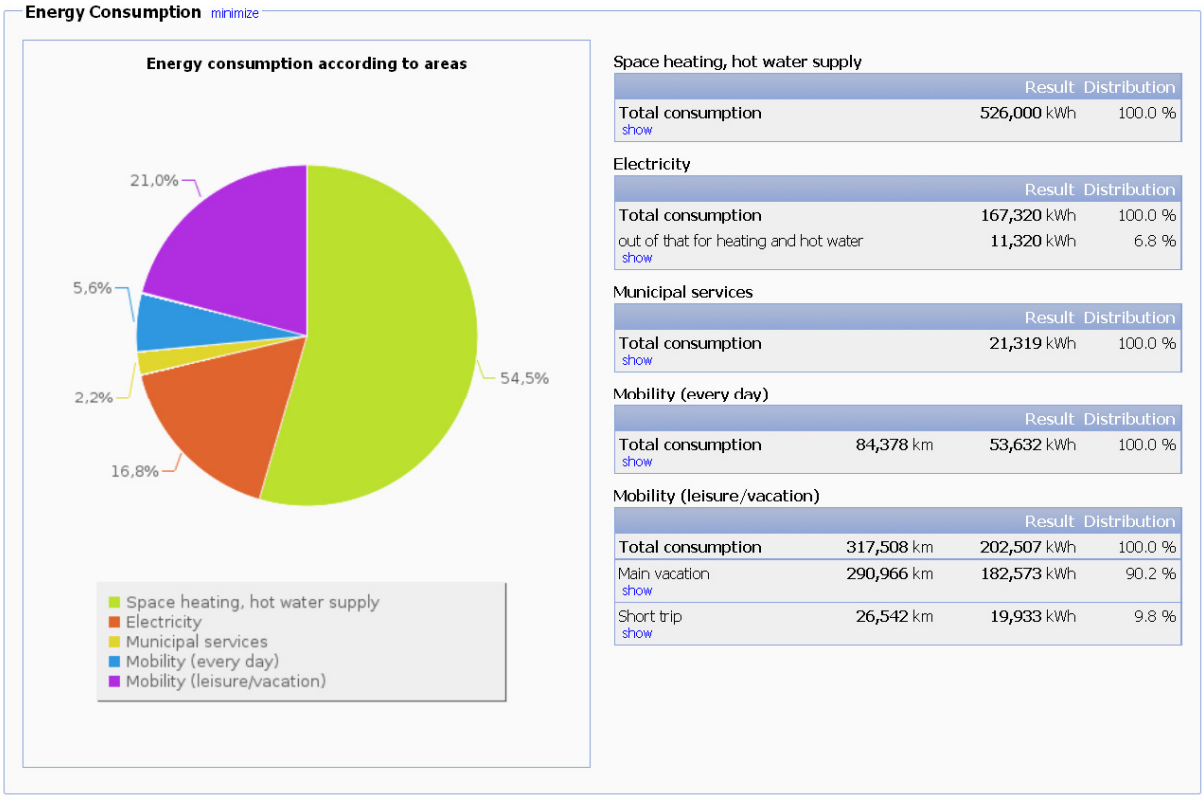


Image 7: Display of datail results of energy consumption in the ELAS-calculator

The representation of the CO_2-life-cycle-emissions is done in the same way. There is additional information with the ecological footprint, the dispersion of the footprint in the seven categories of the SPI (see chapter 2.2)

Image 8 shows the result of the regional economic analysis (REA)

Regional Economic Effects related to one year minimize

Summmary REA	
Turn over in Austria	279,215 €
Value added in Austria	127,760 €
Import to Austria	45,999 €
Jobs in Austria	1.7
Turn over in your federal state	234,339 €
Value added in your federal state	95,576 €
Imports from abroad or other federal states	78,183 €
Jobs in your federal state	1.1
Turn over in other federal states	44,875 €
Value added in other federal states	32,184 €
Imports from other federal states	32,184 €
Jobs in other federal states	0.6

Value added effects according to initiator - Austria

Category	Turn over	Value added	Imports	Jobs
Living Space, construction	0 €	0 €	0 €	0.0
Living Space, operation	109,812 €	49,377 €	17,907 €	0.6
Municipal Infrastructure, construction and operation	1,471 €	813 €	164 €	0.0
External Effects (Mobility)	167,931 €	77,570 €	27,928 €	1.1
Total	279,215 €	127,760 €	45,999 €	1.7

Value added effects according to initiator - Oberösterreich

Category	Turn over	Value added	Imports	Jobs
Living Space, construction	0 €	0 €	0 €	0.0
Living Space, operation	98,720 €	41,095 €	26,189 €	0.3
Municipal Infrastructure, construction and operation	1,244 €	669 €	308 €	0.0
External Effects (Mobility)	134,375 €	53,813 €	51,685 €	0.8
Total	234,339 €	95,576 €	78,183 €	1.1

Image 8: Display of the REA in the ELAS-calculator

Sales: The value in the display includes the sum of all net turnovers (direct as well as indirect sales, sales induced by advances), which result from the activity, in euro per year, in each territorial unit.

Value Creation: This parameter describes the from the activity resulting value creation in Euro per year in each territorial unit.

Employment / employment effect: This represents the sum of all created or ensured, direct and indirect (induced by advances) jobs, measured on full-time equivalent basis (FTE) per year, in each territorial unit.

Imports: This value is the sum of all imports, which are directly or indirectly necessary for the production of goods and services, in €/a, in each territorial unit.

Creating living space: The effects of the construction, modification/ renovation or debolishment of livings space is taken into consideration, all entries refer to one year (one time expenses are discounted on a time period of 66 years).

Housing operation: The effects which result from the operation of a living space are illustrated. Included is the yearly work needed for preparation of room heating and electricity.

Communal construction and operation: includes effects resulting from the construction of streets and the exploitation (sewage, water, electricity) discounted in a time period of 66 years, as well as from services for lighting, snow clearance, road maintenance, sewage operation and maintenance and waste disposal per year.

External effects (mobility): This includes effects of induced mobility of private households. Not included is the yearly mobility for every-day drives and yearly mobility for trips and vacations.

After the as-is-analysis, the user may change into the planning mode. The evaluated data can be modified in this mode and alternations in respect to renovation, expansion, refurbishment or relocation of the residential area can be planned. There are different options to choose from, which are explained in detail in chapter 4.

Scenarios can be played in the planning mode but also directly in the as-is-analysis. The two pre-made scenarios with different model parameters attempt to simulate a long-term analysis of the calculated residential area and are described in detail in chapter 5.

The option planning mode and scenarios are not an option for users in the private mode, only in the community mode.

4 Guideline for the Operation of the ELAS-Calculator (Planning mode)

This chapter explains the differences to the as-is-analysis; the remaining operation of the ELAS-calculator follows analogy to the as-is-analysis.

4.1. Planning mode (As-Is-analysis present)

When changing into the planning mode, one is first asked if he/she wishes to change current residential area or if he/she wants to demolish the residency in order to rebuild it in another location.

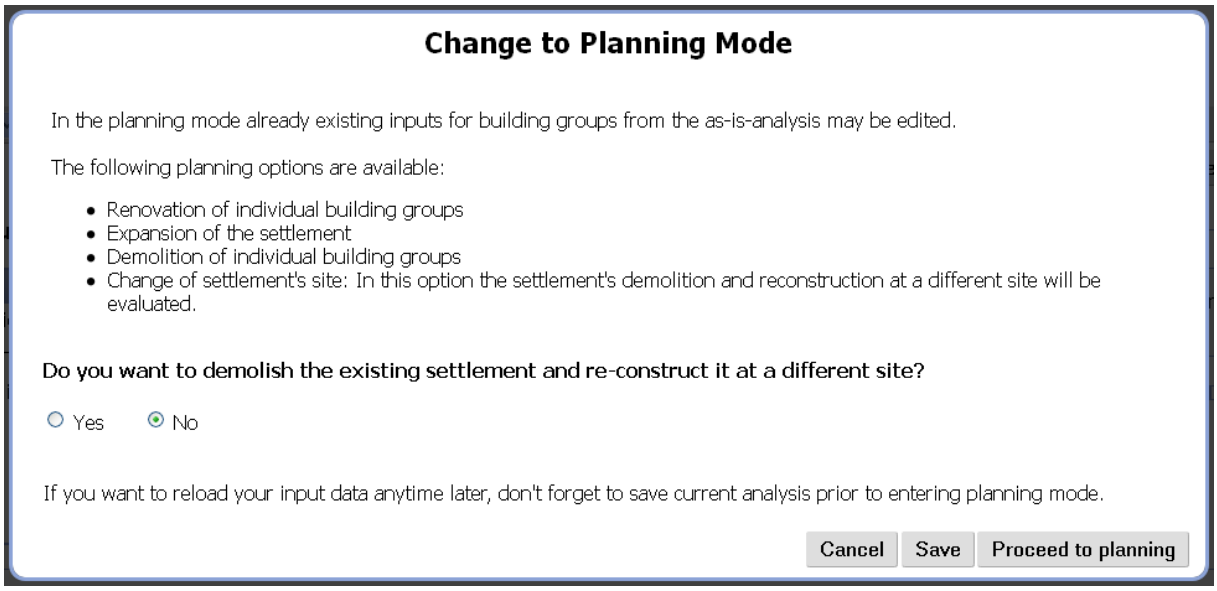


Image 9: Option to change into planning mode

Relocating includes the demolition of numerous building groups and a selection of a new location. The entry happens analogy to the as-is-analysis, however additionally, an *ecological backpack* for the demolition and also for the building itself, if it has not yet been ecologically depreciated, included in the calculation. The ecological backpack takes account for a house which has not yet depreciated but already demolished. The SPI is always depreciated for 66 years and so in the case of a demolishment of a younger building. The res-SPI (not yet depreciated part) is summed up and added to the new planning result.

If the location stays the same, then the user comes into the planning mode based on the as-is-analysis. The already inputed data of the building groups in the as-is-analysis is summarised in a table for the entry of buildings and households. Entries can be edited and completed with the planning button. Renovation, construction of annexes and the demolishment of single building groups count to planning cases. Furthermore, the resident information and the entries of room heating and hot-water preparation can be adapted.

Moreover to the questioning of infrastructure, the user is asked the additional demand of roads, street lighting, sewage etc. There are two further categories among with the display of the results, one for infrastructural additions as well as constructional measures.

4.2. Planning Mode (as-is-analysis not present)

The planning mode in regards to buildings can differ according to the method of operation of the ELAS-calculator. If the user has not completed an as-is-analysis and plans with the "green field", he/she must give all details about the buildings, residents and preparation of room heating and hot-water preparation, just like in the as-is-analysis. Due to the fact that it is a matter of planning, the earliest possible time of construction can is the year of the entry. For this reason it is assumed, that the building which is to be built, must at least correspond to low energy requirement standard. For this reason, the options are limited in comparison to the as-is-analysis. The type of insulation must also be given, because this makes a big impact on the ecological footprint. One can choose between following variants in respect to the building standard and insulation:

- Building standard: low energy requirement house or passive house, both with wood leightweight or massive construction
- Insulation: fossile (XPS, EPS), mineral (mineral wool), ecological (cellulosic fibers)

It is assumed the streets of the inner development and street lighting etc. must be constructed resulting in accordingly expenses and ecological pressure when entering the communal services and infrastructure. However in the sewage system, the distance to waste water treatment plants (main branch) are already assumed and only additional sewage development is asked. The display is carried out in the same was as with the planning based on the as-is-analysis.

5 Guideline to the Operation of the ELAS-Calculator (Scenarios)

Goal of the scenarios is, to give an outlook of the possible development in 30 years (year 2040). The initial situation of an already analysed residential area, independent if existing or planned, is used. The previously evaluated values of the residency are recalculated with pre-defined model parameters.

TIP: Again it is suggested to save and/or print results for each calculation!

There is an option of two scenarios, which the user can choose from and with which he/she can alternate previously entered and calculated values. There are no additional entries required. The scenarios and their inclusive data are deposited in the ELAS-calculator. The goal is to illustrate development for electricity use, electricity mix and mobility. The trend scenario shows the conservative variants in which a development according to trend predictions is assumed. In contrast to this, the green-scenario is a optimal illustration of the future, in which an environmentally friendly society and a more sustainable handling of resources is assumed. The comparison of the two scenarios should especially display the range and clarify the potential towards optimization.

5.1. Trend-Scenario

5.1.1. Electricity

The energy consumption development is assumed with a 2.2 % rise until 2020 according to Wifo (2005). This value is taken over and projected to 30 years. This means that the electricity consumption increases by a factor of 1.92 every 30 years. The electricity mix also alternates. Here a calculation of the future electricity mix for both Austria (table 2, based on the energy strategy) and for the EU was made.

ELECTRICITY MIX - trend electricity scenario [%]								
Waterpower	Solid or luiquid bio mass	windpower	Other eco energy	Natural gas	Oil and it's products	coal	Other energy sources	Nuclear
49,0	8,0	10,9	2,1	19,2	0,6	6,4	0,3	3,5

Tabel 2: electricity mix for austria in the trend scenario

The alternated electricity mix also has effect on those transportation devices, which are opertated with line current (electric car, tramway and O-bus).

5.1.2. Mobility

The amount of PKW kilometres (minus the electric vehicle kilometres) will be changed to bio gas according to 2020 goals. The amount is according to EU commission 10% (EU, KOM(2006)848). The rise of the total kilometres of general mobility was calculated from data of Streicher et al. (2011). The rise is thus a factor of 1.26. The amount of electric vehicles is approximatley 15%. The total vacation kilometres are not increased and stay the same as in the as-is-analysis. The alteration of the modal split of the general mobility for the trend-scenario is based on Streicher et al. (2011). A factor was calculated for every transportation device, with which the modal-splits could be adjusted to. For the vacation mobility, the default values in respect to the dispersion of bio gas and electric cars were adapted.

5.2. The Green-Scenario

5.2.1. Electricity

It is assumed in the green-scenario, the the total consumptioon of a residential area decreases. The reduction is based on the evaluation of the questionnaire in the case study communities. This is a matter of the quantil 25 of the given total electricity consumption of the asked households in each building type (one family house/ row house or multi-story house) and complies with a factor of 0.67. This implies a reduction of nearly one third of today's electricity consumption. An electricity mix of 100% eco-electricity is assumed. This means 100% wind power for Europe and 60% water power, 30% bio mass and 10% wind power for Austria. These values were discussed and defined by the project team in a meeting concerning scenarios.

5.2.2. Mobility

The rise of the total kilometres complies with the value, which has already been stated for the trend-scenario. For this reason, it is assumed that the mobility of the society also rises; however, the type of power to drive the vehicles is changed. Thus the PKW-kilometres are operated only with bio gas or electro drive in a proportion of 70:30. The public transportation is also calculated "green" by operating buses with biogas and tramways and O-buses with the eco-electricity mix.

6 Bibliography

General Data Foundations

ecoinvent, 2010, Swiss Centre for Life Cycle Inventories, Switzerland

International Energy agency, 2008, International Energy Statistics – Electricity for European Union – 27, www.iea.org, letzter Zugriff Dezember 2010

Jungmeier, G. et al. (1997): Gemis-Österreich – Energetische Kennzahlen im Prozessketten-bereich Nutzenergie-Energiedienstleistung; Joanneum Research Institut Graz

Kommission der Europäischen Gemeinschaften (2007): Mitteilung der Kommission an den Rat und das Europäische Parlament. Fahrplan für erneuerbare Energien. Erneuerbare Energien im 21. Jahrhundert: Größere Nachhaltigkeit in der Zukunft" (KOM(2006) 848).

Kratena, K. und Würger, M. (2005): Energieszenarien für Österreich bis 2020. Studie des Österreichischen Instituts für Wirtschaftsforschung im Auftrag des Bundesministeriums für Wirtschaft und Arbeit. Eigenverlag, Wien.

Krotscheck, C., M. Narodoslawsky, 1996. The Sustainable Process Index - A new Dimension in Ecological Evaluation. Ecological Engineering 6/4 (1996) pp. 241-258.

Oswald, G., 2003, Ökologische Bewertung im Holzwohnbau, Dissertation, 117-143.

Öko-Institut e.V., 1999. Erarbeitung von Basisdaten zum Energieaufwand und der Umweltbelastung von energieintensiven Produkten und Dienstleistungen für Ökobilanzen und Öko-Audits; i.A. des Umweltbundesamtes. Berlin. Darmstadt. Freiburg.

Statistik Austria, 2009: Ergebnisse der quartalsweisen Stichprobenerhebungen zum Urlaubs- und Geschäftsreiseverkehr, Datenstand 2009

Statistik Austria, 2009: Statistik des Bevölkerungsstandes, http://sdb.statistik.at/superweb guest/login.do?guest=guest&db=debevstprog, letzter Zugriff September 2010

Statistik Austria, 2010: Feststellung der Bevölkerungszahl für den Finanzausgleich gemäß § 9 Abs. 9 FAG 2008 ("Mini"-Registerzählung)

Streicher, W., et al. (2010): Energieautarkie für Österreich 2050. Feasibility study, BMWFJ und BMLFUW, BM für Wirtschaft, Familie und Jugend und Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (2010): EnergieStrategie Österreich. Eigenverlag, Wien. URL: http://www.energiestrategie.at/, zuletzt besucht am 18.3.2011.

VDMA Power Systems (2010): Strommix in der EU27 – Entwicklung der Stromerzeugung in Europa; Frankfurt am Main; www.vdma.org/powersystems

http://distancecalculator.globefeed.com/World_Distance_Calculator.asp, Ermittlung der Entfernungen am 08.10.2010

REA

Landesregierung Tirol (2005): Mobilitätskosten von PendlerInnen. www.tirol.gv.at/themen/verkehr/verkehrsplanung/mobil/mobilitätskosten.

MCI (2002): Logistikstudie Abfalltransport Tirol. Management Center Innsbruck, Juli 2002.

Landesvereinigung Bauwirtschaft Baden-Württemberg (2005): Straßenerhaltung in Kommunen. Daten und Fakten zum Kommunalen Straßenbau. Stuttgart.

FGSV (1999): Erhaltungsbedarf für Bundesfernstraßen, Landesstraßen und Kommunalstraßen. Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln.

Egger, G. (2009): Benchmarking Winterdienst/Straßenreinigung. Vortrag auf dem 2. Grazer Forum zu aktuellen Fragen der Kommunalwirtschaft, 5.11.2009.

Eibelshäuser, M. (2002): Elfter Zusammenfassender Bericht des Präsidenten des Hessischen Rechnungshofs – Überörtliche Prüfung kommunaler Körperschaften. Darmstadt.

St. Martin a.d. Raab (2008): Niederschrift der Sitzung des Gemeinderates vom 11.4.2008. http://www.sankt-martin-raab.at/cms/images/08-04-11_Protokoll.pdf

LTG (2003): Licht im öffentlichen Raum. Lichttechnische Gesellschaft Österreichs (Hg.), Eichgraben/NÖ.

Deco & Lights GmbH (2010): Gesamtsanierung der Straßenbeleuchtung ohne Budgetbelastung. Modellrechnung. Trofaiach.

Energieinstitut Vorarlberg (2000): Leitfaden energieeffiziente Straßenbeleuchtung. Dornbirn.

LEA (2009): Lichtstraße Oststeiermark – best practice Katalog. Lokale Energie Agentur Oststeiermark (LEA), Feldbach.

BOKU (2009): Kosten Kanalisation und Kläranlage. Univ. f. Bodenkultur, Dpt. Wasser-Atmosphäre-Umwelt, Wien.

Braun, Dr. und Kunz, A. (2005): Kosten und Finanzierung von Straßenausbaumaßnahmen in kleinen Dörfern – Ergebnisse einer Studie zur Ermittlung des Straßenzustandes in Dörfern mit bis zu 2000 Einwohnern (Teil 2). Infodienst der Sächsischen Landesanstalt für Landwirtschaft, Dresden, 08/2005 (S. 23-28). www.landwirtschaft.sachsen.de/lfl

Energie-Control GmbH (2011): Einspeisetarife gemäß BGBl II Nr 42/2010 und BGBl II Nr 25/2011. www.e-control.at

Statistik Austria (2009): Jahresdurchschnittspreise und -steuern für die wichtigsten Energieträger 2009. www.statistik.at.

Heizungsfinder (2010): Die Elektroheizung. www.heizungsfinder.de/elektroheizung/kosten-preise. zuletzt abgefragt am 2.12.2010.

Solarserver (2010): Kostenlose Berechnung thermischer Solaranlagen. www.solarserver.de/service-tools/online-rechner/solaranlage-online-berechnen.html., zuletzt abgefragt am 15.12.2010.

Solarone (2010): Kosten einer Solarthermie-Solaranlage. www.solarone.de/Solarthermie/solarthermiekosten.html, zuletzt abgefragt am 30.11.2010.

AK NÖ (2009): Brennstoffpreise im Jahresvergleich, Sept. 2008.

AK Wien (2008): Die Einzelabrechnung der Fernwärme Wien über die Wärme- und Heizkosten. www.arbeiterkammer.at/bilder/d64/Heizkosten.pdf, zuletzt abgefragt am 19.1.2011

Regionalenergie Steiermark (2010a): Energieträgervergleich, Vergleich der Endenergiekosten verschiedener Energieträger. 25. KW 2010, www.holzenergie.net, zuletzt abgefragt am 19.1.2011

Winkler, F. (2010): Betriebswirtschaftliche Aspekte von partiellem Rückbau und Abriss. Dr. Winkler GmbH, Chemnitz, http://www.dr-winkler.org/downloads/artikelimmozeitung.pdf, zuletzt *abgefragt* am 1.2.2011

Hütter, W. (2010): Sachverständigengutachten. Ermittlung des Verkehrswertes einer Liegenschaft in Aldrans. Innsbruck (www.wienerzeitung.at/immo/0406104.pdf, zuletzt *abgefragt* am 1.2.2011)

Wallbaum, H. (2002): Denk- und Kommunikationsansätze zur Bewertung des nachhaltigen Bauens und Wohnens. Dissertation, Universität Hannover.

Korjenic, A., Bitzinger, F. und Mahdavi, A. (2009): Bauphysikalische, ökologische und ökonomische Bewertung von geförderten Sanierungskonzepten in Wien. Bauphysik 31, Heft 3.

Frischer Windt (2010): http://www.frischer-windt.de/garten-preis-kosten.htm, zuletzt recherchiert am 1.2.2011.

ILS (2010): Leben im Passivhaus. Baukonstruktion, Baukosten, Energieverbrauch, Bewohnererfahrungen. Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen.

Statistik Austria (2007): Wohnungsbericht 2007, Wien.

Regionalenergie Steiermark (2010b): Vergleich der Investitions- bzw. laufenden Kosten pro Jahr zwischen den Wärmeabnehmern von Holzenergie-Contracting Projekten, einer Hackgut-, einer Pellets-, einer Öl- und einer Gaszentralheizung für 10 kW, 15 kW, 20 kW und 25 kW Heizlast; www.holzenergie.net, zuletzt abgefragt am 19.1.2011

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