University of Stuttgart
Institute of Energy Economics and the Rational Use of Energy

Summary of Key Findings

# Integrated Climate Protection and Energy Strategy for Ludwigsburg

**IER Stuttgart**
**DIALOGIK Stuttgart**

**City of Ludwigsburg**

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## Summary of Key Findings

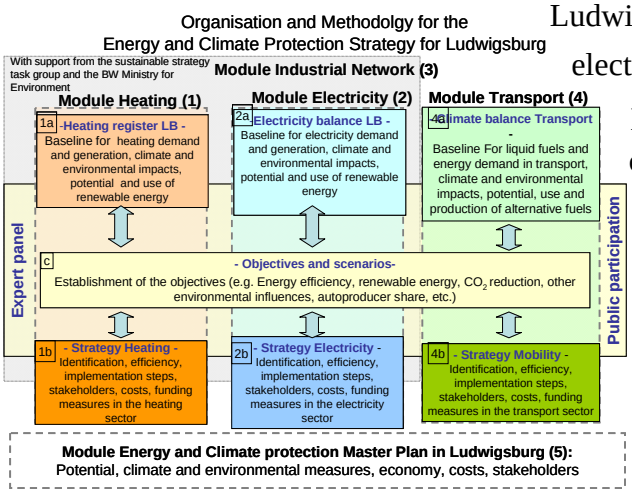
**Objective**

Against the background of the present climate change, finite resources, increasing energy prices, the dialogue regarding energy supply security and the efforts for sustainable management of nature and environment, the City of Ludwigsburg decided to develop an integrated climate protection and energy strategy, the so-called Overall Energy Strategy Ludwigsburg. The City of Ludwigsburg commissioned the Institute of Energy Economics and the Rational Use of Energy (IER) of the University of Stuttgart for this work. The IER involved the DIALOGIK GmbH Stuttgart for work on specific topics. The Overall Energy Strategy also included an expert panel made up of members from the administration, academia, public utilities, and energy relevant institutes, who on the one hand contributed to the foundations during the development of the measures, and on the other hand served as the committee for the expert participation for stakeholders.

**City Development Strategy**

Since the beginning of 2004, Ludwigsburg has been putting a City Development Strategy into action under the slogan „Opportunities for Ludwigsburg“. The Ludwigsburg city council decided at a meeting on the 28th of June, 2006 which principles and strategic objectives would govern the 11 thematic areas of the City Development Strategy. These thematic areas included economy and employment, and mobility and energy, amongst others. The guiding principle for the thematic area of energy was reviewed during the development of the Overall Energy Strategy and a slight modification was made. This guiding principle for the thematic area of “Energy” for the City Development Strategy for Ludwigsburg has been revised and approved by the local council and states: ***Energy management will be sustainable. This will be achieved by saving energy and using energy efficiently, placing greater emphasis on adopting renewable energy and increasing capacity building in this area. This will have benefits for the general climate development and the local air quality. Energy security will increase, growth in the local and regional economy will be promoted and job security in a progressive field will be created.*** The 7 strategic goals for the thematic area of energy are the foundation of the measures and recommended action in the Overall Energy Strategy. Within one of the strategic objectives, a call for the development and implementation of an Overall Energy Strategy is explicitly expressed.

**Methodology** The integrated approach applied in the Overall Energy Strategy for Ludwigsburg, in which the four areas of heating, electricity, industry and transport with their relation to possible contributions to energy efficiency and climate protection are analysed, is based on the methodology rooted in the City Development Strategy. The methodology is divided into distinct *"modules"*. The strategy is based on the assumption that the compilation and assessment of the measures and solutions (strategies) is derived from a comprehensive analysis of the current situation und configuration (status quo). Furthermore, discussions were held with the most important stakeholders in Ludwigsburg.




**Status Quo** The status quo in Ludwigsburg was determined through six sub-tasks. In addition to compiling a list of existing activities in Ludwisgburg with relevance to climate protection, establishing an energy and $CO_2$ balance for 2007, assessing questionnaires about energy use for households in the Schlößlesfeld suburb and analysing the heating demand in the Oststadt suburb on a city block level, installing an energy efficient network in the Weststadt suburb, and cooperating with the Mörike secondary school, a detailed analysis of the possible contribution of renewable energy in Ludwigsburg was undertaken. With regard to the existing activities, Ludwigsburg can already boast several achievements and awards in the field of energy and climate protection, such as 2nd place in competition for national capital cities for climate protection in the category for local authorities of up to 100,000 citizens, or the successful certification according to the european energy award (eea).

**Energy and $CO_2$ balance 2007** The system boundaries for the analysis of the energy and $CO_2$ emissions balance were drawn by the physical borders, i.e. the emissions resulting from energy use in the city are attributed to the city ("bubble principle"). One exception is electricity use, where the polluter pays principle was followed, for which emissions from power plants providing electricity to the city will be attributed to the city although the energy conversion takes place outside of Ludwigsburg. Another exception is the consideration of traffic from the motor vehicle stock ascribed to Ludwigsburg, where the national German average kilometres travelled and specific fuel consumption values differentiated by type of motor vehicle and engine design were applied.

Using this methodology, the actual final energy demand in Ludwigsburg for 2007 was around 2,244 million kWh/a. The majority of the final energy is attributed to households at 45%, followed by transport with 28%. When including the additional energy required to service Ludwigsburg with electricity and district heating, the actual final energy demand increases slightly to 2,316 million kWh/a. Liquid fuels and fuel oil are each responsible for approximately a quarter of this energy demand, while natural gas accounts for 29% and electricity supply for 18%. Renewable energy contributes about 3% of the final energy demand in Ludwigsburg. If the renewable energy supplied through the imported electricity supply were included, this share would increase by 2.5% giving Ludwigsburg a share of 5.7% of final energy from renewable energy in 2007.

| Inventory | | 1990 | 2007 | 2010 |
|---|---|---|---|---|
| $CO_2$ emissions | [kt/a] | 582 | 539 | 521 (Wood burning power plant) |
| $CO_2$ emissions Per capita | [t/a] | 7,1 | 6,2 | 6,0 |

Looking at the demand sectors and the corresponding energy carrier composition, the overall energy relevant $CO_2$ emissions resulted in 539,000 t in Ludwigsburg for 2007. This averages 6,2 t $CO_2$/capita/a. The emission composition mirrors the energy demand sectors in that households are responsible for 45% of actual emissions and transport for 28%. The energy related $CO_2$ emissions according to energy carriers shows that liquid fuels are accountable for a share of 28% and fuel oil for a share of 29%. Natural gas follows with a share of 20% and electricity with a share of 18%. Attributing the $CO_2$ emissions resulting from generating the district heating to the consumption of district heating results in a share of 4.4%. The $CO_2$ emissions in Ludwigsburg were reduced even further with the commencement of the wood burning power plant. This measure alone reduced the emissions by 18,000 t such that the emissions level achieved 521,000 t $CO_2$/a and around 6,0 t $CO_2$ per capita and year.

**Renewable energy potential**

The goal of the potential analysis was to determine the scope for renewable energy for electricity and heating generation for the City of Ludwigsburg. The analysis showed that renewable energy has significant potential to contribute to electricity generation in Ludwigsburg. Renewables could account for over 160 GWh (= million kWh) if wood potential appraised for the city area is extended to include the greater region. This could cover around 38% of today's electricity demand in Ludwigsburg. Photovoltaics would play the major role followed by biomass (regional level) and hydro power use. If a 20% reduction in the overall electricity demand by 2025 is assumed due to the implementation of energy efficiency measures, then renewable energy could have a share

| | Potential | |
|---|---|---|
| | Electricity generation (GWHel) | Heat generation (GWhth) |
| Photovoltaic | 78.0 | --- |
| Wind energy *) | (4.0 per unit) | --- |
| Hydro power | 27.3 | --- |
| Solar thermal | --- | 164.2 |
| Geothermal | --- | 15.8 - 78.8 |
| Waste water | (1.9 sewage gas CHP plant) | 2.2 (5.0 with sewage gas) |
| Wood (wood burning power plant) **) | 5.5 - 53.4 | 10.3 - 99.2 |
| animal dung (biogas unit) | 0.7 | 0.8 |
| energy plants (biogas unit) | 2.8 | 2.9 |
| household compost (biogas unit) | 0.7 | 0.7 |
| Straw | --- | 4.2 |
| **Total (without wind and waste water use)** | **115.0 - 162.9** | **198.9 - 350.8** |

*) bei changes in the regional plan, wind energy would be possible

**) potential in the City of Ludwigsburg and region

of 47% in the City of Ludwigsburg. The potential to use renewable energy for heat generation in Ludwigsburg totals around 350 $GWh_{th}$ (wood on a regional level). This would cover almost 39% of today's heating demand in Ludwigsburg. Solar thermal will play the most significant role followed by wood use and surface geothermal heat collected through geothermal probes and collectors. If a 40% reduction in the overall heating demand by 2025 is assumed due to the implementation of energy efficiency measures, then renewable energy could have a share of 64.5% in the City of Ludwigsburg for the heating demand.

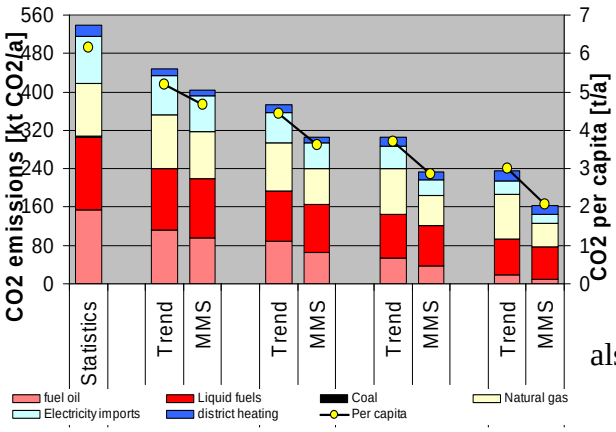
**Expert and public participation**

The work progress and, in particular, the development and assessment of the measures and steps towards implementation of climate protection, sustainable energy use, security of supply, and regional value added in Ludwigsburg were developed as a discursive process together with experts from the city (administration, utilities, expert panel) and the community. Aside steering the project through the expert panel, a round table with experts and a community forum were carried out at the Future Conference on Energy. Involving the participation of the community, business and interested associations at an early stage leads to stronger support in the long term for the Ludwigsburg community and their institutional groups since the measures are developed in collaboration with the community as well as the expert panel. Transparency and acceptance for decisions made in Ludwigsburg provide the community to have a stronger identification with and responsibility for the Overall Energy Strategy and its implementation.


**Scenario**

Building on the round table discussions with the experts and from the Future

**analyses**




Conference on Energy with the community, the proposed measures were developed further and brought into a final format. An integrated scenario analysis was carried out to estimate the future development of energy demand and the energy related $CO_2$ emissions for Ludwigsburg. This shows that climate politics on the European and national level also influence the energy and climate politics for Ludwigsburg and serve as a means to restructure the energy demand and supply towards a more climate friendly structure. The task of the Ludwigsburg stakeholders and the City of Ludwigsburg is to support and accelerate this process, for which an abundance of thematically overarching measures exist in the areas of heating, electricity, transport and renewable energy. In general, the aim is to start today using the available capital and manpower to reduce the current energy demand and increase the range of renewable energy in the future. It is about investing in a climate compatible future.

**Classification of the measures**

Of the 32 measures assessed, 11 measures were shown to have negative specific $CO_2$ reduction costs, i.e. money is saved in addition to the reduction in greenhouse gas emissions. A further 10 measures are close to being cost-effective and 3 measures are characterised with very high $CO_2$ reduction costs, but typically have a leading role as possible implementation options at an early stage. On top of the $CO_2$ reduction costs are also the costs to the city for the implementation of measures and the contribution gained from the value added through the addition of the measures, which are an important part of the assessment criteria.

**Recommended action**

Taking into consideration the current budget restrictions in the city administration, it can be assumed that is not likely that all recommended measures can be implemented although they are cost-effective. Nonetheless, a climate protection programme is presented for Ludwigsburg with a recommendation for short and medium term actions through which a significant share of the calculated $CO_2$ reductions can be achieved. The recommendations are divided into two categories: (1) investment measures for technical implementation and (2) implementation support measures.

**Investment**

In the category of investment measures for technical implementation the fol-

**measures for technical implementation**

lowing short and medium term starting points will be particularly meaningful, according to the evaluators:

1. Using Intracting, a financial mechanism should be made available to enable the renovation plan to realise energy efficient measures gradually in new or old city buildings or in street lighting.
2. The plan to renew and improve energy use in street lighting should be done over time such that old lighting infrastructure, as an example, should be replaced with new technology.

3. The use of biogas, wind, waste water and geothermal energy should be assessed for possible implementation during event or project related surveys (e.g. new construction of buildings or areas, redevelopment of areas), and if found to be economic, these should be implemented.
4. The city vehicle fleet should be transferred step-by-step to the car sharing pool of the Stadtmobil, whereby a stronger visibility should be made in the Ludwigsburg suburbs.
5. The Ludwigsburg-Kornwestheim city utility should promote demand side management (promotion of the demand for energy saving measures) as its own area of business.

6. The heating network, which currently supplies the central, southern, eastern, western and northern suburbs, should gradually be further extended such as to achieve an area-wide supply of district heating for the core of the city in Ludwigsburg. As a first step, the extension in the Weststadt suburb should be scrutinised and implemented as soon as possible.
7. When replacing heating systems in newly constructed buildings or city areas, the supply should be derived from renewable energy (e.g. wood and/or solar, through district, local or waste heating, or from a building CHP unit).
8. The construction of a solar local heating island in the existing building stock should be begun in one suburb which cannot be connected to the SWLB district heating network.
9. Electric mobility should be promoted and extended in Ludwigsburg through the acquisition of hybrid and electric vehicles and electric scooters for the city vehicle fleet, hydro busses for the city traffic and the introduction of Pedelecs for company cars within the city administration to be used for the delivery of goods or for rental to tourists or commuters.

10. A network plan for 2020 should be developed and implemented for the bicycle and pedestrian network.

**Implementation support measures**

In the category of implementation support measures, the following starting points are particularly important, according to the evaluators:

11. To optimise the energy consumption in residential buildings, commercial operations or industrial processes, the affected subsectors and consultants should be offered further training and continued education to integrate a holistic and general trade thinking.
12. The existing energy report on the energy and water consumption of the city buildings and vehicle fleet, the associated costs and the realised measures should be published at shorter intervals.
13. The measurable and accessible data regarding energy carries from renewable sources should be made publicly available via internet and other central places in the city.
14. The topic of energy and climate should be covered in the Ludwigsburg schools for grades 9 and 10 during the general coursework and coupled with audits at the school and at home as well as field trips relevant to the topic of energy.

15. To stimulate the construction of the solar thermal and photovoltaic units, the city should embark on a solar roof campaign.
16. An additional position as energy manager of city buildings should be advertised as soon as possible.
17. The attractiveness of public transport should be increased through the improvement of comfort, offers and the public transport tariff system.
18. The programme planned to offer energy efficiency advice to lower income households by the Ludwigsburg district should be contributed to by the state administration for Ludwigsburg, the ARGE unemployment fund from the Ludwigsburg district and the Ludwigsburg Energy Agency (LEA).

19. The Energetikom should be further supported in their unique role.
20. The City of Ludwigsburg should continue to review and partake in regional, national, and EU-wide funding opportunities and competitions.
21. The cooperation between the City of Ludwigsburg, Energetikom, LEA and the universities should be further strengthened.
22. The City of Ludwigsburg should continue to cooperate closely with the LEA and broaden the opportunities for energy consultations to the citizens of Ludwigsburg.

23. As a first step towards the Mobility Information System for Ludwigsburg (MIL), the use of the car pooling exchange for the city employees of MobiCar should be intensified in 2011 in order to establish the car pooling community.
24. The meetings of the expert panel to the Overall Energy Strategy should continue.
25. To ensure that the Overall Energy Strategy is implemented, the City of Ludwigsburg should allocate adequate staff.

**Outlook** The **25 points** of the programme will enable Ludwigsburg to **halve the per capita emissions** by **2030** in relation to 1990 and to limit the per capita emissions in the **long-term** to a level of **2 t $CO_2$ per capita and year**. Aside for the commitment of financial resources, which will amortise over time, the deciding factors will be the dedication of the stakeholders in the city community as well as ensuring that the city administration has the means to further drive the process. The corresponding **environment** needs to be established.