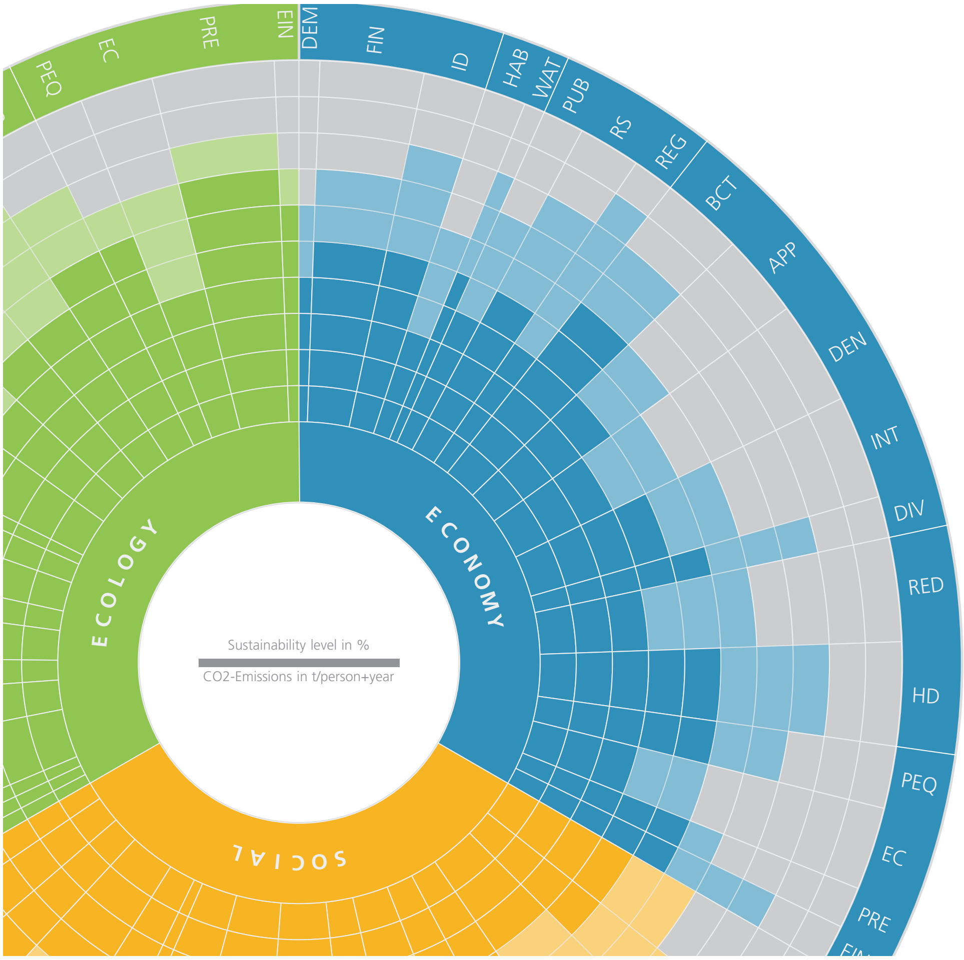

Energy Efficiency in the Neighborhood

An Introduction to the *effort* Instrument

Ressources
Climate Protection
Ecology
Urban Development
Architecture
Building Technology

effort
Energy Efficiency On-Site

The *effort*-Instrument

Five Thuringian companies as well as the Nordhausen University of Applied Sciences have joined to develop a method on how to plan for energy-efficient neighborhoods. This initiative was developed because until now, there haven't been any feasible methods for the planning and implementation of complex tasks that would allow all factors to be considered. This brochure offers insight into the newly developed effort-instrument, which is intended to help make the energy transition in our neighborhoods and communities socially and environmentally compatible without damaging the identity-defining traits of our environment. For an optimized sustainable energy supply, the effort team has considered the energy potential from every neighborhood along with the special conditions of its location. Aspects such as urban planning, historical preservation and ecological affairs are incorporated into the plan. This interdisciplinary and holistic approach to redeveloping energy is an essential feature of the new planning approach.

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TABLE OF CONTENTS	PAGE
Imprint	4
Table of Contents	5
Sponsorship	6
Foreword	7
Introduction	9
Data Collection	14
Inventory Analysis	17
effort-Toolbox	19
effort Sun I	28
Input of Target Figures	30
effort Master Plan	32
Energy Demand Prognosis	37
Potential Renewable Energies	39
Plans of Action	41
effort Sun II	43
Implementation and Evaluation	45
Practical Application of effort	48
Why effort?	51
The effort Team	52
Index	54
Organizational Chart	55

Organizational chart for the effort instrument ... ...

... You can find it by flipping the flap on the back cover >>>>>

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Global changes will not stop in front of our doorsteps. We need a new way of looking at material and energy resources. Global sustainability is only made possible by acting locally on a large scale. Special meaning is given to the energy and ecological transformations of our residential surroundings. Local energy efficiency (effort) is a key global task.

A group of Thuringian engineers and scientists joined forces to transform neighborhoods and to explore new fields of activities. Representatives of different disciplines such as energy and building technology, urban planning, ecology, climate protection, architecture, mobility and social sciences were closely involved in this complex task from the onset. Supported by the BMBF, a planning instrument was developed together with effort its method is explained in this brochure.

The systemic approach should be emphasized. Improving energy efficiency in our neighborhoods and achieving higher self-sufficiency with renewable resources should not adversely effect other sectors. In order to achieve a high degree of sustainability for our neighborhoods, a comprehensive upgrade of all sectors is necessary. The engineers involved in this project have found a wonderful solution by visualizing the 'sustainability sun', which entails the process-oriented monitoring of the transformation as well as the certification of neighborhoods.

I wish the Thuringian engineers and scientists every success in implementing the local energy transition. I also advocate the energy-efficient and resilient city of the future together with the International Year of Global Understanding (IYGU) and its worldwide network of partners, users, and sponsors.

Best wishes,

Prof. Dr. Benno Werlen
Executive Director
of the International Year of Global Understanding (IYGU)

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Introduction

The ever-increasing implementation sustainability, the inevitable adaptation to climate change, and the consistent rejection of atomic energy lead to the energy transition which affects a large portion of society. The implementation of this energy transition is supported by laws and aims to increase the proportion of renewable energies in electricity supply to 80% by 2050.

Compared with the commercial and transport sectors, the building sector has a proportion of 40% as well as the highest energy demand and the highest energy-saving potential. However, this national energy concept can only be implemented if urban redevelopment also takes place. It is therefore essential to save primary energy and reduce the heat demand in the building sector. This can be achieved by decentralizing the supply and increasing the annual modernization rate of energy systems to at least 2%.

... Urban areas carry the heaviest burden of the energy transition.

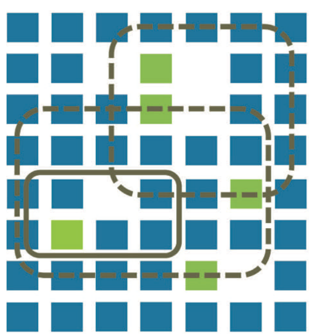
Energetic urban redevelopment will greatly affect our environment. Both the transformation of energy and the change of the urban climate can have an incredible effect on our living environment, quality of life, and health. Socio-physical and cultural aspects as well as the protection and revaluation of ecological needs therefore need to be considered as part of sustainability.

... Sustainable solutions are being sought.

Engineering planning has not been able to offer any possible solutions for such comprehensive tasks. It is usually the energy solutions that are heavily advertised, deemed worthy of funding, or are tried and tested that are chosen. Planning and consulting services dealing with energy, climate protection, and urban development are either too global (administrative action of complete towns) or too limited (energy or urban development and so on only).

... Only with systemic approaches.

In order to realize an optimized sustainable energy supply and find specific solutions, the energy potentials need to be considered keeping in mind local conditions such as land use, spatial structure, ecology, social aspects, developmental potential, traffic structure, historical conservation, building culture and population development. Here, the actors are confronted with a multi-causal conflict structure of interacting fields of activity, which can be resolved or mitigated only in complex balancing processes. The scale for this will be the sustainability with its economic, ecologic, and social dimensions.



Areas of Tension

Decentralized energy supply	⟷	Interests from large suppliers
Use of renewable energy potentials	⟷	Erratic funding policy
Supply optimization in the neighborhood	⟷	Selfish individual interests
Demographic change (shrinkage)	⟷	Increasing land use
Social space planning	⟷	Segregation
Capital gain	⟷	Investments
Energy management area	⟷	Preservation of the cultural landscape
Energy efficiency of buildings	⟷	Aesthetic construction
Internal compression	⟷	Urban ecology, climate
Changes in land use	⟷	Local climate change
...		Etc.

What is effort?

effort ... stands for "On site Energy Efficiency.

Effort stands for "On site Energy Efficiency" and is an initiative founded by Thuringian engineers and the Nordhausen University of Applied Sciences. It has led to the development of a new method for the design and implementation of energy-efficient neighborhoods.

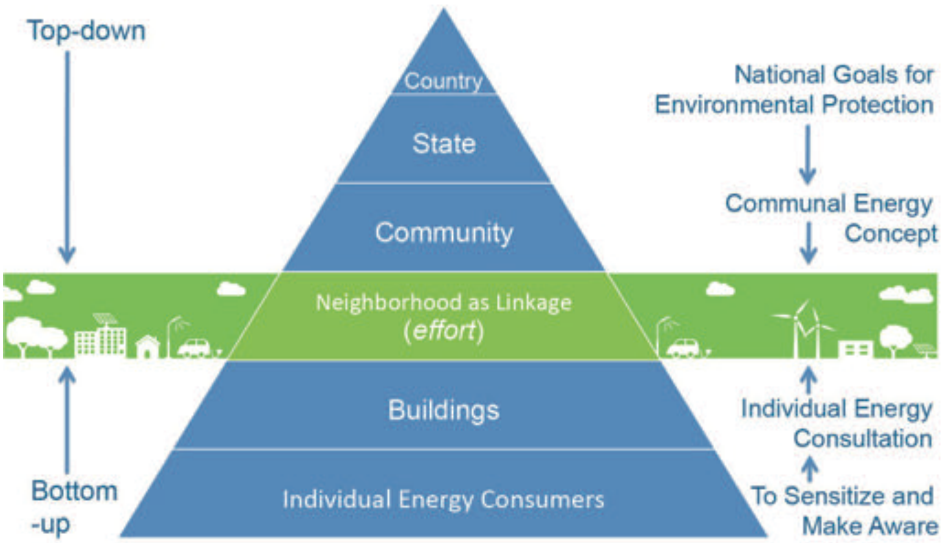
... is based on sustainability and feasibility.

Unlike other concepts, the project initiative distinguishes itself by its interdisciplinarity and complexity as well as its consequent implementation of sustainability and transdisciplinary applications. The project partners are engineers who are involved in these subject areas. They dislike the lack of interdisciplinary solutions and promote sustainable urban redevelopment.

Effort is an instrument that can be used to plan the optimal and sustainable mix of energy supply for the respective neighborhoods (integrated energy concept). With effort, the overall energy efficiency of neighborhoods, urban areas, or rural communities can be defined. Development strategies can be worked out to reduce CO_2 emissions and implement a sustainable engineering plan.

... finds optimization potential in the neighborhood

The expected increase in efficiency is derived from the role of the neighborhood as a distinctive spatial unit of urban remodeling. The systematic link between a building and the city shows the energy optimization potential at the level of the neighborhood. Residents can also be linked top-down-processes (city concepts and promotions) and with bottom-up-activities. The term "neighborhood" refers less to an urban structure and more to a meaningful and summarizing spatial unit.



A special feature of the effort method is that it allows us to see more than just the buildings. The respective neighborhood will also be understood as a whole in order to identify the advantages and disadvantages of the individual and collective solutions for the redevelopment of energy and the decentralized supply of the neighborhood.

How does *effort* work?

... indicators linked to the GIS-based models

The methodology provides everything needed for an integrated neighborhood concept; it combines all the required indicators in a GIS-based model and establishes a causal/semi-causal connection. Spatial resolution must-show a precise map at the property and parcel level.
Project can be planned in a GIS, and the effects on all other indicators can be determined. Several special tools have been developed to evaluate the individual indicator sets as well as the project planning to be derived. The level of sustainability of the initial objective and planning objective as well as the CO_2 balance can be identified.

... structures the selection of relevant indicators

To implement the effort method, the departments involved (resources, ecology, mobility, architecture, city planning and energy/building) have defined appropriate indicators for making an inventory of the neighborhood, deriving project planning packets, and determining the level of sustainability. Specific indicators that are essential for an integrated neighborhood concept, and which can be simply and meaningfully evaluated were selected by the respective departments. For better manageability, the 142 indicators in the 22 indicator sets were pooled.

The *effort* Disciplines / The *effort* Indicator Sets

Energy Technology

- Primary Energy Quality
- Energy Consumption
- Potential Renewable Energy
- Energy Infrastructure

Architecture

- Level of Redevelopment
- Heating Consumption
- The Use of Redevelopment Potential

Urban Planning

- Building Culture and Townscape
- Appearance
- Structural Density
- Intensity of Use
- Diversification

Ecology

- Habitat Quality and Biodiversity
- State of Local Water Resources
- State of Groundwater
- Air Quality

Mobility

- Public Transportation
- Road Transportation System
- Regional Transportation Infrastructure

Resources

- Demographic Structure and Development
- Financial Potential
- Identity

effort Briefly Explained

For details, see the fold-out scheme to the right >>>>>

At the beginning of every effort project, data collection is necessary in order to evaluate the indicators and indicator sets. It consists of consulting institutions, surveying local residents, and analyzing our own records. The data is analyzed and indicators are evaluated using specific methods and software tools of the respective departments. Because of the visualization in the effort „sun I", all the gathered evaluation criteria and indicators will be combined. A complex SUSTAINABILITY EVALUATION of the actual state can be carried out in terms of can be carried out in the dimensions of ecology, economy, and social aspects.

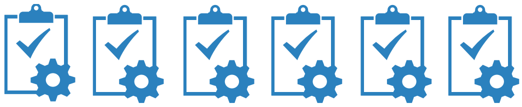
Based on the completeness of the individual indicator sets, the initial state can be determined , and specific objectives can be derived for the neighborhood under consideration (input target figures). The main goal is to increase energy efficiency without adversely affecting the indicator sets.

An effort master plan will be derived from the sub-goals of the individual indicator sets. This will create the framework for the development of the neighborhood. The population and economic forecast will determine the structure of buildings and open spaces. The realizable potentials of renewable energies can be determined on the basis of the effort master plan and its spatial structure. The prognosis of energy demand is based on demographic development and the potential for the renovation of buildings.

Taking into account any possible restrictions, the determination of the potential for renewable energy is based on the building stock and open space inventory of the effort master plan. Several suitable measures have been derived from the action catalogue. These take into consideration the initial state, goals for the neighborhood, and the effort master plan. The system allows for the coordination of measures from individual disciplines, thereby increasing overall sustainability in the neighborhood.

A prognostic status description of the redeveloped neighborhood can now be visualized, with the effort „sun II" (evaluation of sustainability and CO_2 balance) by presenting the effects of the actions on the indicators. These steps form the basis for the implementation and evaluation of the project. The system can eventually be used to certify of energy-efficient neighborhoods.

DATA COLLECTION



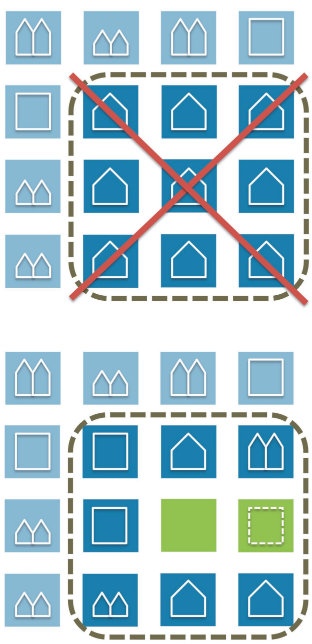
... uses databases and estimation options

The indicators required to assess the neighborhood were to be defined by the subject disciplines. If possible, every indicator should always be based on data. The effort tools also offer a certain tolerance to missing values. Estimates – especially from skilled personnel – must always be possible. The following groups of data are to be included:

... works with structured data groups

> Energy consumption data from private and public buildings
> Demographic data
> Data on the technical and social infrastructure
> Data on other/further supply structures
> Relevant urban development data
> Ecological data
  incl. geological-hydrological, meteorological data

The data will be collected by consulting agencies and municipal authorities, performing internet research and conducting personal surveys (e.g., mapping of the neighborhood). The data will be collected at different levels depending on the respective department. The overall balance limit is the neighborhood.



effort thinks within the NEIGHBORHOOD

There is no clear definition of the term "neighborhood". It is often set to mean the same as a city district, neighborhood, or neighborhood and surroundings. A neighborhood does not simply consist of buildings but describes the entirety of private, semi-private, semi-public, and public spaces and uses within a spatial context. In addition to structural usages (e.g, residential and commercial) roads, recreational areas, and supply units, among others, belong to the neighborhood. In the context of the effort method, the term "neighborhood" does not mean a homogeneous urbanistic unity, but rather is aimed at the formation of sensible and comprehensible energy units.

In practice, the outline of the neighborhood depends on the definition of the relevant authority and where action is needed. If the city only specifies a general area in which the redevelopment measures are to be carried out the processing team can make minor adjustments. Points of view need to vary in order to make specific statements. The following table provides an overview of the disciplines and levels of observation.

effort DEPARTMENTS and Levels of Data Collection

Area of Discipline	Level of observation in data collection
RESOURCES	Neighborhood
CLIMATE PROTECTION	Neighborhood, Overlapping of Boundaries
ECOLOGY	Plot of Land, Neighborhood, City, Region
URBAN DEVELOPMENT	Neighborhood, Plot of Land, Buildings
ARCHITECTURE	Buildings
BUILDING TECHNOLOGY	Neighborhood, Supply Unit, Plot of Land, Buildings / Open Areas / Building Sections

When requesting data, it is useful to form compressed indicator clusters that will be gathered from each authority. On-site inspections are also an essential factor in collecting data. This data is usually the most up to date and helps to assess the plausibility of data collected indirectly. Online data sources need to be checked for reliability.

The disadvantage of this type of data is that it is mostly available at the city level and often has little relevance for the neighborhood. The national offices for statistics can provide some detailed data but usually for a fee. The data sources to be searched are listed in the following table.

effort Data Sources

DATA SOURCES	Data Required
CITY COUNCIL	Population Data, Infrastructure, Ownership
RESIDENTS (QUESTIONNAIRE)	Energy Supply and Consumption Data, State of Redevelopment, Household Size, Estimates on the Neighborhood, Population
ENERGY SUPPLIER, CHIMNEY SWEEPERS, TLVWA, BAFA	Data on the Energy Supply for the Neighborhood, Decentralized Energy Systems, Energy Sources
GOVERNM. AGENCIES	Environmental Data, Population Data
ON-SITE INSPECTION	Facilities, Structure, Stocktaking
RESEARCH (INTERNET/LITERATURE)	Statistical Data, Labor Market Data

effort TOOLS

Data from local network operators, cities, housing cooperatives, and surveys (residents) helps to identify relevant energy and engineering data in the fields of building technology and architecture. If data is missing, statistics can be used. On-site inspections of building renovations by qualified personnel is a reliable source of information.

City Planning: Relevant urban development data from the department of urban planning is collected on the basis of existing maps, plans and on-site inspections, as well as the participation of the community, owners or residents. The data to be collected is determined by the requirements of the indicators and auxiliary indicators.

Resources: This entails working closely with the city and the residents to collect demographic data. Questionnaires are a reliable way of obtaining information from residents. These can be sent by mail (with a stamped, self-addressed return envelope) and/or handed out within the framework of a citizen's event. With regard to the research of labor market data, the employment agency for local governments offers "labor market data in small-scale formation (AkG)". This service is subject to a fee.

Mobility: The parameters of the mobility department are gathered by analyzing aerial photographs and GIS data as well as statistics. On-site visits for collecting data (e.g., checking the conditions of stops) plays an important role.

Ecology: To collect data in the department of ecology, GIS data will be evaluated, and neighborhoods will be developed per parcel. Relevant data will be collected from government agencies and on site.

The GEMIS and Environmental Products Declarations databases from the Institute of Building and Environment, will be used to gather information of building insulation and technology to calculate the carbon footprint.

In the effort project, access to the inventory was facilitated by programming an input mask in which the values of the single indicators can be entered. This tool is based on the method tables of the respective departments.It is then used to determine the actual state of the neighborhood.

INVENTORY ANALYSIS

For the inventory analysis several tools has been developed, to evaluate the sustainability of separate indicators that have been combined. All tools include the following main components and steps:

Appropriate value ranges have been determined for the individual indicators. The degree of fulfillment of each indicator remains within these values. The target values are determined on the basis of these intervals. This could be the maximum, minimum, optimum, or average value of the interval. This variable is designed for the dimensions of sustainability: ecology, economy, and social services.

... determined range of values and target goals

Within this set, the indicators were weighted according to their importance (vertical weighting over factor). This is done separately for the three dimensions of sustainability. The following figure shows an example of the set "potential renewable energy" within the department of Building technology in the dimension of ecology.

... weighted indicators

An Example of an „*effort* Indicator Set"

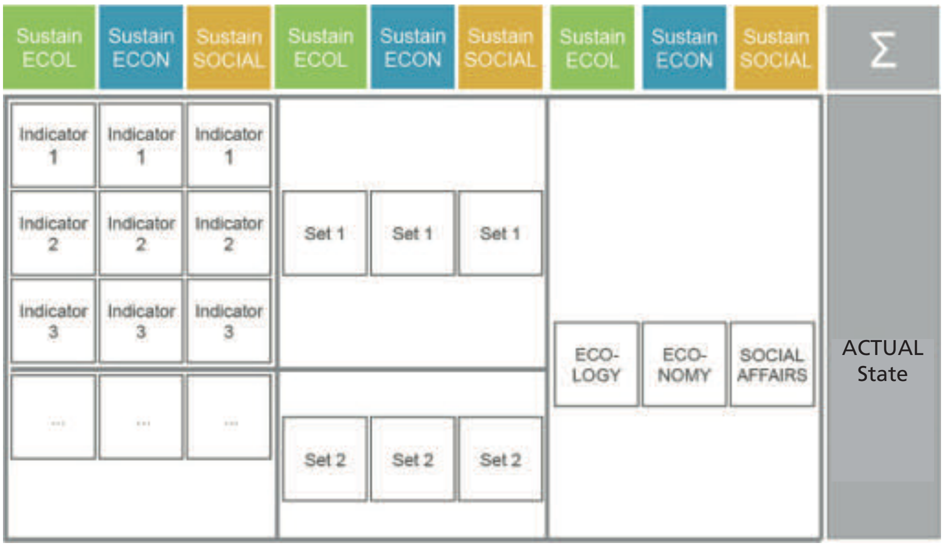
Indicator Set	Indicator	Weighting 'e'
> Potential Renewable Energy	PN Solar Thermal	3
	PN Photovoltaic	3
	PN Geothermal	3
	PN Waste Heat	1

® effort

An example of the makeup of an indicator set for the "potential renewable energy" and its internal, vertical weight. This example shows the weight for the dimension of ecology.

Like the dimensions of sustainability, the weighting of the individual indicator sets will be compared directly by attributing values between 1 and 5. This makes highlighting the extraordinary relevance of a set in a sustainability pillar possible. For example, a set depicting ecological location factors in the dimension of ecology is of greater importance than the population data. Individual ratings that can be read from the tools are as follows:

„**effort** Indicators and Sets“ Principle



„**effort** Inventory Analysis“ An Example for Public Transportation

Indicator	ACTUAL	Ecology		Economy		Social Affairs	
		EG	W	EG	W	EG	W
Distance to Stop	190	69 %	1	69 %	2	69 %	3
Condition of Stop	4	40 %	1	40 %	2	40 %	2
Frequency	37	69 %	2	100 %	2	69 %	3
Connection Quality	3	60 %	1	60 %	1	60 %	3
Drive Systems for Bus Transportation	14	35 %	3	65 %	2	47 %	1
Distance to Train Station	13,200	13 %	2	13 %	1	13 %	1
Results from the public transportation indicator sets:		44 %		62 %		56 %	

effort CALCULATOR

The effort **CALCULATOR** was designed to determine the current heat demand of all buildings in a neighborhood and analyze individual measures related to energy redevelopment and saving without having to do elaborate studies on existing buildings. Priority will be given to estimating the heating demand of a current and future neighborhood, but not the exact determination of the individual demand of a single building. The basis for the effort calculator was developed by the "Institute for Housing and Environment" under the TABULA project records of the housing stock in Germany. An extension to the European records abroad would be possible if necessary.

... uses TABULA as base data set

Based on the records mentioned above, the effort calculator to determine the actual state (actual degree of renovation) of each building in the neighborhood according to individual enveloping surfaces (roof, outside wall, window, and floor). If information cannot be verified because of a lack of cooperation of the owners/residents, appropriate assumptions can be made for the components that cannot be viewed.

... enveloping surfaces differentiated

Taking into account the relevant physical building models of computation done per building, the tool automatically calculates the actual heating demand (HD, ACTUAL), the classification in the energy efficiency classes ("A+" to "H"), and the designation of each projected minimal consumption (HD, MIN) typical for each building. In a subsequent step, individual measures for energy upgrading can be selected for the individual enveloping surfaces of a building. The resulting energy saving (HD, PLAN) for the building is then automatically determined on the basis of the pre-selection. Appropriate deductions (individually adjustable) will be considered in the calculation if buildings are classified as monuments or if the energy cannot be determined.

Likewise, new supplementary or replacement construction may also be considered. Their necessity and range is decided based on urban development and socio-spatial planning goals.

The effort calculator opens up the possibility to determine the overall heat demand of the neighborhood for both the current status as well as for future redevelopment scenarios PLAN and MIN. This is done by merging the individual building-related records into an overall record for the neighborhood.

... calculated varying remediation scenarios

„effort Building Technology: ACTUAL STATE“

LEGEND:

- 80-100%
- 80-100% (Use of renewable energy for facility possible)
- 60-79%
- 60-79% (Use of renewable energy for facility possible)
- 30-59%
- 30-59% (Use of renewable energy for facility possible)
- 0-29%
- 0-29% (Use of renewable energy for facility possible)

NOTE: The map shows the efficiency of the heat generating facility (in %). It also includes an assessment of whether it is possible to use renewable energy with the existing facility.

effort EN.CHART

The effort **EN.CHART** tool enables an evaluation of the degree of fulfillment of the sustainability indicators, indicator sets, and the entire neighborhood. The analysis focuses on heating technology and its energy saving potentials. The suitability of the facilities for renewable energies plays a key part in this. The effort EN.CHART tool works on four levels, including buildings/open-spaces and building sections, plots of land, supply units, and entire neighborhoods. At each level, different fulfillment degrees of the individual indicators are calculated and combined to indicator sets.

... evaluates plant engineering

Primary Energy Quality:
> Sustainability of utilized energy sources in relation to KEA, regenerative share of KEA, CO_2 equivalent, energy cost.

... the energy sources

Energy Consumption:
> Evaluating the efficiency of the system technology based on the ratio between the energy demand of the building and the energy expended (using the plan-state evaluation systems tool).

... the energy consumption

Renewable Energy Utilization Potential:
> Evaluating the utilization of existing renewable energy potential based on solar thermics, photovoltaics, geothermy, and waste heat.

... and the utilization of renewable energy potential

Energy Infrastructure:
> Connection rate of the consumers to power supply networks, taking into consideration the use of regenerative energy sources.

The parameters and indicators on the first (bottom) level will be entered for each of the buildings and open spaces. Each row receives a plot number. At the second level, the buildings and open spaces are grouped according to their plot numbers and each plot is assigned to a supply unit. At the third level, the plots will be combined into supply units. At the fourth (top) level, all supply units will be combined for the overall evaluation of the neighborhood.

A calculation table will be set up for the actual state. The basis of the calculations is the weights of the indicator sets and the fuel list with corresponding assigned figures. If necessary, the fuel list can be complemented and the characteristic values can be changed.

„effort Type and Intensity of Use“

LEGEND:

TYPE OF USE:
- Residential
- Retail/Residential
- Retail
- Gastronomy/Residential
- Gastronomy/Accommodation
- Public Facilities
- Agriculture
- Storage Buildings, Garages, Nearby Buildings

INTENSITY OF USE:
- 0%
- 1-33%
- 34-66%
- 67-99%
- 100%

effort CITY

“Sustainability in urban planning”, is based on the selection of indicators and the compilation of the sets. From an urban planning perspective, a neighborhood is sustainable if it is compact, versatile, and identity-formative. The *effort* **CITY** tool evaluates adequate density and the diverse utilization offers (all life stages and clientele) as well as the local-defining and identity-forming parameters of a neighborhood. It is based on individual indicators, which are summarized in indicator sets as follows:

... stands for Sustainability in Urban Planning

Building Culture and Townscape:	> Space > Building Structure > Monumental/Historical Value > Special Design Quality > Cultural-Historical Significance
Appearance:	> Optical State of Construction > Demand on Design Quality
Density:	> Ground Area Index > Floor Area Ratio > Number of Parking Spaces
Intensity of Use:	> Intensity of Use (Vacant, Partly Vacant)
Diversification:	> Building Structure Density > Ownership Structure > Utilization Consensus

Like the collection of data, buildings will be evaluated on a parcel specific level. The fulfillment of a claim will be checked using some indicators (e.g., space, demands on design quality, or facilities with parking spaces), while other indicators will display the actual state (e.g., intensity of use, and the state of construction). A specific reference and directional value was used for each indicator to evaluate the collected data. These are based on different legal requirements (e.g., building codes, land utilization ordinance, and the Thuringian building regulations), statistical average values and the operationalized urban development model. Individual indicators must therefore include only relevant plots of land. The classification of the neighborhood also provides an essential basis for inventory valuation in the “Thuringian Urban Space Types”.

... evaluated very specifically

... considers reference and directional values

*The **“Thuringian Urban Space Types”** were developed in 2011 under the direction of the Bauhaus-University of Weimar, within the framework of the research project “Options for Action to Improve Energy Efficiency in Existing Buildings”. The research project is based on the foundation of the urban space types, which is a result of the study “Models and Potentials of Solar Urban Development” led by Dr. Dagmar Everding (2005) and the “German Federal Environmental Foundation”. It also is based on the landscape types from the research project “Use of Urban Open Spaces for Renewable Energy”.*

effort HUMAN

... takes into consideration the social-communal and financial situation in the neighborhood

The effort **HUMAN** differentiates the value ranges between the city and village/rural context. The three indicator sets (population structure and development, financial potential, and identity) illustrate the social evaluation of the relevant areas of a neighborhood. The population structure is closely linked to its identity and financial potential. Bringing the three sets together gives an overall statement about the social and financial conditions in the neighborhood. Some indicators are included in several indicator sets because these are important for determining the sustainability of the set. With regard to the financial potential of the population, the local economy, and the local community/city, no monetary value will be determined. Therefore no monetary values but rather qualitative values will be attributed to the evaluation of dependencies and the analysis of the "Sun II" measurements.

To determine the sustainability status of a neighborhood, the actual of each indicator must first be compared to its respective target value and then evaluated. For each indicator, the target value is determined in reference to evaluation interval, which is based on average values for Thuringia. Based on these intervals, each of the three dimensions of sustainability (ecology, economy, and social services) will determine a target value for each indicator individually, the allocation of actual value, and the three weighting levels of the respective fulfillment degree: three values per indicator, three values per set (which result from the degree of fulfillment of indicators), and one value for the overall sustainability of the neighborhood.

3 sets to describe social-communal factors in the neighborhood:

> Population Structure and Development

> Financial Potential

> Identity

Reference interval for urban and rural/village: Differences between urban and rural regions

Setting the target values: 3 dimensions plus city and country

Weighting the available data of the reference plane: High precision of the value = high weighting
> Quarter: 3
> City: 2 or 1

Survey of the population

Overview of the "Resources"

In order for building- or neighborhood level values to receive a higher weighting than for the entire city, the data availability level (neighborhood, city, and municipality) is weighted. The method is thus designed for different comprehensive data foundations. The respective weighting (smallest unit being the neighborhood) can be seen in the image. After that, the importance of each indicator, its influence, and its importance for a neighborhood will be weighted (influences the neighborhood very strongly or less strongly). This takes place in the three dimensions of sustainability within a set by directly comparing of the indicators in the respective set. Together with the target degree of fulfillment, the total degree of fulfillment can be determined. The weighting all sets in the three dimensions of sustainability is done in the overall evaluation in direct comparison with the other departments.

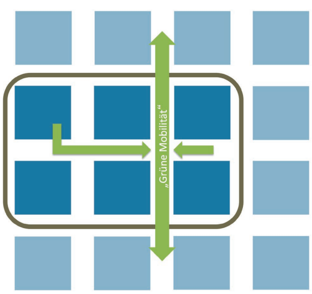
effort MOBILE

With the development of the effort **MOBILE** tool, a neighborhood can now be evaluated with respect to existing mobility structures and potentials. Development goals can be derived, design measures can be adapted, and the influence of implemented measures can be evaluated.

... collects and evaluates the mobility structures

For the collection and evaluation of mobility structures, three sets of indicators with 26 subordinate individual indicators were formed. The indicator sets include the areas of public transportation, traffic systems, and structures of supply. For each individual indicator, a specific minimum and maximum reference range was defined on the basis of literature research. A degree of fulfillment for the actual state can thus be calculated for each dimension of sustainability. Neighborhood-related mobility parameters were gathered by analyzing aerial photographs, statistics, and GIS data. Any additional data that was needed was collected on site.

Based on the sustainability levels calculated for the actual state of the individual indicators, the overall sustainability of all indicator sets for the neighborhood in question can be determined. Depending on the degree of sustainability, next step involves assignment to one of the three pre-defined classes.

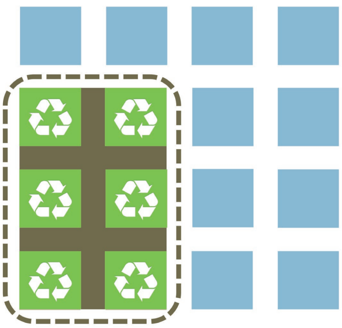


effort ECO.LOG

... recognizes neighborhood-specific ecological quality

With the development of the effort **ECO.LOG** tool, neighborhood specific ecological qualities can be calculated and deficits can be characterized. Extensive data collection and studies can be bypassed with this tool. The 4 indicator sets were selected from 11 indicators. These are to be understood as the maximum level because some indicators such as "stagnant and/or flowing water" are not available for every neighborhood.

The individual indicators were evaluated plot by plot in a GIS. The results for the indicators are combined from the calculations and investigations of individual criteria. If certain criteria can not be directly determined or calculated, operationalized procedures are applied for "measurability" (e.g., allocation of classes to specific characteristics). On the other hand, if the criteria can be calculated, they will be determined only for certain sealed and unsealed areas, because only environmentally effective areas with a natural function are to be assigned. One exception is the determination of water and air quality. In these cases, they will be calculated and evaluated objectively, or on a neighborhood-specific basis.



Within the framework of neighborhood observation, the plot results are apportioned for the entire neighborhood. The reference and target values for the three dimensions of sustainability were determined to evaluate the ecological, economic, and social sustainability.

„**effort** Inventory Analysis" Example: Environment Quality

Indicator	ACTUAL	Ecology		Economy		Social	
		EG	W	EG	W	EG	W
Harmful Substance (Pollutant)	7.5	75 %	2	100 %	3	-	-
Functionality	1.9	25 %	3	-	-	-	-
Erosion	8.6	100 %	1	86 %	1	-	-
Biotope	4.8	48 %	2	52 %	3	-	-
Amount of Green	0.4	4 %	3	96 %	2	7 %	1
Living Environment instead of Habitat		39 %		82 %		7 %	

The indicator-specific performance levels can thus be determined. The entire sustainability of the sets is determined based on the sustainability levels calculated. The overall sustainability is then classified into one of three predefined classes.

Based on this classification, neighborhood-specific goals can be continuously selected based on general pre-defined objectives. Basic and essential ecological information or qualities/deficiencies/concerns will later be incorporated into the master plan.

In an integrated approach with other disciplines, ecologically burdened areas can be developed in accordance with the urban requirement and the use of the local energy potential. This can be accomplished by applying the methodology within the framework of effort as well as optirisk® (www.optirisk.de).

effort CO_2

With the effort **CO_2** tool, a neighborhood can be analyzed taking into consideration the use of energy sources, building services, and the degree of restoration with regard to the current and future greenhouse gas emissions. The basic energy data of a neighborhood is provided by building-services engineering and architecture.

... calculates the greenhouse gas emissions

Databases need to be set up to evaluate the energy characteristics. To make sure that the CO_2 calculation is transparent and updatable, balancing limits were set up to calculate emissions in the neighborhood. For this purpose, the final energy-based territorial balancing principle was used and extended by the aspect of gray energy. The entire life cycle of materials or a product used in the restoration will be taken into consideration.

... takes the entire life cycle into consideration

The aforementioned parameters are included in the effort CO_2 tool, which allows a standardized and transparent assessment of greenhouse gas emissions from before and after the restoration.

... enables a differentiated evaluation of sustainability

effort Indicator Sets for the Evaluation of Sustainability

The table below shows relevant sets in the dimensions of ecology, economy, and social affairs. The composition of the three dimensions from "effort-Sun I" are slightly different because some sets have no relevance for certain dimensions. An overview of the disciplines for the indicator sets (including their weighting and affiliation to the three dimensions of sustainability) can be seen in the following table:

No.	Indicator Set	Ecology	w	Economy	w	Social	w
1	Demographic Structure and Development	DEM	1	DEM	1	DEM	4
2	Financial Potential of the Population	FIN	1	FIN	5	FIN	3
3	Identity	ID	1	ID	3	ID	5
4	Habitat Quality and Biodiversity	HAB	5	HAB	2	HAB	3
5	State of Local Water Resources	WAT	3	WAT	1	WAT	3
6	State of Groundwater	GW	2				
7	Air Quality	AIR	3				
8	Securing and Promoting Public Transportation	PUB	2	PUB	2	PUB	4
9	Securing and Promoting Road Systems	RS	3	RS	3	RS	3
10	Securing and Promoting Regional Structures	REG	2	REG	2	REG	5
11	Building Culture & Townscape	BCT	1	BCT	4	BCT	5
12	Appearance			APP	4	APP	4
13	Structural Density	DEN	4	DEN	5	DEN	1
14	Intensity of Use	INT	3	INT	5	INT	3
15	Diversification / Variety			DIV	2	DIV	5
16	Level of Redevelopment	RED	3	RED	5	RED	3
17	Heating Demand	HD	3	HD	5	HD	3
18	The Use of Redevelopment Potential	URP	3				
19	Primary Energy Quality	PEQ	2	PEQ	3	PEQ	2
20	Energy Consumption	EC	3	EC	4		
21	Potential Renewable Energy	PRE	5	PRE	2		
22	Energetic Infrastructure	EIN	1	EIN	2		

SUN I

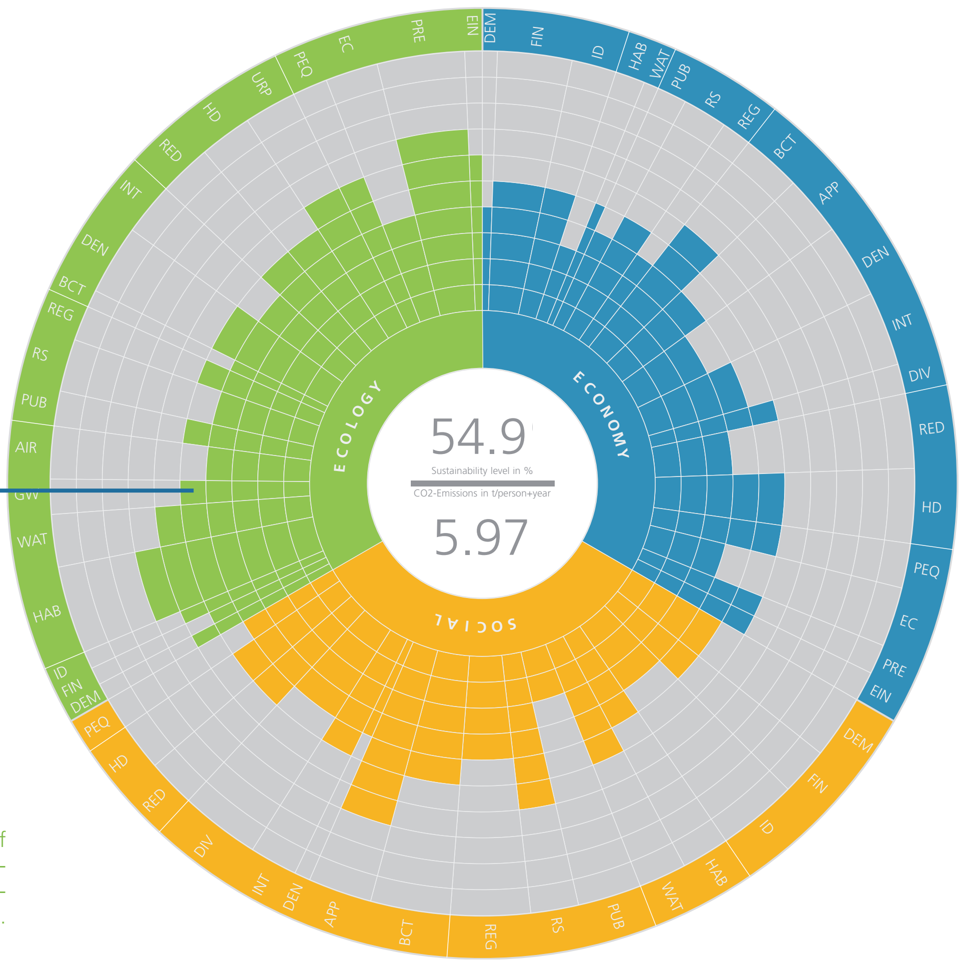
SUSTAINABILITY EVALUATION I

The effort-methodology evaluates the sustainability of a neighborhood in the dimensions of ecology, economy, and social affairs. It is measured on the performance level, which is why a specific reference value has been made for each set in each dimension of sustainability. The performance levels allow for the depiction of the actual state in the three dimensions of sustainability. A weighting of the individual sets against each other causes a prioritization in the dimensions ("horizontal weighting"). Relevant potentials and deficits can thus be highlighted. The automatically generated "effort Sun I" allows for a clear depiction of the actual-state of a neighborhood. The linking of seven tools lies behind this description. These tools can be used to calculate the sustainability values in the various subject areas. The individual indicators are evaluated and combined into sets.

For details, see the fold-out scheme in the cover on the right >>>>>

effort Sun I (ACTUAL STATE)

ACTUAL Value



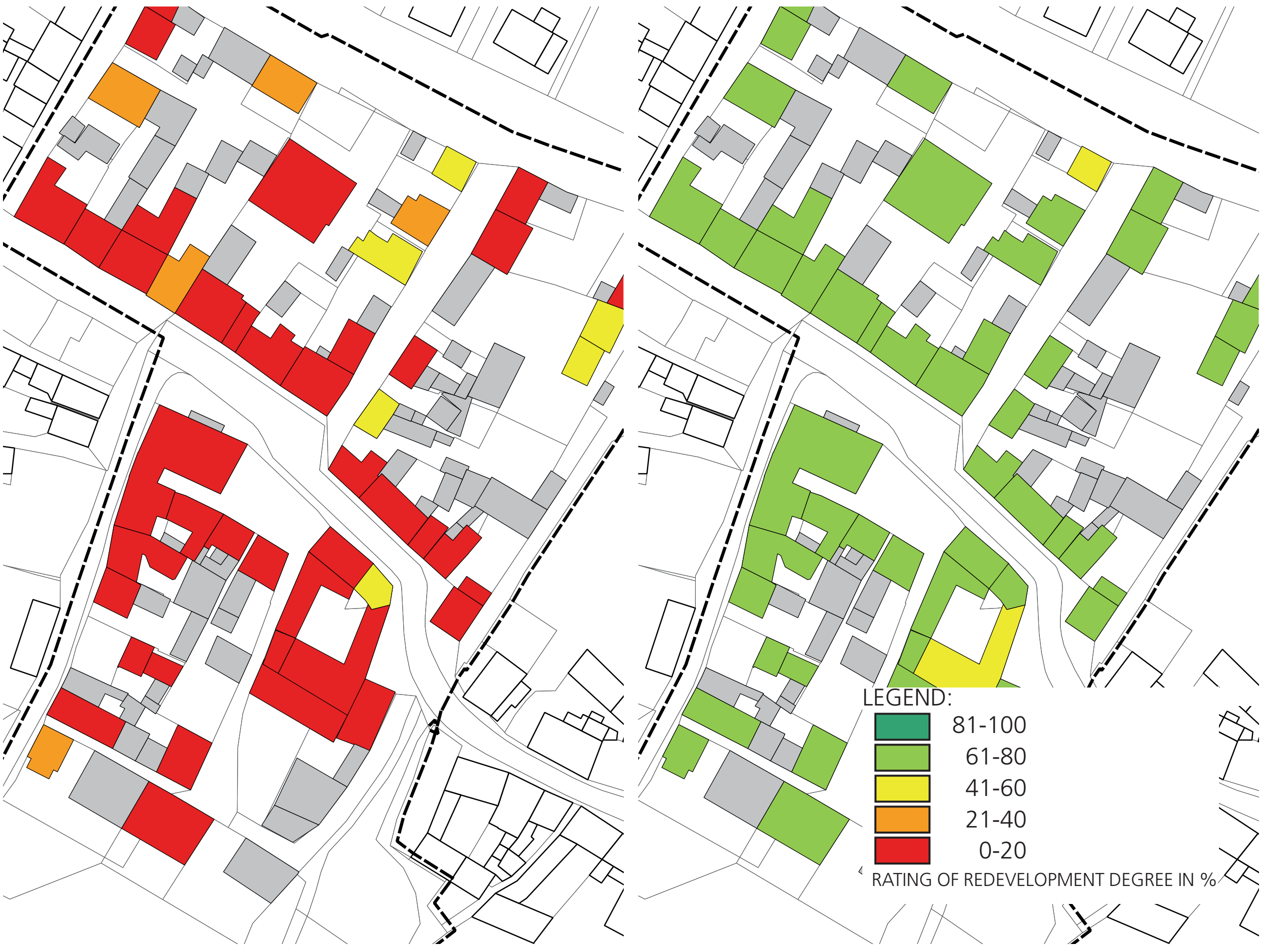
The two numbers in the center of the sun show the sustainability level (in %) and the CO_2 consumption (in tons per person and year).

TARGET FIGURES

The entire sustainability for each neighborhood can be determined from the sustainability levels of the individual indicator sets.

The result of the actual-state assessment will be displayed in three classes or levels (performance level up to 60%, between 60 and 80%, and between 80% and 100%). These classes, are then associated with target definitions defined according to the actual state and the specific conditions. The target definition of the sets is subject to a hierarchy: for the implementation of energy efficiency or conversion areput first. Although not all indicator sets are considered on an equal level, a prohibition of deterioration applies to all sets (with the aim of improvement).

"effort ACTUAL Degree of Development" "effort PLANNED Degree of Development"



Input TARGET FIGURES

The initial state of the individual indicator sets can be determined based on their performance level. With the help of the various tools and algorithms from the effort toolbox, indicator-specific objectives can also be derived for the neighborhood under consideration. The basic concern is the improvement of each initial state and the maintenance thereof (where appropriate), but by no means deterioration in the assessment of the individual indicator sets. The main focus is on increasing in the energy efficiency of the neighborhood. Thanks to the holistic approach of the effort method and the dependencies between individual measures in effort table, the complex parameters from the overall spectrum of sustainability i.e., in the ecologic, economic, and social contents will be addressed.

For details, see the foldout cover scheme to the right. >>>>]

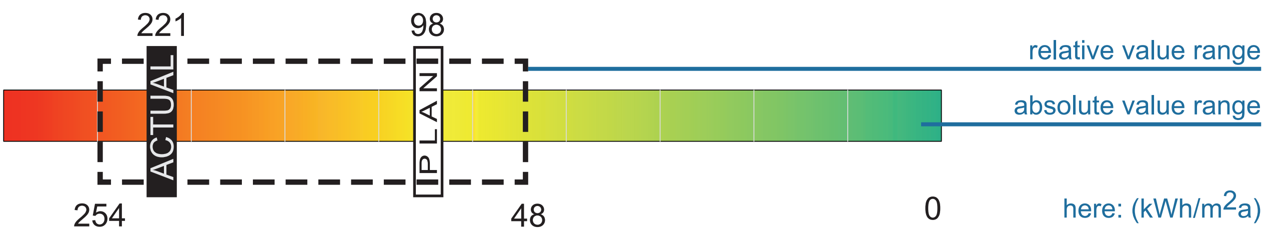
…determines the performance level for the ACTUAL-values and the PLAN-values

Brief explanation: The “effort Slide Control”

Developed by us, the “effort Slide Control” represents both a simple and powerful tool for visualizing individual and complex issues. One of our images shows the energy efficiency on a bar that runs from red to yellow to green.

The determined ACTUAL value of an indicator or indicator set (see black controller) as well as the projected PLAN value (see white controller) is positioned on a bar based on a concrete action scenario. This positioning allows the initial classification of both values within an absolute value range (between 0 and 100% or, like in the example below, between 0 kW/m^{2}a and >250 kWh/m^{2}a). A second (relative) value range overlaps the absolute value range, which takes into account the neighborhood-specific characteristics as well as the actual reference values. Here is an example: a neighborhood from the 19th century with landmarked façades can definitely not touch a new passive house settlement with its heating requirements. All the more important is the classification of the actual values and the PLANNED values in a neighborhood-specific value range.

Example “effort Slide Control”



"effort Master Plan"

LEGEND:

URBAN RECOMMENDATION FOR DEVELOPMENT:
- Development [Priority 1]
- Development [Priority 2]
- Development [Priority 3]
- Development [Priority 4]
- Public Area (green)
- Potential Energy Surface | Wild-card Space

BUILDINGS WORTH PRESERVING:
- D Single monument and landmark ensemble
- Buildings with cultural and historical significance

AREA BOUNDARIES:
- Area Boundary, closed
- Area Boundary, predominantly closed
- Spatial Frame
- Demand on Design Quality

effort MASTER PLAN

The effort Master Plan sets the conceptual stage in the effort methodology. It is defiend itself as a total package that consists of the following parts:

For details, see the foldout cover scheme to the right. >>>>>

> The Urban Development Model
> Conservation Recommendations
> Recommendations for New Areas
> The Thematic Concept Maps

The Term "Master Plan"

In urban development the term "Master Plan" refers to an informal planning instrument in terms of framework or development phases. The "Master Plan" expresses conceptual recommendations for action in a plan and text for the area under examination.

Urban Development Model

The urban development model will be drafted for the neighborhood and presented as a part of the map of the neighborhood. It represents the basis of both the urban inventory analysis and future planning within the framework of the effort-methodology. It contains key statements for construction and open space. The priority of development, vast green areas, and surfaces with development potential are shown.

The priority of the development is structured into four weighting categories for which assessment is based on the perception and the situation in the urban structure. The highest priority is assigned to partial areas in the centre of the location or immediately on the adjoining lines. These plots are to be included first in future development. Furthermore, priorities 2 to 4 are graded, whereas subareas of priority 4 are on the outskirts of the location without any perception or can be found within the block.

Large-scale public or private green spaces such as parks, small garden allotments, or contiguous garden zones should be kept clear of development and are to be understood as conceptual specification. The exclusion of these green spaces is based on urban structural or ecological parameters such as flood protection or fresh air supply.

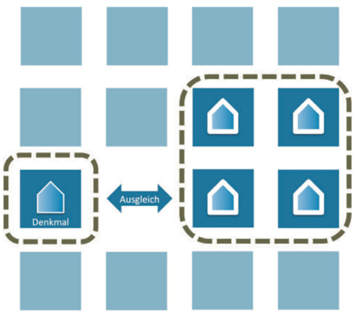
…uses "Wild-card Areas" as a chance for neighborhood development

Depending on the future development of the population and the neighborhood, development, open spaces, or (energy) technical facilities are available to the „Wild card" surface areas for needs-based supplements.

…takes landmark protection into consideration

The individual landmarks or the culturally and historically significant buildings will be separately identified in the model. They are identity-shaping, distinguishing features that are to be kept at a high standard of design quality at all costs.

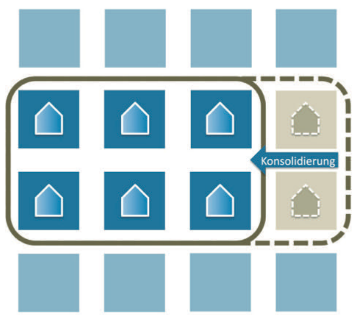
In all development activities, the redevelopment of energy, the reconstruction of buildings, and the development of open spaces are definitive requirements for the spatial frame and design quality in the urban planning model.



Conservation Recommendations

Complex calculating operations will be performed on the basis of the neighborhood-GIS as a result of assessments of the optical state of construction, level of restoration for the development, and the building technology of the individually heated buildings.

Such overlapping/intersecting of the aforementioned parameter, with estimates on the landmark value for urban relevance allows a recommended course of action for dealing with the existing structure with regard to the spatial frame as well as the usability (development or open space). This allows for the identification of buildings that should be replaced because of their poor condition or urban relevance.



The first assessment will be included in the next step with regard to demographic development, intensity of use, and the urban priority in order to derive neighborhood-specific recommendations for action from the initial statements, which are generally valid. Thus, buildings can be evaluated or also torn down because of the shrinkage/consolidation. These evaluations are, of course, not to be understood as a binding specification. Rather, they constitute a valuable technical basis for subsequent planning and discussion.

Recommendations for New Areas

It may be necessary to evaluate land for new construction projectsin order to further develop the neighborhood to be considered. As a result of the inventory analysis, the need for additional areas with respect to the variety of use/housing supply, demographic development and the development objectives expressed by the client or community must be determined. This potential space requirement should be demand-oriented for the neighborhood and covered in the inventory in accordance with the conditions of urban design. New buildings from gap closure or building replacement in priorities "1" or "2" will then be realized, and necessary space boundaries will be closed. The implementation of new buildings on the designated wild-card areas will either follow or form an alternative.

…enables demand-oriented land designation

Although it can be difficult to realize accessible homes in dense historical city centres, demand-oriented accommodation can be supplemented in wild-card areas.

Conceptual Topic Cards

…created GIS-based recommendations for action

The basis of the urban and energy development concept for the neighborhood is primarily formed by the "preservation recommendation" as well as the specification for demand-oriented recommendations. Based on this, conceptual topic cards including the necessary calculations as well as the development measures and the balancing of CO_2 can be derived. The conceptual topic cards form an essential basis for the building location and parcel-specific location of the individual measures and therefore include the possible participation of the owners or the evaluation of key plots of land.

The next step is to determine and to use the energy savings potential. For this, the energy savings potential of the buildings and the housing technology will be considered and presented accordingly. In order to meet the demand of the energy (heat) supply, the effort-methodology not only focuses on using renewable energy potentials but also on forming supply units. The topic card "surplus/deficit heat" serves as a meaningful limitation to this energy supply unit.

The development potential of open and green areas – primarily the unsealing and sealing potentials of the non-built plots of land and the development potentials of the green spaces and structures – can also be derived from the corresponding conceptual topic cards.

“effort Energy Efficiency: ACTUAL-STATE”

“effort Energy Efficiency: PLANNED”

LEGEND:

	A+	0-10
	A	1 1-15
	B	16-25
	C	26-50
	D	51-100
	E	101-150
	F	151-200
	G	201-250
	H	over 250

PLANNED Energy Efficiency in kWh/m2a

ENERGY DEMAND Prognosis

For details, see the foldout cover scheme to the right. >>>>>

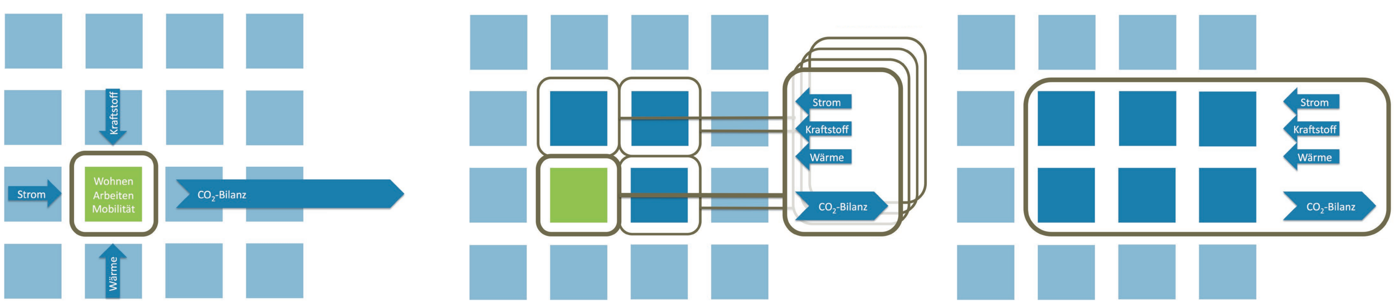
effort considers both the state of energy output and the potential of all forms and groups of energy of a neighborhood, as well as its extended local conditions. The direct energy data, urban development and historic preservation as well as environmental and social aspects can be incorporated into the planning. This affords a holistic optimization of the planning approach.

The prognosis of the future energy demands of a neighborhood presents an essential basis for planning the conversion of the energy supply (locally produced if possible) to regenerative energy. The prognosis serves as a target/orientation for the subsequent individual measures. For example, the energy redevelopment of existing buildings and/or the reinforcement or the renewal of the building technology as well as the decentralized energy supply infrastructure. Moreover, it forms the basis of the process-accompanying CO_2 balancing in the neighborhood.

Corresponding consumption prognoses for the respective neighborhood can be created, without the need for costly studies on existing buildings, when taking into consideration the actual state and using different redevelopment scenarios with the help of the effort toolbox, the effort calculator, and the effort EN.CHARTs.

The graphical preparation of the information in a GIS shows the object-based potential increase in efficiency, thereby allowing the targeted approach of the individual participants.

As part of the later implementation of the action package, the aforementioned assumptions can be verified with respect to the initial state and resulting potential. They can then be used for the process-accompanying forward projection of the overall balance in the internal effort database.



“effort Potential Renewable Energy”

Sub-topic “Surplus/ Heat Deficit”

LEGEND:BUILDINGS (SOLAR THERMAL POWER) [kWh]

- 50,000 to 110,000
- 0 to 50,000
- -100,000 to 0
- -200,000 to -100,000

LAND PLOT (GEOTHERMAL POWER) [kWh]

- 300,000 to 700,000
- 0 to 360,000
- -75,000 to 0
- -160,000 to - 75,000
- Energy Supply Unit

TIP: The map shows – for both the buildings and open areas of a plot – surplus potentials and deficits in regard to the heat supply via solar thermal (solid colored-in areas) and geothermal (cross-hatched areas) energy.

Potential
RENEWABLE ENERGIES

A central goal of effort is the energy optimization of the neighborhood, with respect to the highest possible degree of self-sufficiency through renewable energies. The potential for renewable energy is based on the inventory of the buildings and open areas of the master plan, with taking into consideration the possible restrictions.

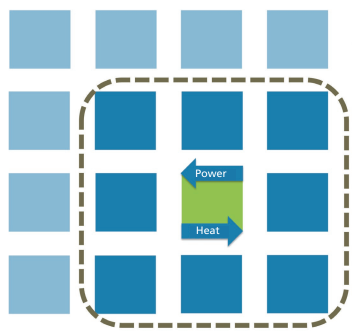
For details, see the fold-out cover scheme to the right. >>>>

The first phase of effort examines the inventory situation in terms of heat demand, heat supply, and renewable energy potential. The condition of the existing heat generation plants, as well as the potential supply deficits and surpluses in the production of regenerative energies were worked out.

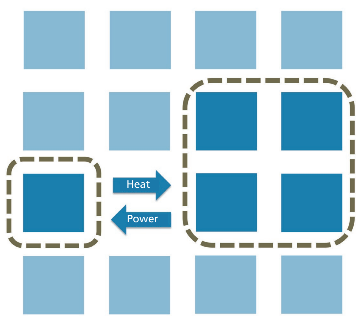
In interaction with other disciplines – especially architecture – the focus is now on reducing energy consumption throughout the neighborhood and largely replacing it with regenerative energies like geothermal energy, solar heat and waste heat utilization.

The actions relate to the building stock which can be upgraded through redevelopment. Furthermore, the efficiency of the plant technology and the sustainability of the fuels being used will be considered in order to reduce the energy consumption in the neighborhood through the use of highly efficient power supply technologies.

The potential for the power generation of buildings and open areas will be considered on four levels. At the lowest level, the buildings and open areas will be examined in isolation, and the potentials will be determined. In the next level up, all elements of a field or plot of land will be combined, and a self-sufficiency rate will be determined. Here, the deficits and profitable elements will be identified and combined in order to optimize the utilization of energy in the next level. On this basis, it is possible to form local supply units in a neighborhood through the joint usage of producible energy in order to achieve a high level of self-sufficiency. The highest level covers the entire neighborhood and will be used to determine the overall sustainability in cooperation with all other disciplines.



The final aim of the study is to develop a model of the energy balance of the future neighborhood and create a prognosis of the energy consumption.



“effort Conservation Recommendation”

LEGEND:

- Preservation
- Preservation or Replacement Construction
- Preservation or Replacement Construction or Demolition
- Preservation or Demolition (recommended)
- Replacement Construction
- Replacement or Demolition
- Demolition (recommended)
- Demolition (long-term)
- Demolition (short-term)
- Demolition (immediately)

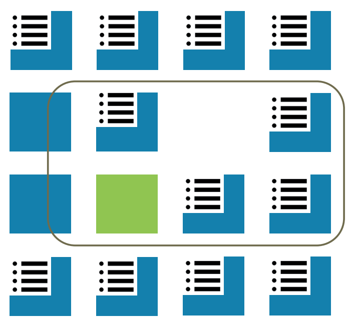
Coordinated
ACTION PLANS

For details, see the fold-out cover scheme to the right. >>>>

The individual discipline measures are defined within the framework of effort in order to improve the actual conditions in the neighborhood. There is a certain order that must be maintained because the measures in terms of efficiency, must be applied according to their priority. The urban planning, social, and ecological disciplines function as a framework and serve as a supervisory authority within the sustainability rating in order not to adversely affect the quality of life in the neighborhood but rather strive for improvement.

Based on the framework conditions (social-communal development, urban planning, and ecological concerns) the initial state will be determined by the master plan. Future energy demands to be determined, and land areas for regenerative energy can be found. On this basis, the PLANNED values of the individual indicators of each neighborhood can be specifically calculated for architecture, building technology, and mobility. These disciplines have defined quantifiable measures.

An action plan catalogue was developed to determine the PLANNED values for the non-quantifiable indicator sets. Here, the measures of the individual subject areas along with individual indicators are listed. It was determined whether there was a positive or negative dependency (or none at all) on a measure for the individual indicators. This way, the extent to which the respective indicators has changed can be calculated at the end. The measures that are to be selected are oriented at the pre-determined performance level and are defined in three variants (basis variant, excellence variant, and theoretic optimum). Through the calculation which was carried out in a similar manner to sustainability rating I, the performance level for the PLANNED state of the neighborhood can be evaluated.



…offers neighborhood-specific action plan catalogues

The resulting measures from the individual disciplines will be examined and bundled into a complimentary integrated action plan catalogue according to their influence on other indicators. A recommendation for the greening of roof surfaces for areas that have solar usage potential can thus be avoided.

In addition to the action plan catalogue, the application of extensive methods may be necessary in order for the integrated approach of the effort methods to be satisfactory. This could be the case for areas in need or with a chance of revitalization as well as for recommended security measures for the hazard prevention of contaminated sites. With the "optirisk" method, they can be developed according to the urbanistic demand and using locally owned energy potential (see, www.optirisk.de).

optirisk

Carbon Footprint in the Example of Building Technology

Energy consumption can be reduced by improving the engineering that depends on the heat transfer system as well as the condition of the building. Both the operating costs as well as greenhouse gas emissions can be reduced by using highly efficient heat sources in conjunction with renewable resources and environmental energies such as solar heat and geothermal energy. Improving the ventilation situation can also help to save energy. The ventilation of renovated buildings through controlled ventilation systems with heat recovery can reduce heat loss through ventilation and thus the consumption of heat energy. Building redevelopment in connection with the creation of consumption units for the common use of locally generated energy contributes to the improvement of sustainability for an entire neighborhood.

SUN II

SUSTAINABILITY EVALUATION II

Building on effort sun I, which initially only showed the actual state of a neighborhood (each shaded dark in the image), effort sun II additionally shows the changes in the various sets of indicators in individual dimensions of sustainability. The action plan based PLANNED values that were described above will be displayed in a lighter shade. In addition, the PLANNED values for the overall sustainability of a neighborhood (in %) and the CO_2 emissions per capita (in tons per year) will be displayed in the center. effort sun II thus provides a detailed and complex representation of the overall process of energy redevelopment and illustrates its positive dynamic.

For details, see the foldout cover scheme to the right.>>>>

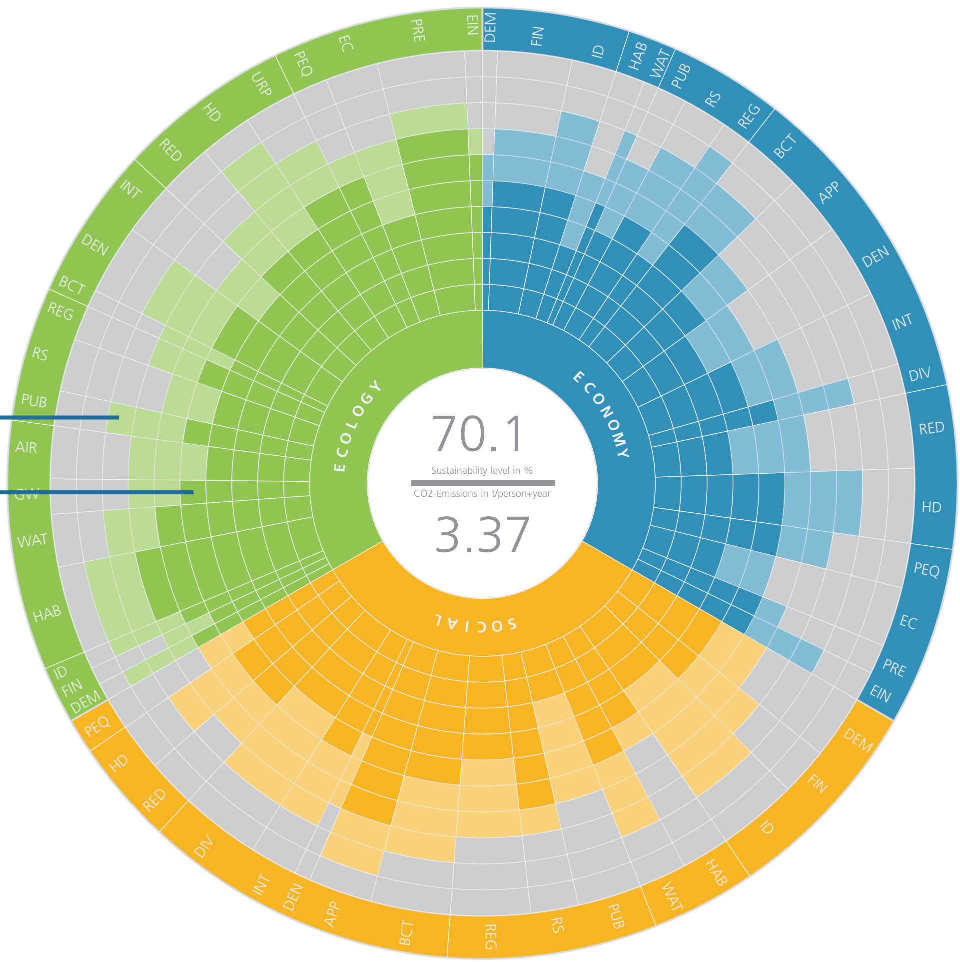
...effort SUN II connects TODAY with TOMORROW

effort Sun II ACTUAL and PLANNED State)

PLANNED Value (light)

ACTUAL Value (dark)

The two numbers in the center of the sun show sustainability level (in %) and the CO_2 consumption (in tons per person and year).



The sustainability assessment based on the "effort-Sun of Sustainability" was first presented at "ICSDEC- International Conference on Sustainable Design, Engineering, and Construction" in May 2015, in Chicago IL.

POWER Supply Rate
(Buildings and Open Areas)

HEAT Supply Rate
(Buildings and Open Areas)

SOLAR HEAT Potential
(Buildings)

PHOTOVOLTAIC Potential
(Buildings)

PHOTOVOLTAIC Potential
(Open Areas)

GEOTHERMAL ENERGY Potential
(Open Areas)

effort to go

IMPLEMENTATION & EVALUATION

In the effort atlas, all essential results of the transdisciplinary analyses and concepts for the energy redevelopment of the neighborhood examined will be summarized. Selected inventory and planning data will be graphically represented and explained in the form of a simulated GIS application. The main focuses are the initial situation and options for action as well as the potential for an optimal and sustainable mix of energy production and energy utilization in the neighborhood. The effort atlas allows concrete data to be collected on the basis of more intensive and necessary discussions about the objectives and action measures of the energy redevelopment of a neighborhood with the land and building owners as well as political and administration institutions.

For details, see the foldout cover scheme to the right. >>>>

…the effort atlas depicts goals and measures

The high degree of flexibility of the effort-methodology allows for the further preparation of energy redevelopment measures, a detailed discussion of options, and a differentiated implementation strategy, including the consideration of individual investment options in particular. The GIS-based modeling of the structural and energy redevelopment options at the neighborhood level enables the presentation of different scenarios with little effort. The effort-atlas can serve as a guide for further preparation and the implementation of measures for energy redevelopment for a neighborhood as well as the accompanying and final evaluation of the redevelopment process.

The comprehensive approach makes the effort methodology special. Not only will the energy-related and structural aspects of the redevelopment or renovation of existing structures be analyzed and processed conceptually but also all three sustainability aspects – ecology, economy, and social affairs – including the cultural dimensions of urban development.

…the effort evaluation makes progress visible

What's more: the effort methodology enables the specific reference, implementation, and evaluation of climate protection objectives, in particular the reduction of CO_2 at the relevant implementation level in the structural inventory – the neighborhood!

INTEGRIERTES QUARTIERSKONZEPT Musterviertel
Kooperationspartner: Stadtverwaltung Zukunftsstadt

Category	60% savings in heating costs	Renewal of the system technology	Use of solar heat
1	■	■	■
2	■	■	
2	■		■
2		■	■
3	■		
3		■	
3			■
4	Use o Savings less than 60%		

"effort-Impulse and Key Projects"

LEGEND:

IMPULSE PROJECTS BY CATEGORIES:

- 1 (3 of 3 Options)
- 2 (2 of 3 Options)
- 3 (1 of 3 Options)
- 4 (Modernisation of building insulation)

SURPLUS of SOLAR POWER:

- marginal
- moderate
- high
- supply unit
- key-project

Impulse and Key Projects

In order to have an adequate start for the energy redevelopment, it is important to implement the necessary measures as soon as possible.

Depending on the initial situation and the goals, the action plans can be very comprehensive. The process of the integrated energy development in the neighborhood can also take several years.

…effort defines catalyts and „lighthouse projects"

The designated impulse and key projects can have a positive effect on the neighborhood development as catalysts or „lighthouses". Residents, owners and other actors can therefore be sensitized and encouraged to actively take part. Action groups can also participate in this process and drive the implementation of the energy transformation.

The results implementing the effort method and the chosen measures show a sound basis for action for the energy and urban development of the neighborhood examined. In principle, several development scenarios are possible. The minimum-option, which means keeping the actual state and its slight improvement, can only be an option for neighborhoods that already have a high degree of sustainability. The maximum option and achieving excellence (sustainability of 80%-100%) is probably unrealistic for most neighborhoods.

The most realistic option is the optimized development scenario, which is defined by topic-related concept cards for the neighborhood examined. Based on its presentation the measures are efficiently and progressively implemented, and the sustainability of the neighborhood is improved. This action plan not only presents the buildings in the most detailed way possible for minimizing carbon emissions but also includes impulse and key projects for energy-related development of the neighborhoods. These key projects have a high priority and special meaning for the development in a neighborhood i.e., a specific large set of actions for a long-term implementation. They stand for a focused and goal-oriented use of necessary means and resources in order to achieve a sustainable development in the neighborhood. Single measures meant to implement initial steps are referred to as impulse projects.

…action plans

The client therefore recieves an action plan at the start of the energy transformation of the neighborhood. The action plan shows which properties/actors/owners need to be involved in the short-term development of the neighborhood. Key and impulse projects are selected in close coordination with affiliated partners and/or the municipality/client.

Initial Results

By the time the editorial deadline for this brochure has been reached, the effort-team will have processed the effort methodology in four neighborhoods in the Thuringian cities of Wiehe, Schleiz, Meiningen and Erfurt. The respective integrated concepts for the neighborhood represent the enormous potential in our cities as well as the heterogeneity of the starting position in the neighborhoods. The results clearly show that enormous improvements regarding the energy demand and the CO_2 balance can be achieved for the neighborhood with successful implementation of the methodically developed and proposed measures.

Comments on the CO_2 Balance

The heat and electricity demand of private households account for nearly 30% of the final energy consumption in Germany. This energy consumption produces about 231 million tons of CO_2 annually, which is equivalent to about one-fifth of the total CO_2 emissions in Germany. With the effort tool neighborhoods were analyzed with respect to the current and future energy demands and greenhouse gas emissions including the use of energy sources and building technology as well as the degree of redevelopment. The CO_2 balance differentiates the sectors of heat, electricity, and mobility. The entire CO_2 life cycle of materials or products used in the context of the proposed redevelopment measures have been taken into consideration. CO_2 emissions must be calculated in order to review national/political climate objectives and evaluate measures concerning the potential significance to the climate.

Using conventional redevelopment measures including the insulation of roof, façade, and basement ceiling, the energy demand can be reduced from 27% (Schleiz) to 52% (Wiehe). With ambitious redevelopment measures it is possible to reduce the energy demand to around 70% (Wiehe, Erfurt, Meiningen). If one were to invest in modern and appropriate building technology of today's EnEV guidelines, the potential energy savings are even greater. Investments in renewable energy for heat and power demand coverage show effects. Up to 30% of the heat demand in the neighborhood of Schleiz wasmet by solar thermal systems.

A positive development with regard to CO_2 emissions was initiated by the methodically developed and proposed redevelopment measures in the field of heat demand coverage. The emissions were reduced to between 45% and 55% in all neighborhoods examined. The differentiated results stem from the differences in building density, the actual state of the buildings, the roof area available, and restrictions related to landmarks.

After deducting the roof area for the use of solar thermal systems, the roof surface for the installation of photovoltaic systems remains. This roof surface covers 75% and 58% of the energy demand in the neighborhoods in Wiehe and Erfurt, respectively. In Meiningen and Schleiz, the energy demand was completely covered! The latter neighborhoods are thus self-sufficient in terms of electricity demand and can feed excess electricity into the public grid. The energy demand coverage from the renewable energy is clearly reflected in the CO_2 balance of the neighborhood examined. Thus a reduction of CO_2 emissions from 50 to 100% could be achieved.

In addition to heat and power, the third parameter that influences CO_2 balance is mobility. Because the mobility behavior in the neighborhood cannot be determined because of the small-scale level, the Thuringian energy balance from 2014 was used as a basis for calculation. An individual CO_2 emission in the amount of existing traffic in the neighborhood was also taken into account.
An overview of the essential results achieved by the application of the effort-methodology is shown in the following table:

CO_2 Balance of the Examined Neighborhoods (Both ACTUAL and PLANNED)

Neighborhood	*ACTUAL-State*	*PLAN-State*
Wiehe	*5.99*	*3.73*
Erfurt	*2.49*	*1.55*
Schleiz	*2.91*	*1.13*
Meiningen	*3.34*	*1.88*

The CO_2 balance of the neighborhoods in the ACTUAL and PLANNED state (t CO_2 per head and year)

Fossil fuels such as natural gas or heating oil still account for over 80% of the heat generated in the neighborhoods. Substituting these fuels with renewable energy sources is a primary goal of the sustainable design of the neighborhood.

Depending on design and building density, the analysis shows great potential for generating heat by means of near-surface-level geothermal and solar thermal energy. In some neighborhoods (Schleiz), almost the entire heat demand is covered by geothermal systems. The surplus production can be used to export the supply support neighboring consumers.

Level of Sustainability of the Neighborhoods Examined (Both ACTUAL & PLANNED)

Neighborhood	*ACTUAL State*	*PLANNED State*	*Improvement*
Wiehe	*52*	*67*	*129%*
Erfurt	*56*	*70*	*125%*
Schleiz	*53*	*65*	*123%*
Meiningen	*49*	*62*	*127%*

The level of sustainability of the neighborhood in the ACTUAL and PLANNED state (%)

Conclusion

The practical application results clearly show that the creation of supply units for the common production and use of electricity and heat represents and interesting alternative to the conventional supply and distribution of centralized heat – especially in heterogeneous areas with strongly differentiated building density and type. Energy transport loss will be reduced and a comprehensive utilization of the energy potential from environmental energies will be made possible.

Decentralized, synergetic supply networks with boundaries of the neighborhood – or even beyond them – represent a way to increase the sustainability of the neighborhood.

The results also show that a clear improvement of the overall level of sustainability can be connected to urban energy redevelopment. The sustainability index of the neighborhoods examined improved by an average of 26% and thereby reached values on the upper third of the scale without having to „pull out all the stops“ of energy conversions. Further improvements in the level of sustainability are still possible with a corresponding intensification of efforts.

Which Advantages Does *effort* Offer?

The application of the effort-methodology provides municipalities with the benefit of actually responding to the complex challenges of urban redevelopment in the neighborhood.

Here, effort is a key component in the informal planning with its unprecedented systemic practical approach. Not only are the energy and structural aspects of the redevelopment or reconstruction of the existing buildings and spatial structures analyzed and conceptually processed but also all three dimensions of sustainability (ecology, economy, and social affairs) including the cultural aspects of urban development.

The effort methodology addresses the neighborhood as being the "right place" for future-oriented climate protection projects - from strategic planning to implementation to their evaluation.

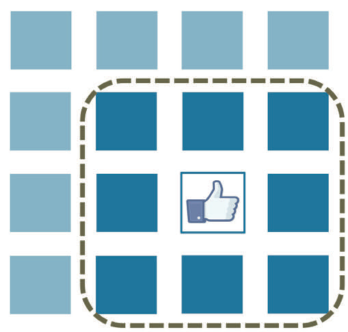
With the effort tool, measures to improve energy efficiency and climate protection can be implemented in such a way that other conditions/indicators within the context of the neighborhood are not adversely affected.

Better yet: the balance of the systematic examination offers possibilities for:

> The optimal use of renewable energy at the neighborhood level
> The adaptation to demographic development
> The counteracting of segregation
> The increase in ecological quality
> The avoidance of heat islands through micro-/macro-climatic adaptation
> The adaptation of the Modal Split to trends towards higher sustainability
> and much more

and thus provides a local advantage over other neghborhoods and cities.

There are so many reasons to use effort. Let us advise you. We will actively support you in overcoming the major challenges of the urban energy redevelopment!



ENERGIEWERKSTADT powered by *effort*

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ENERGIEWERKSTADT eG offers complex services from a single source with the aim of contributing to the creation of regional value. To help you implement your intentions, our independent, interdisciplinary network team can offer you individual creative solutions that cater to your needs in the following areas:

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www.ENERGIEWERKSTADT.de

We create concepts for your neighborhoods!

Based on the effort method, sustainable neighborhood concepts are created by our well-coordinated team. Only with the *effort* team can you have the results and experience of two years of research and development work incorporated into future projects.

ENERGIEWERKSTADT®eG forms the legal and organizational framework for our cooperation. Among other benefits, you as a client of a complex service – our customers – do not need to address and coordinate a multitude of contracts and contacts.

The organizational *effort* is noticeably reduced with ENERGIEWERKSTADT®eG as the sole contact partner and contact. This creates surprising freedom for you as a community or company. Take this chance. We look forward to you contacting us at www.energie-werk-stadt.de .

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Building Technology IPH Klawonn.Selzer GmbH

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www.iphks.de

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ORGANIZATIONAL CHART for the *effort* INSTRUMENT