Energetic Long Term Analysis of Settlement Structures

FACTSHEET

1. ELAS – Point of Departure

The current state of knowledge on the research topic is broad in case of energy-efficient building at the level of individual buildings, but still relatively patchy in terms of settlement structure aspects. Energy consumption, energy savings and energy supply are current issues in different areas, including spatial planning. Until now, there has been no holistic view that included all aspects of the system "settlement".

For this particular reason, a detailed fundamental research about relations between energy consumption, energy supply and residents in respect of mobility and lifestyles was the main goal of the so called ELAS-project. As one outcome of the project the ELAS-Calculator was developed. A total analysis under wide system boundaries was carried out. For example, the houses of different building periods, technical infrastructures, site factors, behaviour of residents concerning mobility and other energy relevant aspects were included. Energy supply options and their long-term effects on the environment as well as social and economic developments were considered.

Austria is a good example for versatile decentralized residential structures. The large amount of mountainous regions resulted in numerous buildings and farmyards in individual layers. These splinter settlements result in high energy demand used for heating, municipal services and mobility. A large number of buildings were constructed at times, when energy was cheap and insulation technologies were not really attractive. However, today, this entails increasingly negative effects.

There are different possibilities to act concerning these old buildings. In the ELAS-Calculator one can choose from renovation, expansion or demolition and reconstruction of buildings at the same or different site. The ELAS-project should offer important information about the mentioned residential area types in Austria and beyond that, in order to give a base for sustainable energy policy decisions. The ELAS-Calculator enables private persons to get an impression about individual energy consumption and its economic and ecological effects.

2. The ELAS-Calculator

The goal of the ELAS-Calculator is to represent all effects of a residential area in respect of the energy use as a unified parameter. With that all effects can be made comparable. Sectoral linkage and advances are considered similarly as in the ecological footprint or in the economic input-output calculation. The ELAS-Calculator is available as a free web-based tool and meant to deliver insightful results to diverse target groups such as communities, planners, architects, and builders and also interested private people.

The ELAS-Calculator should permit these target groups to analyse a settlement and/or individual buildings. One can utilize the calculator in the *private* or the *municipal mode*. The private mode is intended for individuals, who are especially interested in how various criteria affect the personal footprint, energy consumption and added value. The questions are asked more simply in comparison to the municipal mode, so that the calculator can also be used with less theoretical background. The municipal mode is thought to view a settlement as a whole wherefore numerous building groups are defined. Structural parameters are questioned in detail; however, changeable defaults are continuously suggested in order to simplify the entry.

The phases which are seen as decisive parts of the lifecycle in the ELAS-Calculator are renovation, demolition of buildings and construction of new buildings and equipment. This means for example, the renovation part of the lifecycle of an old building or for a new building, to consider the energy for reconstruction and operation until the first upcoming renovation. The decision-relevant relations between energy consumption, energy supply and residents including mobility and other energy relevant aspects with special consideration of location, about the lifecycle of settlements, can be demonstrated with the help of the ELAS-Calculator.

Project partners BOKU IRUB TU Graz STUDIA

Funding klima+ energie fonds FFG LAND OBERÖSTERREICH STADTGEMEINDE FREISTADT

Structural, economic, social, environmental and technical parameters are included in the analysis. The results occur in four categories: energy consumption, CO_2-emissions, ecological footprint (calculated with the SPI, Sustainable Process Index), regional economic parameters (turn over, regional added value, employment and imports). Defaults were taken on the one hand from current studies and on the other hand from extensive surveys. A total of 587 households and 1,047 people from ten case study settlements in seven communities where questioned. When selecting the case study settlements, the highest possible variation of the structural parameters (five degrees of centrality, building type, building period, renovation etc.) was regarded.

The ELAS-Calculator serves as a long-term analysis of energy of existing or planned residential areas. Important parameters of the settlement project (e.g. location parameters, existing or planned living space, existing or planned energy supply, existing or expected population, planned technical facilities) are to be inserted. Thereupon, the ELAS-Calculator estimates the energy consumption of the residential area for heating, electricity and operation of public infrastructure.

For the long-term analysis over 30 years, two pre-assembled scenarios (trend-scenario, green-scenario) are available. Similarly as in the private mode, input data regarding residential structural, infrastructural and building-related parameters can be alternated by individual changes of the input data. With this it can be seen, which affects parameters (like location, residential planning, construction, operation of the buildings and technical infrastructure) have on the energy consumption for construction, low temperature heat, electricity and expected mobility of the residents over a time period of 30 years.

The calculation of a settlement can initiate from the following point:

- As-is-analysis of a settlement
- Planning a project „from the Green Field“

As-Is-Analysis (Status Quo)

In this mode data for an already existing settlement are questioned. On six pages parameters about location, buildings (including space-heating and hot water supply), electricity (consumption and production), municipal services and infrastructure, mobility and regional economic values have to be filled in.

The degree of centrality is a main factor to calculate the mobility. The user defines his/her geographic location by choosing a centrality level between 1-5 with the help of a criteria catalogue and the questioning aid of the calculator:

- Centrality Level 1: location without centrality, no intact local supply
- Centrality Level 2: location without centrality, however intact local supply present
- Centrality Level 3: small center
- Centrality Level 4: district capital
- Centrality Level 5: superregional centre

After selecting the degree of centrality, the user must define the km-distance to all higher levels. From this, the mobility of the residents can later be determined. Due to the fact that in most cases the user (e.g.: planner) does not know the mobility of the entire residential area, the calculation of the mobility is done in the background of the ELAS-Calculator. The calculator helps itself with a database, which was the outcome of an extensive survey in the ten case study settlements carried out within the scope of the ELAS-project. The survey included five degrees of centrality, three age-groups and the travel purpose: With that 75 specific modal splits could be generated as a basis for the calculator. The calculated mobility data are shown to the user and can be modified at any time. Everyday mobility and vacation mobility were taken into account.

Relevant data for following categories have to be entered: site-specific data, buildings and households, electricity, municipal infrastructure and services, mobility and regional economic analysis. After that the result page gives information about ecological and economic parameters which are explained below in the paragraph “Results”. In the As-is-analysis, the results refer to a year and include the operation of living space and communal services of the considered residential area or living unit.

Summary, results related to one year

Category	Result
Energy Consumption	7,378,967 kWh
Ecological Footprint (SPI)	638,124,837 m^2
CO_2 Life Cycle Emissions	2,278,914 kg
Turn over	2,494,748 €
Value added	1,151,827 €
Imports	406,441 €
Jobs	14.9

Planning a Settlement

This calculation type is only available in the municipal mode. Private persons can carry out planning by returning to the according input page and changing certain parameters. Nevertheless, this option will be explained briefly.

Planning can be carried out in the municipal mode based on “green field” or based on an As-is-analysis. The ELAS-Calculator provides information about ecological and economic affects the planned projects with the chosen structures would have on a certain location. When changing from the As-is-analysis to the planning mode, the user has different options e.g. renovating, expanding, demolishing and/or relocating a settlement.

The pressure of an “ecological backpack” is formed when a building is demolished that has not reached its ecological depreciation period of 66 years. In this case, the remaining ecological footprint and the footprint created by the demolition itself (e.g. for machinery use) are added to the one of the new building.

The questionnaire is similar in the structure to the As-is-analysis and also the results are illustrated in the same way. Compared to the As-is-analysis however, operation and construction within the settlement are taken into consideration in the planning mode.

Scenarios

This calculation method is only available in the municipal mode. Private persons can design their own scenario by returning to the entry page and after completing calculation in the As-is-analysis and alternating certain parameters. Just like in the planning mode the next paragraphs should give an insight into the scenarios.

The scenario building is available at the result page after a calculation in the municipal mode. Supported by two pre-assembled scenarios, the results of the analysed settlements are mapped onto the year 2040. Based on the already existing entries, a new calculation with alternated data in the areas of mobility and electricity is made. The user can choose between:

1) The Trend-scenario is based on current predictions in the areas of energy and mobility: the energy consumption (electricity) rises yearly by 2.2%, the electricity provision changes. In the section of every-day mobility, the total kilometres will increase by 25% while the amount of biogas cars will elevate by the year 2040 to 10% and the amount of electric cars to 15%.

2) The Green-scenario is based on responsible handling of energy and resources: the total energy consumption of a settlement will decrease by 33% and will be covered 100% by eco-electricity (from water, biomass, wind etc.). The total kilometres will increase as in the trend-scenario by 25%, car-operation will be driven solely by biogas cars (70%) and electric cars (30%) and bus operation will be only run on biogas.

The results are recalculated after each scenario and can be compared with each other.

The private mode is meant for individual people, who are especially interested in determining how various criteria affect the personal footprint, energy consumption and economic values. Compared to the municipal mode, the questions are simplified so that one can operate the calculator with minor knowledge.

Results

The ELAS-Calculator results in both; economic and ecological aspects of one or more properties in a settlement. The user receives data in the following categories:

- Energy consumption
- Ecological footprint
- CO_2 – lifecycle - emissions
- Turn over
- Value added
- Imports
- Jobs

The methods and background of the different calculations are briefly presented below:

Energy Consumption

The energy consumption is determined differently based on the operation mode of the calculator. In the As-is-analysis, the entire energy consumption value is calculated (including room-temperature, hot-water, electricity, operation of municipal infrastructure and mobility). The energy consumption for infrastructure construction is additionally included in the planning mode. In this case the embodied energy for the construction of buildings, streets, sewers, demolition and renovation is taken into account. This energy consumption for construction is shown separately from that caused by operation on the results page. The embodied energy refers to the cumulated energy demand (CED) and includes energy out of the production chain for products (e.g. bricks).

Ecological Footprint (Sustainable Process Index, SPI®)

There are various types of ecological footprints, which incorporate human behaviour to different extents. One calculation method is the so called Sustainable Process Index (SPI®). In this method all material and energy flows, 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 involved emissions. The higher the ecological footprint is, the more harmful it is for the environment.

CO_2 – Emissions

The amount of CO_2 emissions can be calculated out of 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 basic idea goes back to 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 bed shows a CO_2 sink. The amount emitted per year can be calculated based on the sedimentation rate of the ocean bed. The term “life-cycle-emission” means that emissions are not only local in the settlement, they are meant in a global frame.

Regional Economic Analysis (REA)

Both residential areas and individual buildings are regional economic factors. Construction, administration and consumption happen where humans live. People must satisfy their basic needs. These include housing, work and education, free-time and social contacts as well as supply of goods and services. Most of these basic needs have an economic side: 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 or they have to carry costs which cannot always be covered. Residents, investors, operators, suppliers and authorities should know which economic effects they have to face.

A regional economic analysis presents economic effects, with emphasis on those with relation to the energy consumption of a settlement. The REA results in turn over, value added and imports and jobs. The results of the

ELAS-Calculator are presented for the entire state or the province the settlement is situated in.

3. Calculation Examples

The following example is meant to show, which entries are required and what results the ELAS-Calculator offers. In order to illustrate the functions an example in the municipal mode is given, so that the planning mode can be explained as well. The example is a fictive settlement and the calculations are divided into 3 steps:

1. As-is-analysis
2. Settlement Expansion (based on As-is-analysis)
3. Scenarios based on the expanded settlement

The settlement consists of four one-family-houses with low-energy construction. For this settlement the As-is-analysis is carried out. In the second step (planning mode), the settlement is expanded by two one-family houses with passive house standard. The required entries for the ELAS-calculator are shown in the following table. The additional data for the planning (step 2) is shaded grey.

Site-specific data			
Nation	**Austria**		
Federal state	**Styria**		
District	**Feldbach**		
Municipality / City	**60410**		
Inhabitant information			
Inhabitants of town / city:	**3,059**		
Inhabitants of the district:	**67,400**		
Degree of Centrality			
degree of centrality	**3**		
Distance to degree of centrality 5	**63.00**		km
Distance to degree of centrality 4	**11.00**		km
Electricity (including planning)			
Total electricity consumption of households	**28,960**		kWh
Own electricity production	**3,000**		kWh
Buildings and Households			
Building period from 1991			
Building type	**One or two family house**		
Building standard	**Low energy house (wood lightweight construction)**		
Number of buildings	**4**		
Total living space	**640**		m^2
Building lot area	**3,000**		m^2
Already renovated	**-**		
Number of households	**4**		
Number of residents	**12**		
Age distribution (below 15 / 15 - 29 / 30 - 59 / over 60)	**2 / 2 / 6 / 2**		
Energy performance indicator	**40**		kWh/(year.m^2)
Total space heating demand	**25,600**		kWh / year
Provision of space heating	Pellets	**50**	%
	Solar-thermal	**20**	%
	heat pump	**30**	%
Hot water demand per person	**1,000**		kWh / year
Total hot water demand	**12,000**		kWh / year
Provision of hot water	Pellets	**50**	%
	Solar-thermal	**20**	%
	Heat pump	**30**	%
Planning options			
Renovation (insulation)	**No renovation**		
Demolish building	**No**		
Additional living area (building additions):	**0**		
Insulation of building additions	**No renovation**		
Building period from 2011			
Building type	**One or two family house**		
Building standard	**Passive house (massive building)**		
Number of buildings	**2**		
Total living area	**300**		m^2
Area building site	**1,400**		m^2
Renovation (insulation)	**ecological insulation**		
Number of households	**2**		
Number of residents	**5**		
Age distribution (below 15 / 15 - 29 / 30 - 59 / over 60)	**1 / 2 / 2 / 0**		
Energy performance indicator	**15**		kWh / year.m^2
Total space heating demand	**4,500**		kWh / year
Provision of space heating	Heat pump	**100**	%
Hot water demand per person	**1,000**		kWh / Jahr
Total hot water demand	**5,000**		kWh / Jahr
Provision of hot water	Heat pump	**100**	%
Municipal Services and Infrastructure			
Road network			
Existing internal development (municipal road)	**250**		m
Additional internal development (municipal road)	**0**		m
Existing internal development (secondary road)	**0**		m
Additional internal development (secondary road)	**0**		m
distance to center of town/city (total)	**2.000**		m
External development (municipal road)	**1.500**		m
External development (secondary road)	**500**		m
Road service			
Road cleaning	**3**		Tours / Year
Mowing and trimming	**4**		Tours / Year
Snow removal	**20**		Tours / Year
Sanding	**15**		Tours / Year
Snow pole setting	**2**		Tours / Year
Others	**0**		Tours / Year
Street lighting			
Electricity consumption (existing):	**2,144**		kWh
Electricity consumption (additional):	**0**		kWh
Number of lighting devices (existing):	**8**		
Number of lighting devices (additional):	**0**		
Sewage treatment			
Original amount of sewage per year	**2,184.16**		m^3
Additional amount of sewage per year	**642.40**		m^3
linked to sewer lines?	**Yes**		
Treatment plant	**central**		
Sewage treatment technology	**Two stage (mechanical, biological**		
Treatment plant (de-central)	**No**		
km sewer line from settlement to treatment plant (existing)	**2.00**		km

km sewer line from settlement to treatment plant (additional)	**0.10**	km
Electricity consumption sewer pumps (total)	**0**	kWh
Organised waste collection		
Residual waste	**Yes**	
Used paper	**Yes**	
Plastic	**No**	
Bio waste	**Yes**	
Tree clipping, lawn clipping	**Yes**	
Used glass	**Yes**	
Used metal	**No**	
Bulky waste	**Yes**	
Waste collection point		
Distance	**1.80**	km
Regional Economic Analysis - REA		
Construction of living space		
Construction of settlement		
One family house – low energy	**1,631**	€
Operation of living space		
Residential heating		
Heating costs - pellets	**410.58**	€
Heating costs – solar thermal	**120.75**	€
Heating costs – ground heat pump	**112.86**	€
Electricity		
Electricity costs – consumption, kWh	**0.18**	€
Cost saving for electricity – feed-in production	**0.38**	€
Municipal infrastructure operation		
Building		
Development costs - sewer, water, electricity	**400**	€
Operation		
Services – electricity costs lighting	**0.18**	€
Services – lighting maintenance	**27.70**	€
Services – road services	**2.08**	€
Services – road maintenance	**1.50**	€
Services – sewer operation	**2.02**	€
Waste removal-km – costs of tours	**0.41**	€
External Effects (mobility)		
Every day mobility		
Motorised individual transport – car, motor cycle-km	**0.51**	€
Public transport - train, bus ... - km	**0.11**	€
Leisure/vacation		
Motorised individual transport – car, motor cycle-km	**0.51**	€
Public transport - train, bus ... - km	**0.11**	€
Other transport - airplane-km	**0.15**	€

Calculation Results As-Is-Analysis and Planning (Step 1 and 2)

The next table shows the total results for the considered settlement per year. The planning differs from the As-is-analysis by the settlement expansion. This includes two passive houses in massive construction with ecological insulation and a total of 300 m² living space, 5 residents aged up to 60 years and an infrastructural expansion of the sewage system. This example forgoes a detailed representation.

As-is-analysis

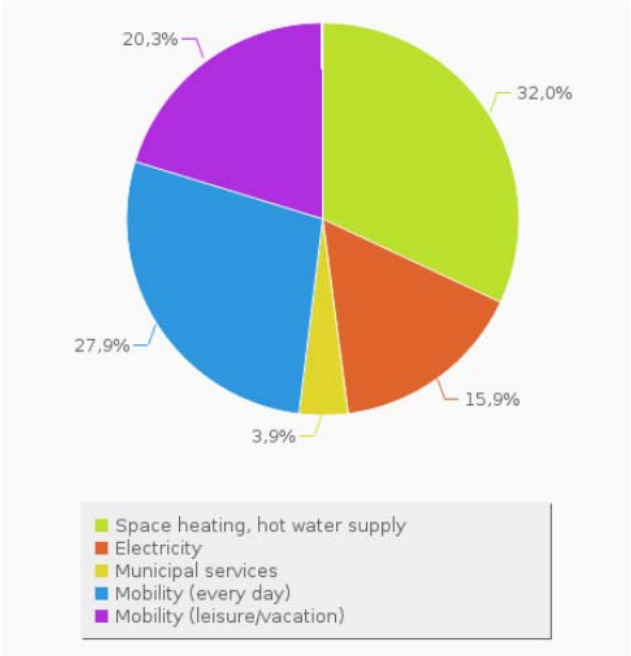
Category	Result
Energy Consumption	**117,528** kWh
Ecological Footprint (SPI)	**9,327,621** m^2
CO_2 Life Cycle Emissions	**37,742** kg
Turn over	**52,891** €
Value added	**24,562** €
Imports	**8,549** €
Jobs	**0.2**

Planning based on As-is-analysis

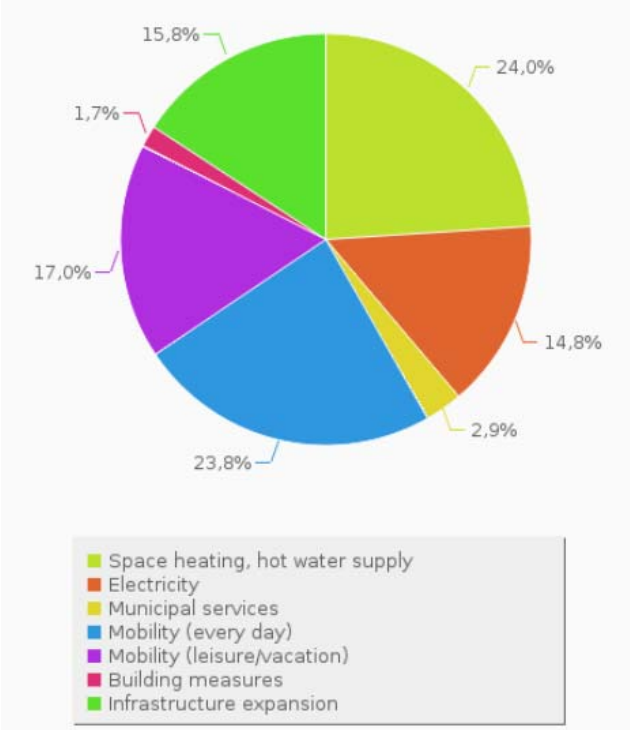
Category	Result
Energy Consumption	**161,657** kWh
Ecological Footprint (SPI)	**13,708,444** m^2
CO_2 Life Cycle Emissions	**54,532** kg
Turn over	**85,588** €
Value added	**39,823** €
Imports	**13,680** €
Jobs	**0.4**

The following diagrams show the detailed results for energy consumption, the ecological footprint and the regional economic analysis. The output data in the ELAS-Calculator are represented both in tables and in diagrams which enables specific comparison. The user may print both the input data as well as the results page. With the help of a project title that can be set in the beginning it is possible for the user to keep track of the different projects. The data is saved locally on the PC as an *.elas-File and cannot be readout by any other program. In this way, given data is kept private and protected.

As-is-analysis



Planning based on As-Is-analysis



The dispersion of the energy consumption is shown in the diagrams. The additional pie chart sectors, which are created through the construction of buildings and communal infrastructure (in this example: sewer) in the planning diagram are especially noticeable.

The ELAS-Calculator shows the ecological effects of a residential area and its residents. Table 5 illustrates an overview of both the CO_2-emissions as well as the ecological footprint.

CO_2 life cycle emissions, As-is-analysis

Result area	Result	Distribution
Space heating, hot water supply	**4,306** kg	11.0 %
Electricity	**11,150** kg	28.5 %
Municipal services	**2,002** kg	5.1 %
Mobility (every day)	**13,158** kg	33.7 %
Mobility (leisure/vacation)	**8,463** kg	21.7 %
Total	**39,080** kg	**100** %

Ecological Footprint (SPI), As-is-analysis

Result area	Result	Distribution
Space heating, hot water supply	**1,143,922** m^2	12.3 %
Electricity	**3,670,187** m^2	39.3 %
Municipal services	**580,381** m^2	6.2 %
Mobility (every day)	**2,258,743** m^2	24.2 %
Mobility (leisure/vacation)	**1,674,388** m^2	18.0 %
Total	**9,327,621** m^2	**100** %

CO_2 – life cycle - emissions, Planning based on As-is-analysis	Ecological Footprint (SPI) Planning based on As-is-analysis

Result area	Result	Distribution
Space heating, hot water supply	**4,306** kg	11.4 %
Electricity	**12,419** kg	32.9 %
Municipal services	**2,003** kg	5.3 %
Mobility (every day)	**10,552** kg	28.0 %
Mobility (leisure/vacation)	**8,463** kg	22.4 %
Total	**37,742** kg	**100** %

Result area	Result	Distribution
Space heating, hot water supply	**1,669,117** m^2	11.5 %
Electricity	**5,123,107** m^2	35.4 %
Municipal services	**645,991** m^2	4.5 %
Mobility (every day)	**3,916,652** m^2	27.1 %
Mobility (leisure/vacation)	**2,344,144** m^2	16.2 %
Building measures	**480,125** m^2	3.3 %
Infrastructure expansion	**275,558** m^2	1.9 %
Total	**14,454,693** m^2	**100** %

The results of the regional economic analysis (REA) of this example are viewed in the following table. The values “living space, construction” and “municipal infrastructure, construction” derive from the planning project.

Sunmmary REA	
Turn over in Austria	**85,588** €
Value added in Austria	**39,823** €
Import to Austria	**13,680** €
Jobs in Austria	**0.4**
Turn over in your federal state	**69,476** €
Value added in your federal state	**28,576** €
Imports from abroad or other federal states	**24,927** €
Jobs in your federal state	**0.3**
Turn over in other federal states	**16,112** €
Value added in other federal states	**11,247** €
Imports from other federal states	**11,247** €
Jobs in other federal states	**0.1**

Value added effects according to initiator - Austria

Category	Turn over	Value added	Imports	Jobs
Living Space, construction	**10,007** €	**4,881** €	**1,402** €	**0.1**
Living Space, operation	**15,836** €	**6,915** €	**2,624** €	**0.0**
Municipal Infrastructure, construction and operation	**4,951** €	**2,657** €	**549** €	**0.0**
External Effects (Mobility)	**54,794** €	**25,370** €	**9,105** €	**0.3**
Total	**85,588** €	**39,823** €	**13,680** €	**0.4**

Value added effects according to initiator - Steiermark

Category	Turn over	Value added	Imports	Jobs
Living Space, construction	**7,921** €	**3,542** €	**2,741** €	**0.1**
Living Space, operation	**13,811** €	**5,406** €	**4,133** €	**0.0**
Municipal Infrastructure, construction and operation	**4,104** €	**2,150** €	**1,056** €	**0.0**
External Effects (Mobility)	**43,639** €	**17,478** €	**16,997** €	**0.2**
Total	**69,476** €	**28,576** €	**24,927** €	**0.3**

Calculation Results: Green-Scenario (Step 3)

The Green-scenario is based on a responsible handling of energy and resources, which will lead to following changes until the year 2040:

- Electricity: Total electricity consumption of the settlement decreases by 33%, 100% eco-electricity (from water, biomass, wind etc.)
- Mobility: increase of the total kilometres complies with the trend-scenario (25%), cars will run on biogas (70%) or electric (30%), bus will be powered solely with biogas

The next table demonstrates the effects on the fictive settlement of the calculation example compared to the planning results. The ELAS-Calculator gives detailed results of the scenarios diagrams as well as in graphs. However, in this example there is just a brief overview given.

Planning based on As-is-analysis

Category	Result
Energy Consumption	161,657 kWh
Ecological Footprint (SPI)	13,708,444 m^2
CO_2 Life Cycle Emissions	54,532 kg
Turn over	85,588 €
Value added	39,823 €
Imports	13,680 €
Jobs	0.4

Green - scenario

Category	Result
Energy Consumption	141,520 kWh
Ecological Footprint (SPI)	5,908,327 m^2
CO_2 Life Cycle Emissions	20,856 kg
Turn over	84,212 €
Value added	38,329 €
Imports	13,003 €
Jobs	0.3

In this case, by assuming the green-scenario, the fictive settlement will experience an energy reduction of nearly one-third by the year 2040. This also reduces the ecological footprint and the CO_2 - life cycle - emissions. They are cut down by one half in the Green-scenario. For this reason, this kind of development can be seen ecologically meaningful and the REA results show no negative effects from an economic point of view.

4. Conclusion

Residential areas and also single buildings are considerable energy consumers while having a static behaviour. This makes them important in terms of energy policy. The ELAS-Calculator makes essential contributions for various target groups, due to the fact that ecological and economic effects of a settlement can be predicted. The ELAS-Calculator is based on a systematically approach, which does not isolate residential areas but rather views them as a part of a communal network.

The results of the ELAS-Calculator can also be used as an important discussion and decision basis. In building projects, additional factors other than classical arguments for realisation (e.g. construction costs) are becoming more and more significant. The induced energy consumption, ecological footprint, CO_2-emissions and regional economic effects of a settlement or single building can be clarified with the help of the ELAS-Calculator.

The scenarios reveal not only the present effects of a building project, but also long-term future effects. In this way the ELAS-Calculator can make a major contribution to sustainable settlement developments.

Project Team

University of Natural Resources and Life Sciences, Vienna

Department of Landscape, Spatial and Infrastructure Sciences

Institute of Spatial Planning and Rural Development (IRUB)

Gernot Stöglehner, Hermine Mitter, Michael Weiß, Georg Neugebauer

Graz University of Technology

Institute for Process and Particle Engineering (IPPE)

Michael Narodoslawsky, Nora Niemetz, Karl-Heinz Kettl, Nora Sandor, Michael Eder

STUDIA - Schlierbach

Study Centre for International Analyses

Wolfgang E. Baaske, Bettina Lancaster

Funding Authority

The ELAS-Calculator was created within the research project “ELAS - Energetic Long Term Analysis of Settlement Structures” during 2009 – 2011. The project was funded by the climate and energy funds and carried out in the program “Neue Energien 2020” (project number 818915). Co-funding was through Upper Austria and Lower Austria as well as through the municipality of Freistadt.

Imprint:

Institute of Spatial Planning and Rural Development (IRUB)
University of Natural Resources and Life Sciences, Vienna
Peter-Jordan-Straße 82, 1190 Vienna, Austria
Project Management: Gernot Stöglehner
Project Team: Hermine Mitter, Michael Weiß, Georg Neugebauer
Contact: gernot.stoeglehner@boku.ac.at

Institute for Particle and Process Engineering
Graz University of Technology
Inffeldgasse 21b, 8010 Graz, Austria
Project Management: Michael Narodoslawsky
Project Team: Nora Niemetz, Karl-Heinz Kettl, Michael Eder, Nora Sandor
Contact: narodoslawsky@tugraz.at

Studia Schlierbach
Panoramaweg 1, 4553 Schlierbach, Austria
Project Management: Wolfgang Baaske
Project Team: Bettina Lancaster
Contact: baaske@studia-austria.com

Project partners:

Funding: