Energy-Efficiency-Plan
District of Schwäbisch Hall

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CENTRAL EUROPE is a European Union program that encourages cooperation among the countries of Central Europe to improve innovation, accessibility and the environment and to enhance the competitiveness and attractiveness of their cities and regions.

CENTRAL EUROPE invests €231 million to provide funding to transnational cooperation projects involving public and private organizations from Austria, the Czech Republic, Germany, Hungary, Italy, Poland, the Slovak Republic and Slovenia. The program is financed by the European Regional Development Fund and runs from 2007 to 2013.

About VISNOVA

The CHALLENGE of VISNOVA pursuits an integrated approach which addresses both the supply (provision of sustainable energy) and demand site (efficient use). Based on best practices collection, transferred and tested in pilot measures (both pre-investment and small investment), included to regional energy development plans adopted with a political vote, financial resources from national programmes will be explored and responsibilities for the plans' implementation assigned.

Thus, VIS NOVA partners aim to integrate a concept of energy autonomy based on renewable sources and energy efficiency into regional development policies, public authorities in rural regions need adequate planning instruments to avoid isolated approaches that fail to unfold the full potentials for territorial cohesion, competitiveness and employment. Furthermore, public authorities lack profound knowledge about the transferability of European good practices and have poor access to cutting-edge innovations in intelligent energies.

The overall OBJECTIVE of VISNOVA is to cover in the medium and long term up to 100% of the territory's energy demand by energy being produced off regional resources. Sustainability and a secured supply shall be turned into a location factor; the possibility to determine prices can be exploited as a new incentive to promote economic development. Moreover, regional added value and hence employment in the energy sector is strengthened.

With other words, the aim is to integrate instruments to promote energy efficiency ("Energy Efficiency Plan") based on EU good practices, new technologies and transnational learning into regional development policies. The project therefore assists rural regions to plan and to take action to create new value added in the renewable energy sector, to secure local energy supply, to improve energy efficiency performances, to strengthen their competitiveness as locations for economic activities, and to promote territorial cohesion comprehensively.

Furthermore, pilot investments and feasibility assessments subject to transnational peer review test and demonstrate new means to exploit endogenous energy sources in a sustainable way and enhance their efficiency.

Already existing energy/regional development agents (usually those participating in the project) will assume the competency of a regional sustainable energy centre to master the energy development plans' medium and long-term implementation.

Contents

List of abbreviations

°C	degree Celsius
AGEB	Agency for Energy balances
BAFA	Federal agency of economy and export-control
BDEW	federal association of energy and water-economy
CHP	communal heating / power station
bspw.	for example
BW	Baden-Württemberg
CO_2	carbon dioxide
DENA	german energy agency
EnEV	enactment of energy saving
EnMS	Energy-management-system
GWh	Gigawatt hour
GWh/Jahr	Gigawatt hour per year
IEKK	integrated energy and climate protection concept
IKT	Information- and communication technologie
KfW	kredit institute for reconstruction
km	Kilometer
km^2	square kilometer
KMU	smaller and middle companies
kWh	Kilowatt hour
kWh/m^2a	Kilowatt hour per square meter and year
KWK	power-heat-coupling
LED	Light emitting diode
LK	district
LK SHA	district of Schwäbisch Hall
LNF	light commercial vehicles
m ü. NN.	Above normal (see level)
ÖPNV	short range public transportation

PKW	car
RLT-Anlage	air conditioning system
SHA	Schwäbisch Hall
SNF	heavy commercial vehicles
stat. LA-BW	land statistical office of BW
WSVO	ordiance on thermal insulation

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1. Introduction

Climate protection and transition to a renewable energy are all the rage not only since the nuclear disaster in Fukushima, Japan. Governments around the world have made it their goal within the climate to limit the increase in average temperature of the earth to two degrees Celsius. As part of the energy revolution of the conversion of energy supply and an increase in energy efficiency have been adopted by the federal government. In Baden-Württemberg (BW) additional targets were agreed in 2013 to the Baden-Württemberg Climate Change Bill. Purpose of this Act is, in the context of international, European and national climate change targets, to make an appropriate contribution to climate change by reducing greenhouse gas emissions by 2020 compared to 1990 by 25%, while contributing to a sustainable energy supply (cf. KSG BW, 2013, § 4 climate protection goals). Thereby counties occupy a particularly role to achieve the objectives of climate protection and energy policy, since these important functions take in increasing the energy efficiency and the development of renewable energies.

In the district of Schwäbisch Hall (LK SHA) advances the development of renewable energies above already exemplary. Already in 2006 the country council decided to provide SHA 100% from renewable energy sources as a long-term goal issued. In order to achieve this goal as quickly as possible, in addition to the expansion of renewable energies, the tapping of potentials for increasing energy efficiency and the necessary reduction of energy consumption in the various consumer groups.

The purpose of this work is to conduct an initial energy-efficiency-potential analysis in LK SHA based on consumer groups households, industry, transport and the public sector. First, it is about the representation of the actual state, starting from 2010, followed by the demonstration of potential within the consumer groups in the period to 2030. Moreover, the calculated potentials with the initial situation in the LK SHA are compared and on the accessibility of the mentioned climate protection target reviewed in the climate Change Bill. Finally, the results of this work in relation to the region itself as well as the regional value are classified and identified a concept for monitoring the actual future development.

2. Study scope

In mapping 1 you can find the basically structure and the scope of the study of this plan in an overview:

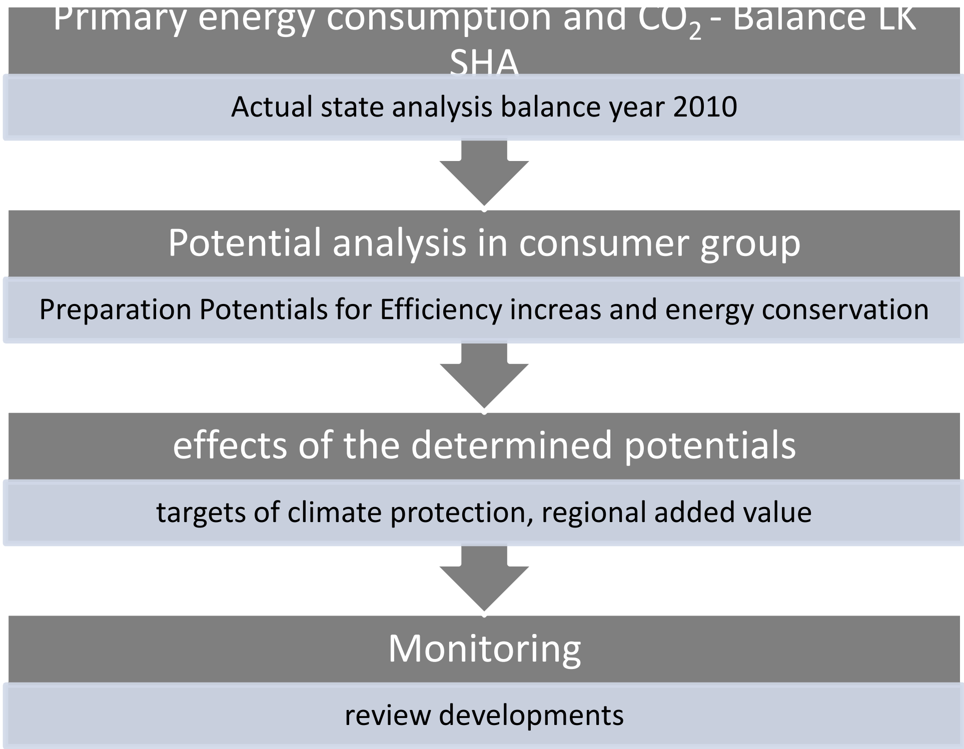


Figure 1: Structure and scope of study

The investigation in this work illuminates the LK SHA starting from the energetic actual situation in 2010. This data is currently the latest and were therefore used as the basis for the primary energy efficiency analyzes of the individual consumer groups. They spring from the county area and are identifiable by the Statistical Office of Baden-Württemberg (stat. LA-BW) as well as annual balance sheets of energy supply companies (eg Stadtwerke Crailsheim GmbH) were reported and other institutions (eg energy center). Following the energy balance a balance of emissions based on carbon dioxide (CO2) is created.

The potential considerations presented in Chapter 5 are based on current studies, surveys, research, and even assumptions and they try to constitute the developments in the different consumer groups of the district of Schwäbisch Hall represent up to 2030 according to current knowledge. However, it is important to remember that these are future events and deviations in the actual future cases are quite possible. In this work, only studies on energy saving and energy efficiency potentials are performed on the consumer side basically. Thus, it is essentially a rational use of energy on the demand side. Therefore, the observation contains no studies on the supply-side efficiency improvements from the power plant to the consumer, for example (eg) centrally via a conventional power plant or decentralized renewable energy. Furthermore, in each area no substitutions of energy sources are made. It is examined according to current knowledge, how large the potential savings are for the same technology and the same fuels. Furthermore, no detailed cost considerations for each potential are raised. In Chapter 6 (market approach and regional value) the costs are considered as a general obstacle to efficiency measures and identified solutions.

Following the analyses of potential in the various consumer groups, these are compared with the figures for 2010 and called the potential savings in energy within the viewing frame by 2030. In addition, it is analyzed what surface effects the results achieved in specific to the regional value and the region itself. Finally, a concept for the monitoring of actual future developments is presented.

For the sake of readability, the linguistic form of the generic masculine is used in this preparation. For all personal names means the chosen formulation both sexes, even if for reasons of easier readability, the masculine form is used.

3. Brief information district Schwäbisch Hall

In the following the district of Schwäbisch Hall ist o be examined in a short information.

The LK SHA is located in the region of Heilbronn-Franken in the northeast of BW. In the following Figure 2 the LK SHA is shown in the smaller area of BW with the dark brown marked. The larger fragment illustrates the district, divided municipalities. The city of Schwäbisch Hall is shown in red, SHA is the seat of the district administration and Crailsheim next to SHA is one of the two major district towns. The district is crossed of Kocher and Jagst (rivers), tributaries of the River Neckar. Table 1 provides brief information about some facts about the LK, it will be discussed later in this section in more detail.

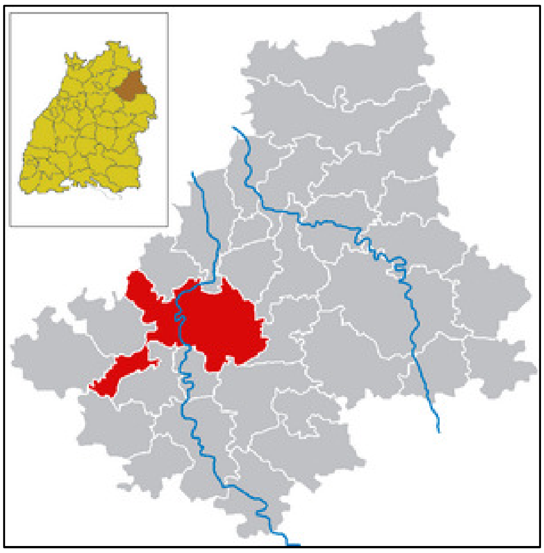


Figure 2: map LK SHA, (FDB,2014)

Inhabitants	188.500
area	1.484 km²
population density	127 Einwohner/km²
number of cities and municipalities	30
major district towns	Schwäbisch Hall
	Crailsheim
site of the administration of the district	Schwäbisch Hall
highest point	564 m ü. NN
lowest point	227 m ü. NN
municipal partnerships, twinnings	LK Nordsachsen, Sachsen
	LK Zamosc, Polen
	Stadtbezirk Taizhou, China

Table 1: brief information LK SHA

The LK SHA is the fourth largest district in BW and counts with around 188,500 people in about 1,480 square kilometers (km ²) area, which corresponds to 127 people per km2, the thin settled areas throughout Germany. In comparison, at the federal level average 230 people share one km2 (see LA-SHA, 2011, p.4). From 1980 up to 2005 the population of the district has increased in numbers steadily, since 2006 this has declined slightly.

From the rural classification, the LK is part of the Hohenloher Ebene, on the heights of the Swabian-Franconian Forest mountains and to parts of the Franks height. The highest point is on 564 meters above sea-zero (m above sea level. NN.), the deepest point at 230 m above sea level. Adjacent areas are in the west the district of Hohenlohe, in the southwest the istrict Rems-Murr and the LK Heilbronn, in the south Ostalb, in the east the Bavarian LK Ansbach and in the north the district of Main-Tauber (in accordance with REU, KRAUß 2013, p.3). The LK SHA is divided into 30 municipalities, with about 800 locations. Partner counties are the LK North Saxony in matters of LK Zamosc in Poland and the Municipality Taizhou in China. A cultural exchange and the maintenance of contacts between administrations and companies are the goals of the partnership relations (see LA-SHA, 2011, p.7).

The following Table 2 shows the distribution of the individual sectors of the circle establishments, number of employees and gross value added:

economic sector in LK SHA	share of firms	number of employees	gross value added in Million Euro
service sector	41%	60.000	3.200
manufacturing sector	39%	37.000	2.119
agriculture and forestry	20%	3.200	84

Table 2: economic sector LK SHA by comparison

In 2010 around 100,000 people were working in the LK SHA (see LA-SHA, WFGmbH, 2012, p.37). The largest employer is the building society Schwäbisch Hall AG, with 3,375 employees. It belongs to the field of services, which almost makes up the lion's share of the total of more than 6,000 companies with 41% and approximately 60,000 people which are employed. This sector, measured by employment, has grown most in recent years. The manufacturing sector comprises 39% of the farms in the LK SHA, the focus is the engineering sector, what induced many suppliers to develop (see LA-SHA, 2011, p.23). Mostly medium-sized company with around 37,000 workers who are active in electrical engineering, iron, sheet metal and metal fabrication, as automotive suppliers, in wood processing, food industry and in the paper and printing industry, identify the manufacturing sector. The region itself is essentially rural in nature, which so far is reflected that the agriculture and forestry with 20% of farms has yet quite significant proportion of the total number of establishments. The number of employees amounts in agriculture and forestry, but only to around 3,200 and is steadily falling for a decade. The great mix of various sectors is typical for the circle, as described above. The unemployment rate lies at 3.2% in Germany: comparison to a relatively low level and for years this rate has been the lowest in the whole region (see LA-SHA, WFGmbH, 2012, p.29).

The gross value added at basic prices of all holdings of LK SHA rose from 1999 to 2009 by 38% (based on LA-SHA, WFGmbH, 2012, p.40). The gross value added comprises the generated output of industries areas, i.e. the sum of the final products of goods and services at basic prices less intermediate consumption. In 2009, the ratio for the LK SHA was in total 5,403 million euros. The share of the service sector is around 59% at the largest (3,200 million euros), followed by manufacturing with a share of 39% (2,119 million euros) and finally, the agriculture and forestry with a share of about 2% (84 million euros).

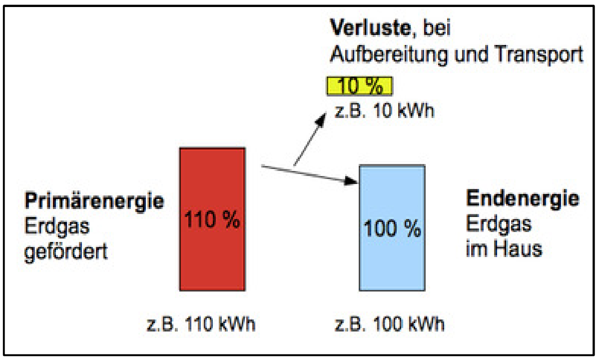
4. Primary energy consumptions and CO_2- balance (carbon footprint)

The following chapter will first explain general concepts for understanding the energy, the various consumer groups in LK SHA will be characterized and analyzed their energy habits in the reference year 2010. After analyzing the energy consumption the associated CO2 emissions will be determined.

The following terms have been prepared in accordance with embodiments of the Federal Agency for Civic Education (see BPB, 2013, chap. What is energy, p.2). Power is defined as the ability of a medium to perform mechanical work to dissipate heat or emit radiation. The internationally valid physical unit is joules (1 joule = 1 watt-second) (see Concise Oxford, 2004, p.84). Energy is, in more general terms, the ability to effect change. Thus, energy is a prerequisite for the sequence of processes. This energy according to the energy conservation law can be neither created nor destroyed, but merely transformed. Generally, the amount remains in a complete cycle system equal to this, however, the usable portion changed. In common parlance is nevertheless spoken surfaces of production, consumption or saving energy, as these can only be used in certain forms. Primary energy refers to a type of energy, which is related to the naturally occurring forms or sources of energy. This includes both, finite sources of energy (e.g. crude oil, lignite, uranium or natural gas) and renewable energy (e.g. wind, water, solar radiation, geothermal and biomass). Primary energy sources are often not directly, but only after further conversion and transport steps available. This converted energy-casting mold is called final energy. Final energy is, for example, the electric current, which is provided for use at the outlet, the heating oil tank in the basement or the fuel for the car. From the final energy it´s also merely possible to used only a certain amount to cover the particular needs of energy. This percentage is called useful energy. Useful energy is the energy that is available to the consumers for their needs in different applications (e.g. in the form of light, mechanical energy, heat or cold). In this work is compared superficially after the primary energy and investigated. The unit in which the primary energy is expressed predominantly in this work is gigawatt hours (GWh). One GWh are a million (1 * 106) kilowatt-hours (kWh).

Depending on the energy carrier which already indicated conversion of primary energy to final energy is associated with different losses, the occurring environmental impacts are taken into account. The ratio between primary energy used to final energy is called the primary energy factor. With help of the primary energy factor each energy source can be made comparable.

the following Figure 3 shows the relationship between primary energy and final energy by the example of natural gas. In this example, 110 kWh of primary energy must be encouraged to provide 100 kWh of final energy. The primary energy factor of natural gas is therefore 1.1. The remaining 10% (here: 10 kWh) of primary energy are energy losses in the processing and transportation of natural gas to the end user. In Table 3, primary energy factors of various fuels are listed in the heating sector: In general, the primary energy factor is the smaller, the greater the renewable share is. The primary energy factor of the local and district heating from combined heat and power (CHP) or heating plants, for example, depends on how big the share of renewable energy is (e.g. in the form of biogas) to provide the heat. Therefore ranges of values and not an absolute numbers are specified.



carrier of energy	primary energy factors
fuel (oil)	1,1
natural gas	1,1
coal	1,1 bis 1,2
wood	0,2
district heating from CHP	0 bis 0,7
district heating from heating plants	0,1 bis 1,3

Figure 3: factor of primary energy in natural gas 1,1, (EFD, 2014)

Table 3: energy carrier and factor of primary energy, (Ecotec, 2014)

In the sector of “electricity” the still valid primary energy factor of 2010 was varied from 2.6 in the framework of the Energy Saving Ordinance (Energy Saving Ordinance) in 2014. Since May 1, 2014, the value applies to 2.0. Attention will be the changed in recent years power mix by the strong expansion of renewable energies in the Federal Republic. From 2016, this will be further reduced to 1.8 (see SP, 2012). As a result, techniques that require electrical power for their usefulness, have a lower primary energy consumption of the consumer groups, and are more advantageous in comparison energy than before.

After this brief introduction to the various concepts and relationships of energy, the energy consumption in the various consumer groups in the comparative year 2010 are shown below. Consumer groups which are mentioned are the households, trade, transport and the public sector. The transport sector is considered separately due to the different derivation of the consumption.

4.1 Privat households, trade and public sector

Households: A household in this work is "any cohabitants and forming an economic unit community of persons as well as persons who live alone and do business (e.g., sole tenant). Different people belong to a private household, e.g. also non-family members/ people (e.g. staff) "(Gabler, 2014, private households, oS).

Trade/commerce: Basically, the commercial includes any "planned, carried out in intent on winning sighting, stable long-term self-employment" (Gabler, 2014, commerce, oS). In this EEP, the following areas are summarized among this group due to the economic structure of the LK SHA: the manufacturing sector, the service sector and agriculture and forestry.

Public sector: "label for public bodies, especially in connection with its activities as an entrepreneur (public company) or in respect of its assets (Treasury). The term is most commonly used to the participation of the local authorities (municipality, Municipalities, federal and state governments) or their companies (public enterprises) to characterize the economic life "(Gabler, 2014, the public sector, oS). In this group of consumers all supplied, operated and maintained buildings and the equipment by the municipalities and cities are summarized for this EEP.

As initial data for the analysis of the energy consumption in the various consumer groups are given only the final energy consumption of the year 2010 in the consumer groups by Stadtwerke Crailsheim GmbH and the energieZENTRUM in each case (see REU, KRAUSS, 2013, p.6). To obtain the primary energy consumption, various assumptions have been made. As already mentioned, it is necessary for the determination of primary energy consumption on the basis of the final energy consumption of primary energy factor. In the following, the determination of the primary energy factors for heat and power is shown in LK SHA in Table 4:

carrier of enrgy	share main heating systems in % (LK SHA)	primary energy factor energy carrier	calculated factors
long distance heating	17%	0	0
natural gass+LPG*	22%	1,1	0,242
electricity	8%	2	0,16
coal	1%	1,2	0,012
wood (Pellets, wood chips)	12%	0,2	0,024
			0,88

*Liquefied Petroleum Gas (Autogas)

		primary energy factors LK SHA
heat	**calculated**	**0,88**
electricity	**given EnEV2014**	**2**

Table 4: calculation primary energy factors for heat and electricity LK SHA

In the distribution of heat the main heating systems of the year 2010 of the LK SHA is known. There were used about 40% of the heat generator based on fuel oil, followed by natural gas (22%) and district heating (17%). Above average to other counties is the use of wood, wood pellets and wood chips (12%). Worth mentioning, the proportion of electric heating systems is also about 8%, against this the use of coal is only a small proportion (1%) (see REU, KRAUSS, 2013, p.7). With the help of individual primary energy factors of the energy sources, from these data an average was formed and used for viewing. In Table 3 (see page 8), the individual factors were mentioned, which were also used for calculation. Stadtwerke Schwäbisch Hall GmbH issued a primary energy factor of zero (see Annex p.3) free of supplied with district heating network buildings. In the calculation it was considered for district heating of the entire county. Taking into account the main heating, the calculated average value for the heat supply in the LK SHA is by a factor of 0.88 (in green). The EnEV 2014 valid factor of 2.0 has already been mentioned for the electrical energy selected.

In the following Table 5 and in Figure 4 the calculation of primary energy consumption, starting from the final energy consumption and taking into account the primary energy factors in LK SHA, according to consumer groups and types of use, is shown in GWh per year (GWh / year):

	End energy consumption due to consumer groups and kind of usage in GWh/Jahr						
	private households		industry		public sector		
year	heat	electricity	heat	electricity	heat	electricity	
2010	1039	381	1921	670	55	19	
	primary energy consumption due to consumer groups and kind of usage in GWh/Jahr						
	private household		industry		public sector		
year	heat	electricity	heat	electricity	heat	electricity	
2010	912	762	1687	1340	48	38	**total**
	1674		**3027**		**86**		**4787**

Table 5: Primary energy consumption household, trade, public sector

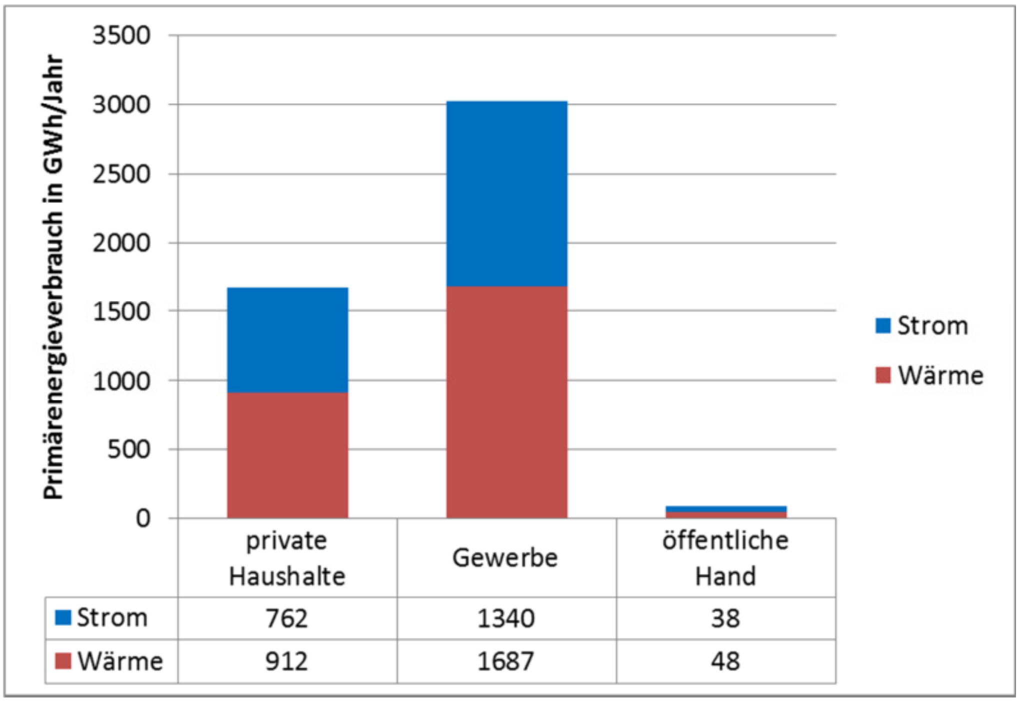


Figure 4: primary energy consumption, households, trade, public sector

In total sum 4,787 GWh of primary energy consumed in the three consumer groups in 2010. From the graph it can be seen that the commercial sector accounts for the largest share with about 3,027 GWh / year. Furthermore, households are responsible with 1,674 GWh / year of primary energy consumption. Only around 86 GWh / year are caused by the public sector. In all three consumer groups prevails the allocation of approximately 55% to 45% of heat flow in primary energy consumption as shown in Figure 4 each in red and blue.

4.2 Traffic

In the transport sector belong passenger cars (automobiles), motorcycles, light commercial vehicles (LNF) up to three and a half tons and heavy commercial vehicles (SNF) and a fine of up to 38 tons of weight under. The basis for the calculation of the primary energy consumption in the transport of LK SHA details of the stat. LA-BW to the financial performance in 2010 (see stat. LA-BW, 2014, annual mileage, shown in Figure 5). In this study, the stat. LA-BW were the freight rail and air transport and inland waterway are not considered, as these are represented in the LK SHA only to a very limited extent.

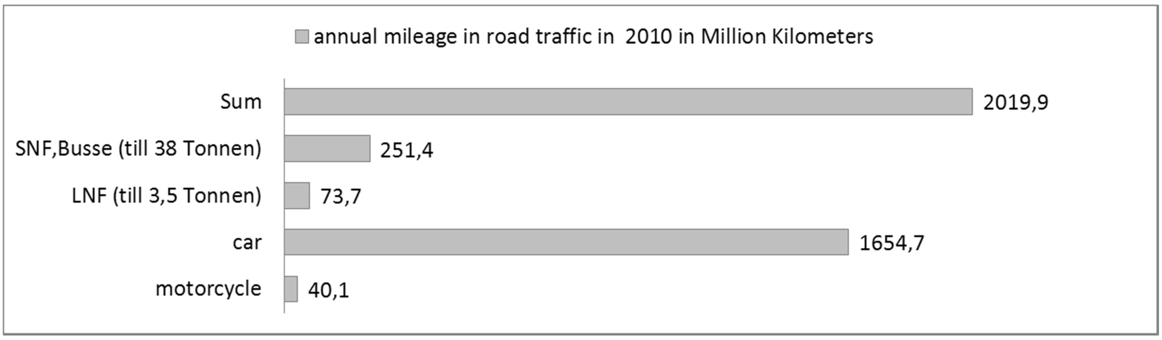


Figure 5: Year mileage LK SHA 2010, (stat.-LA-BW, 2014)

In 2010, the observation cars driven two billion kilometers (km) in LK SHA. The largest number (around 82%) of driven km were doing by car (1,654 million km). SNF and buses recorded with 12% (251 million kilometers) nor a significant proportion of the driven km, while UAA and motorcycles together account for only about 6% (113 million kilometers)..

Table 6 shows the determination of the primary energy consumption of transport in LK SHA based on the yearly performance compared to 2010:

vehicle	motorcycle	car	LNF (till 3,5 Tonnen)	SNF,Busse (till 38 Tonnen)	Sum
annual mileage in million kilometers	40,1	1654,7	73,7	251,4	2019,9
average of consumption in liters of 100km	5	7,5	15	25	
liters fuel/year	2.005.000	124.102.500	11.055.000	62.850.000	
end energy consumption GWh/year*	19	1.206	107	611	1.944
primary energy consumption GWh/Jahr**	24	1.508	134	764	**2.430**

*35 MJ/ Liter as choosen middl-average of fuel value of petrol and diesel
so 9.72 × 10 ^ -6 GWh of final energy are contained in a liter of diesel

**Primary energy factor diesel: 1,22
Primary energy factor petrol: 1,29
chosen: 1,25

Table 6: determination primary energy consumption in traffic LK SHA

Basis for the determination of the primary energy consumption of transport in LK SHA were the aforementioned annual mileages for the different vehicle types (first and second row of the table). For these various vehicles an average fuel consumption per 100 km (see DIW, KIT, 2012 S .7 +9) was accepted (third line) by the author of this work in the next step, with the help of a study by the German Institute for Economic Research in Berlin, and the Institute for Transport Studies at the Karlsruhe Institute of Technology. From these data, the annual fuel consumption for every type of vehicle was calculated in liters (fourth row).

The annual fuel consumption in liters was then using the calorific value of the fuels gasoline and diesel (voted: 35 mega joules / liter (MJ / liter), BDBe, 2014) according to the Federal Association of the German bioethanol industry in final energy consumption in GWh / year equivalent (fifth row). Using primary energy factors of diesel (1.22) and petrol (1.29) (see ESU, 2008), an average factor of 1.25 was chosen for the primary energy consumption for the different vehicle types to determine (sixth row). The primary energy consumption of transport in LK SHA amounts in the comparative year 2010, under the given assumptions in total to 2,430 GWh.

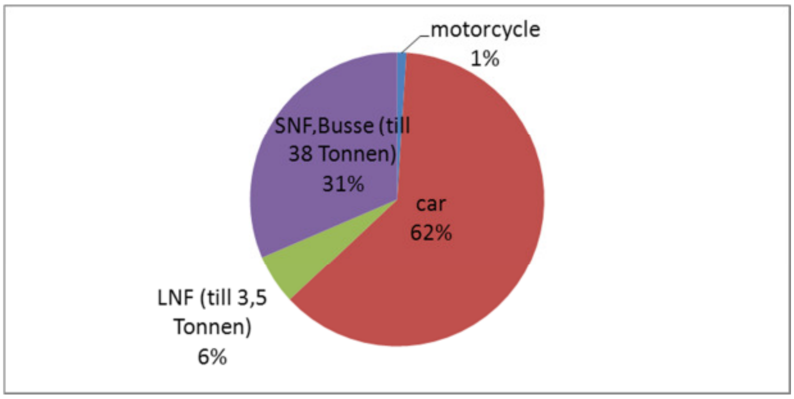


Figure 6: Amount of vehicles in primary energy consumption of traffic

As shown in the following figure 6, the car makes 62% (1,508 GWh / year) of primary energy consumption. Further noteworthy is the consumption of primary energy by the SNF and buses with a share of 31% (764 GWh / year). The number of vehicles in comparison with the car is relatively small; however, the vehicles have to record half of the primary energy consumption of the car. This is partly due to the significantly larger average fuel consumption of large and heavy vehicles, which on average is about three times as larger as in conventional cars (see DIW, KIT, 2012, p.7 +9) and the other to explain longer average driving performance over the year. A relatively small share in total 7% of primary energy consumption, make the LNF to three and a half tons, and motorcycles from (of 158 GWh / year). The one the number is relatively small, and on the other hand especially motorcycles cannot be operated in the winter to a large extent.

4.3 Summary primary energy consumption LK SHA

	primary energy consumption in GWh/Jahr	amount in primary energy consumption in %
private households	1674	23%
industry	3027	42%
Transport	2430	34%
public sector	86	1%
total	7217	100%

Table 7: result primary energy consumption in the consumer groups 2010

In Table 7 and in Figure 7, the primary energy consumption of different consumer groups which are developed in this chapter, are listed again in comparison. This included total consumption for both, the heat and electricity to primary energy in the household sector, the commercial and the public sector.

The consumption of all four consumer groups in the administrative case is compared by 7,217 GWh / year. The industry consumed with a share of around 42% (3,027 GWh / year of primary energy consumption) the most energy. The traffic with approximately 34% (2,430 GWh / year) and the sector of households with 23% (1,674 GWh / year) continue to represent a large part of the primary energy consumption. The public sector has around 1% (86 GWh / year) only a very small proportion.

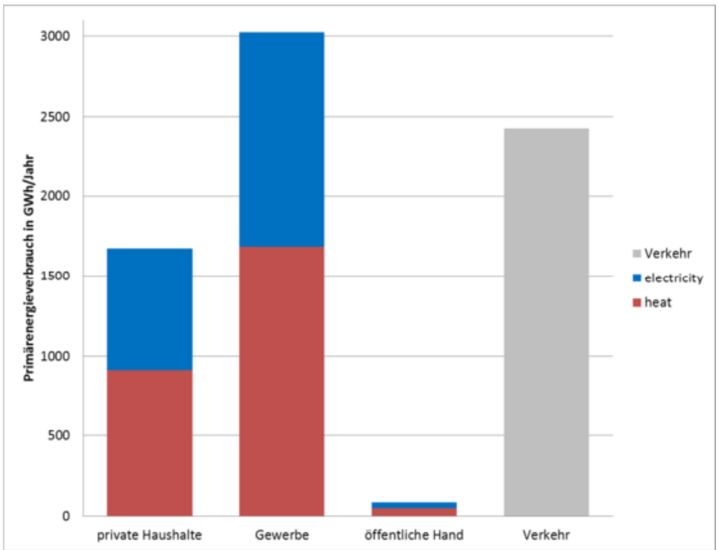


Figure 7: result of primary energy consumption in the consumer groups 2010

4.4 CO_2-Balance

In the introduction of this work, the aim of the state government was already trying to save mentioned greenhouse gas emissions. Ostensibly, it is about CO2, what affects a share of about 90% of the greenhouse gases character (see Bakan, RASCHKE, 2002). This work was renounced under a closer examination of other greenhouse gases.

Emission generally means the dispensing of certain substances, especially the kind and the amount of importance (based on Kallausch, 2013). The objectives of the Federal Government therefore refer to the CO2 emitted to the reduction. Greenhouse gas emissions are ostensibly from the combustion of fossil fuels in the various consumer groups. A more detailed introduction to CO2 is located in the appendix (see Appendix S.4). The stat. LA-BW (see stat. LA-BW, 2013) gives, as shown in Table 8, a source-related emissions balance of different consumer groups in 2010 on the energy consumption. The presentation refers to the primary energy consumption according to the energy balance. The source-related representation means that the emissions are proven at the source, i.e. be the location of the emission source such as a plant or at the location of the traffic. With the help of energy consumption quantities and the respective emission factors, CO2 emissions were extrapolated to the different areas. However, it should be noted that the distribution of various consumer by the stat. LA-BW has been variously defined in Table 8 as it has been done in this work. The households, the service sector (abbreviated here with GHD) and other consumers are summarized in a group, the industrial (corresponds to the manufacturing sector) and the transport considered separately:

	CO2-emissions in 1000 Tons	stakeCO2 emissions in %
Householda/GHD/other consumers	298	29%
Industry/firings	190	19%
transport/traffic	531	52%
Sum	1019	100%

Table 8: CO_2- balance LK SHA, 2010, (stat. LA-BW, 2014 (2))

The CO2 emissions are in total 1.019 million tons in the LK SHA. Around half (52%) of the CO2 emissions caused by traffic (531,000 tons). The calculation of the emissions in the transport sector includes motorcycles, passenger cars, LNF, the SNSF and buses. Underlying this case the performance of the different vehicles on built-up areas as well as rural roads. The values for mileage will be charged with specific emission factors (see stat. LA-BW, 2013 (2)).

The group of households, GHD and other consumers has for nearly a third charge (29%) of the emissions (298,000 tons). The emissions of this group are valued according to causes of heating systems in households and other small consumers in small businesses, in service companies, public institutions and farms (see stat. LA-BW, 2013 (2)).

The CO2 emissions of industrial furnaces alone 19% (190,000 tons) of emissions. The area is divided in one hand, subject to approval incineration plants which have a rated thermal input greater than one megawatt the basis for the calculation of emissions are the annual energy consumption quantities from invoices associated with the emissions statements of operations. On the other hand, the group is divided into no approval required combustion plants, less than one megawatt thermal output. The calculator uses amounts of fuel with connected emission factors, as with the group households, GHD and other consumers connected (see stat. LA-BW, 2013 (2)).

5. Consideration on potential in energy efficiency

In this chapter, the findable potentials in the various consumer groups in LK SHA be designated in energy efficiency and their effect tested for energy consumption will be named. Initially, the concepts of energy efficiency and conservation are discussed. Following this demographic development in the LK and the already mentioned potential assessment in the households, restaurants, transport and the public sector is mentioned. The potential in the emissions of CO2 is not individually in each consumer group, but worked out at the end of this chapter in total.

5.1 Terminologies

Energy efficiency means an optimum ratio of benefits to input energy, the energy consumption should be kept as low as possible. In most studies not the absolute energy efficiency is given, but the percentage increase in this or its inverse, the percentage of energy savings (in accordance with WI-CUEI GmbH, 2008, p.1). For this purpose a small example: Two cars of the same model drive the same route. One of the cars is more efficient than the other by an optimization of the motor and the journey takes 12% (i.e. 1-88 / 100) less fuel (= percentage energy savings, there 12% of the amount of fuel). Thus, this fuel-efficient car, at constant conditions, with the same amount of fuel 13.6% (100 / 88-1) can cover more distance (= percentage increase in efficiency of 13.6% thanks to the new engine).

The energy saving is the simplest and most cost effective way of saving energy basically. It is fundamentally about the question of whether any form of energy consumption is needed. There are many ways to avoid unnecessary use of energy without making investments. An intelligent and conscious use of energy usually leads already to a significant decrease in consumption (see BPB, 2013, p.12). Improving energy efficiency has always been an energy saving.

In the following, the percentage energy savings rather than the percentage increase in efficiency in the various consumer groups in LK SHA is given in this work.

5.2 Demographic process in the district of Schwäbisch Hall

The demographic development is defined as the change in population number and structure within a viewing period. The energy consumption is influenced significantly by the number of people living in SHA LK and work, as well as their user behavior. Society advances in age as a whole due to declining birth rates and medical progress.

Table 9 below shows the population development of the LK SHA by the year 2030. Data was issued in the context of structural data report from the District Office SHA and industry Promotion Agency (WFG) of LK SHA issued (see LA-SHA, WFG Ltd., 2012, p.22):

year	2010	2020	2030	development compared with 2010 in %
number of total population	188.500	186.457	184.400	2,2%

Table 9: Process population number LK SHA till 2030

In the future, SHA is expected to a decreasing in the number of population in the district. Compared with the reference year 2010, the number of persons living in LK SHA will decrease from 188,500 to approximately 4,100 (2.2%) on 184 400 in 2030. In the region of Heilbronn-Franken and in the country BW an even stronger decline by up to 3.5% is expected. Demographic change will thus also affect the LK SHA. There will be an increase in the future in the population aged over 60 years. On the other hand, one is forecasting a decline in the age groups of fewer than 20 and 20 - to 60-years-old (see Annex P.5). This has, among other impacts on the expected future energy demand, which is expected to stagnate for years.

5.3 Potential consideration of private households

In general, households in the LK SHA, as described in Chapter 4 (p.14), will be responsible for around a quarter of the entire primary energy consumption.

Base for the consideration of the potential for households in LK SHA is a study of the German Association of Energy and Water Industries (BDEW, 2010) on the energy consumption in households. Therein, the share of final consumption of different applications was determined in the household (BDEW, 2010, p.9), see first and second column in table 10 below:

applications	stake applications in end energy consumption	end energy in GWh/year	primary energy factors	primary energy in GWh/year	stake in primary energy consumption
heating	73%	1037	0,88	912	54%
amount heat	**73%**	**1037**		**912**	**54%**
hot water	12%	170	2	341	20%
process heat	5%	71	2	142	8%
mechanical energy	6%	85	2	170	10%
Information and communication	2%	28	2	57	3%
lightening	2%	28	2	57	3%
amount electricity	**27%**	**383**		**767**	**46%**
in total	**100%**	**1420**		**1679**	**100%**

Table 10: determination amount of applications in primary energy consumption

With help of the share of final energy consumption of the given final energy consumption of households in LK SHA (see Chapter 4, p.11 and third column in the table) as well as those already given primary energy factors for heat and power (fourth column in the table) we could imply to the distribution of applications on the primary energy consumption of households in LK SHA (last two columns in the table).

The scope of this heater contains besides providing space heating and hot water via the central heating. The provision of hot water for showers, for example, is partly electrically. This part is considered within the scope of hot water. In addition, this scope containing the by power consumption for providing hot water for washing machines and dishwashers (see BDEW 2010, p.9). The drive for washing machines and dishwashers is attributed to the mechanical energy. The mechanical energy comprises, according to the BDEW used in households' electric motors for actuators, pumps and compressors for cooling and refrigeration applications. The process heat for example, contains the consumption for cooking, baking and drying. The Information and Communication includes, for example computers, phones and consumer electronics. The lighting summarizes the last application All bulbs in the household together.

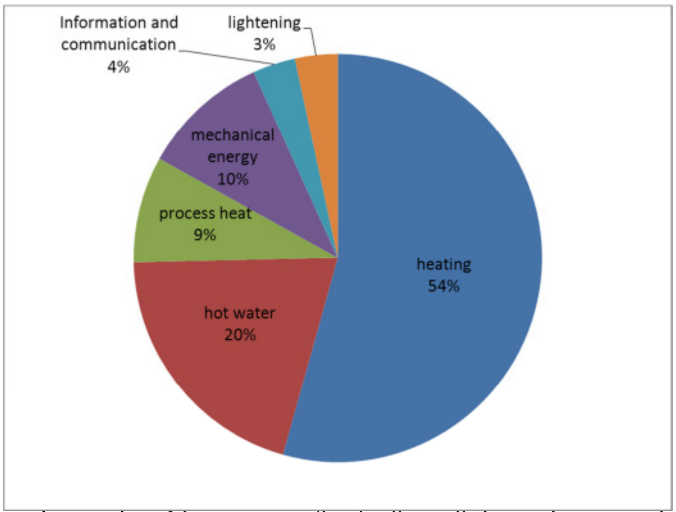


Figure 8: Primary energy consumption by usage, private households

In the adjacent figure 8, the breakdown by applications developed is shown again on the primary energy consumption: In the households around 54% of primary energy for the provision of space heating and hot water is centrally consumed over the heating. The electrical supply of hot water (including dishwashers and washing machines) makes a consumption of 20%, the process heat from a fuel consumption of 9% of primary energy consumption. Drives in the devices for the provision of mechanical energy in electric motors and compressors have a share of 10%. Smaller proportions of primary energy consumption of devices make the information and communication (4%) and lighting (3%). In sum, current applications are responsible for around 46% of primary energy consumption in the households of the LK SHA.

Below efficiency potential in both the heat and the electricity sector are determined in the current range of households and measures are generated to reduce energy consumption.

5.3.1 Heat sector private households

In the provision of space heating via heating the greatest potential for savings in private households are available. Efficiency improvements in space heating are ostensibly to achieve by improving the energy efficiency of existing buildings and consider basically the savings on heat energy in private households. It is about the "minimization of heat demand and its efficient coverage" (JOCHUM, PEHNT, 2010): The demand for heating indicates how much energy is needed to compensate for heat losses (transmission and ventilation losses) in a household and the need a comfortable room temperature is to cover.

Among the mentioned transmission losses refers to the release of heat through the walls, the roof, the floor, the closed windows and doors. This can sum up to 60% of the losses in a building after OEBEKKE (2010). The ventilation losses arising from opening windows and doors in everyday as well as the necessary ventilation of the budget and are responsible for about 10% of the losses. This raised transmission and ventilation losses are largely offset in the winter by the heat supply with a heater to ensure a comfortable temperature in the building. The heating technology itself is up to 30% of heat loss, e.g. by exhaust radiation and piping losses, responsible. Smaller heat gains may be the body heat of people, the waste heat from electrical appliances as well as the solar gains through the sunlight.

year of construction	demand of termal heat in kWh/m²a
vor 1978	250
1978 bis 1984	170
1984 bis 1994	110
1995 bis 2002	100
2002 bis heute	30-90

Table 11: demand of thermal heat

Since the statutory introduction of the first Thermal Insulation Ordinance (WSVO) at the end of 1977, the heating demand of buildings is significantly reduced until today. As part of the WSVO, later renamed as Energy Saving Ordinance (EnEV), limits for transmission losses in components were introduced. Through these limits and the development of new insulation techniques it succeeded a demand in heating for residential buildings, as shown in Table 11, to be reduced to well below 100 kilowatt-hours per square meter per year (kWh / m² a) (based on BMVBS, 2009, p.16). However, this low value is only valid for new buildings. As shown in this table, existing buildings have a much greater need for heating depending on the time when they were built. Buildings which were built before the first WSVO at the end of 1977, are now considered as energetically old buildings and are responsible for a large part of the heat consumption.

In the following the average primary energy consumption in kWh / m² of the buildings before and after 1978 will be demanded with the help of the aged structure of the buildings in the LK SHA, through the aforementioned heat demand and with the help of the so-called degree of utilization of heat sources:

	number of houses	amount in %
bevore 1978	30613	63%
after 1978	17980	37%
in total	48593	100%

Table 12: age distribution of buildings LK SHA

In the adjacent table 12 a section of the age structure of the residential buildings is shown in LK SHA. These approximately 30,600 residential buildings have been built before the first WSVO, which corresponds to 63% of the approximately 48,600 residential buildings. After the first WSVO in 1977 up to 2010 about 17,900 buildings were built (37%) (based on REU, KRAUSS, 2013, p.7).

Thus, in the LK SHA 63% of the buildings have an average of 250 kWh / m² on heating requirement. Since a majority of more than 40% of the heating systems used in the district are based on fuel oil (see REU, KRAUSS, 2013, p.7), an old oil boiler, with an annual utilization rate of 0.8 was used for the calculation of the primary energy consumption of a household in kWh / m², as a further reference. To compare various heat sources in their energy use over the years the so-called annual utilization rate was introduced. As a measure of the energy efficiency of a boiler it indicates that, up to how much of the final energy used one energy source will be implemented over the entire year into usable heating energy (similar to HD, 2012). The utilization ratio is influenced significantly by the amount of heat in the operating exhaust and surface losses of heating technology. An efficiency of 0.8 corresponds to a boiler, which was installed in 1975. The author of this work assumed that in old buildings already once the heat source was replaced after 20 to 25 years for reasons of wear (see IKZ HOME AUTOMATION, 2004). With the help of the heat demand and the degree of utilization of the heat generator it was first indicated to the energy consumption and then summarized on the primary energy consumption for space heating of an old building in kWh / m² closed, the procedure is briefly described here:

- Demand of thermal heat: 250 kWh/m²a
- Oil-boiler stock: utilization ratio 0,8
- -> final energy consumption: (250 / 0,8 = 313 kWh/m²a)

With the help of the primary energy factor of fuel oil (1.1) it was indicated of the primary energy consumption in kWh / m² of a building, which was built before 1978:

- Final energy consumption: 313 kWh/m²a
- Primary energy consumption: 313 kWh/m²a * 1,1 = 344 kWh/m²a

This calculation is grayed out in the following Table 13:

year of construction	number of buildings	share on buildings in total	Average of the demand of thermal heat in kWh/m²a	utilization ratio heating boiler after years of construction
before 1978	**30613**	**63%**	**250**	**0,8**
till 1984	3402	7%	170	0,85
till 1994	5831	12%	110	0,9
till 2002	6317	13%	100	0,95
till 2010	2430	5%	50	0,99
Sum	48593	100%		

demand of thermal heat in houses before 1978 in kWh/m²a	utilization ratio of heating boiler before 1978	primary energy consumption of biuldings before 1978 in kWh/m²a	Average of demand of thermal heat after 1978 in kWh/m²a	average of utilization ratio of heating boilers after 1978	Primary energy consumption of buildings after 1978 in kWh/m²a
250	0,8	344	110	0,92	131

Table 13: demand of thermal heat and utilization ratio of heating before and after 1978

There was a similar approach for the building after 1978: In white is at the top of the chapter the number till 2010 shown, its a share of total buildings whose heat demand and the assumed utilization rate of installed heating technology. The utilization degree of heating technology has continually improved. Nowadays efficiencies of 0.99 can already be achieved.

From these data an average for the heating demand (110 kWh / m² a) and the efficiency (0.92) of the building after 1978 was determined in the lower part. With the help of this information, the average primary energy consumption of the building was calculated according to 1978 kWh / m² a turn, taking into account the primary energy factor:

- Average of the demand of thermal heat for building after 1978: 110 kWh/m²a
- Average oft he utilization ratio of heating technique after 1978: 0,92
- Primary energy factor 1,1
- -> Primary energy consumption: 110 / 0,92 * 1,1 = 131 kWh/m²a

(Note: It was assumed, by the author of this paper for simplicity, that the energy of the heating systems are equal before and after 1978, and thus the primary energy factor remains the same).

Under the given assumptions (= 313/131 kWh / m² a) the primary energy consumption of buildings in 2010, which were built before 1978, is approximately 2.6 times higher than the consumption of buildings by 1978.

With the help of these findings and the proportion of the buildings prior to 1978, the proportion of these buildings in the total energy consumption of the year 2010, as shown in the following Table 14, could be defined:

	share of buildings	primary energy consumption in kWh/m²a	primary energy consumption in emphasis in kWh/m²a	
before 1978	63%	344	217	
after 1978	37%	131	48	
			265	**Sum**
			77%	**share in primary energy consumption of buildings before 1978**

Table 14: determination of the amount on buildings energy consumption before 1978

Within the help of the established average primary energy consumption before and after 1978 and the age structure of the building in LK as weighting, it was implemented on the share of energy consumption of the building prior to 1978. Buildings that were built before

1978, have a share of 77% in energy consumption for heat in the household sector. Because of the aspects identified a large portion of energy consumption, the potential investigation in the heat of private households must first be limited on superficially buildings which were built before 1978.

The goal has to be to bring the existing buildings before 1978 on the cutting edge of technology in the context of energy renovations. There are generally three ways to reduce the energy consumption using an energy renovation:

- **Redevelopment of the building envelope**
- **exchange of the heating technique**
- **redevelopment of the building envelope and exchange of the heating technique**

In the following the potential savings for the three different choices compared to a building with a primary energy consumption of 344 kWh / m² are shown in Figure 9. As adoption of the following measures, the floor space remains the same before and after the renovation. Thus, it is easier to imply on the energy consumption before and after the efficiency measures:

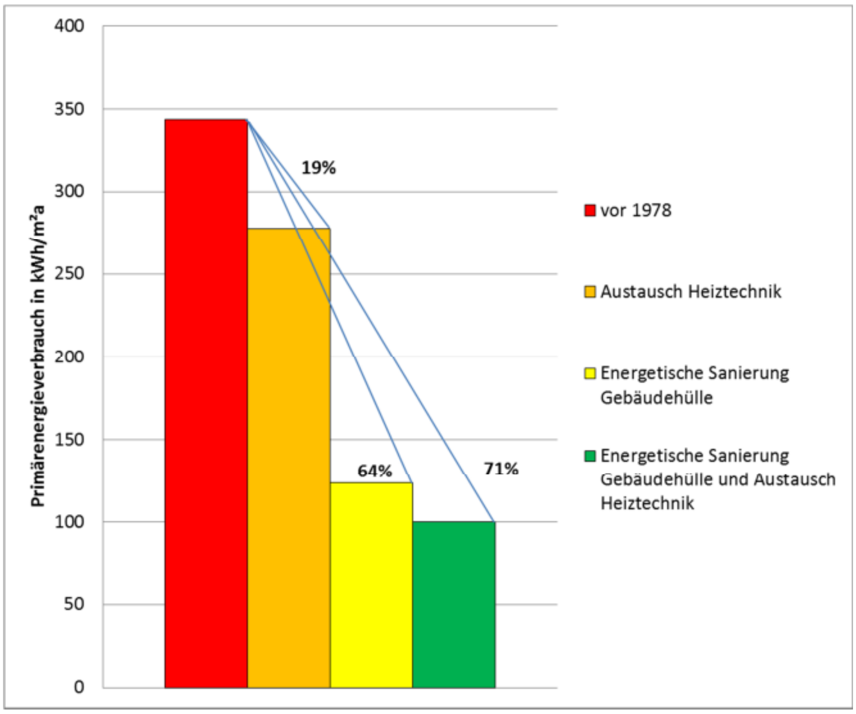


Figure 9: potentials of energetical redevelopment of old building

The procedure for each possibility will be explained in more detail below:

energetical remediation of building envelope

building	demand of thermal heating (kWh/m² a)	end energy consumption with standard oil fired boilers (kWh/m²a)	primary energy consumption (kWh/m²a)	**assumption of savings**
before 1978	250	313	344	
assumption	90	113	124	**64%**

utilization ratio of standard oil fired boilers	0,8

Table 15: potentials of energetically redevelopment of the building envelope

The energy-saving renovation of the building envelope (Table 15) can in principle be performed on individual components of a home or for the complete shell. To these belong, part of the building envelope, such as mentioned above, for example the roof, the outer walls, the ceiling and the basement window. Based on an average heating demand in buildings of 250 kWh / m² a, the assumption is made that this average can be reduced by energetic remedial measures to the building envelope of the heating requirements of a built prior to 1978 building to 90 kWh / m² a. Among other things, a study of the Federal Ministry of Transport, Building and Urban Development has shown that this can be certainly implemented in energy renovations (see BMVBS, 2009, p.17). However, this means a total Insulating in entire building envelope and the exchanges to triple-glazed windows The heating is not exchanged in this way. Thus, the utilization ratio of 0.8 is maintained. Converted to the primary energy consumption for space heating, this means that those is reduced from 344 kWh / m² to 124 kWh / m² a. By professional, energetic modernization of the complete building envelope, it is possible to save about 64% of primary energy consumption, because the aforementioned transmission heat losses can be reduced to the building many times. The losses of the heating system still remains to the same, because it is not exchanged.

(Note: Due to the energetic modernization of the complete building envelope, it may be necessary, to install a ventilation and air-conditioning (HVAC system) in the renovated building to provide the necessary air exchange, on order that the household still can guarantee this!)

exchange of heating systems

buildings	demand of thermal heating (kWh/m² a)	end energy consumption of oil-condensing boilers (kWh/m²a)	primary energy consumption (kWh/m²a)	**assumption of savings**
before 1978	250	253	278	**19%**

utilization ratio of oil-condensing boilers	0,99

Table 16: potential substitute of the heating system

By the sole replacement of heating equipment (Table 16) around 19% on energy consumption can be saved. The old oil-fired boiler with an efficiency of 0.8, is replaced by a new oil-fired condensing boiler with an efficiency of 0.99. Due to an improved efficiency of the newly installed heating system less fuel is basically needed for the provision of space heating because the heating system can implement almost 100% of the energy contained in the fuel in space heating. In contrast to standard- and low-temperature heating systems devices with condensing boiler also use the heat of condensation of water vapor contained in the exhaust gas (based on BDH, 2013, p.50). The heating itself therefore causes less exhaust and radiation losses. However, the sole replacement of heating equipment, keeps the transmission heat losses remain high through the building envelope.

Under the new Energy Saving Ordinance boilers, which were installed before 1978, must be replaced from 01 May 2014. From next year, all heating technologies, which were built before 1984, have to be replaced. This doesn´t apply for low temperature and condensing techniques. Other conditions in the replacement of heating equipment are made in the Baden-Württemberg Renewable Energies Heat Act: When replacing a heating system 10% of the future heat must be generated by renewable energy sources e.g. solar, geothermal or wood. The consumer has the choice whether to continue in using conventional fuels such as heating oil or natural gas in the heating or not. If conventional fuels are used continually, the heating can be supplemented with a solar water heating system (see ZA, 2014) to achieve the required 10%, for example.

combination in the remediation of the building envelope and the exchange of heating systems

buildings	demand of thermal heating (kWh/m² a)	endenergie consumption with oil-condensing boiler and insulation (kWh/m²a)	primary energy consumption (kWh/m²a)	assumptions of savings
before 1978	250	313	344	
assumption	90	91	100	**71%**

utilization ratio of oil-condensing boilers	0,99

Table 17: combined potential

The third option is a combination of the two previous versions with the energy-efficient renovation of the building envelope and the replacement of heating equipment (see Table 17). This has a primary energy saving of around 71% compared to the old result. In this case, the primary energy consumption of the original is reduced from 344 kWh / m² to 100 kWh / m² a. The insulation of the building envelope should be followed by the adjustment of the heating technology and not vice versa, in order to avoid an over-sizing of the heating system.

The efficiency measures to be combined for a need-based heat supply are shown at a quick glance:

- insulation of the buildung envelope
  - Roof
  - Exterior wall
  - Basement ceiling
  - Substitute of doors and windows
- Substitute of the heating system
  - Modernisation of the heating system via improved utilization ratio
  - Optimization of the regulation and control
  - Insulation conduction lines
  - modern heat surrender station on adequate level of temperature
  - hydraulic reconcilation

The greatest efficiency gains can be realized by the matching of all involved components (see DENA, 2011, p.2). In addition to the minimization of the heat demand, heat generation on the heating, the heat transfer via the distribution and the heat transfer via the radiator example the components are: Depending on the current state alone by optimizing the regulation and control of the heat generator a consumption reductions of up to 20% is realistic. An essential element is the adjustment for daytime and the night-time reduction to the actual demand. The heating installer, a chimney sweep or a specialized and certified energy consultant can configure the control. In general, care should be taken of the correct use of the house in the winter to the correct room temperature. In the living areas a temperature of 20-22 degrees Celsius (° C) is optimal, in rooms with light physical activity, such as the kitchen, a lower temperature (e.g. 18 ° C) should be set. In sporadically used spaces already 15 ° C may be sufficient. The room temperature is controlled by means of the thermostatic valves of the radiator, for example, a room is heated to 20 ° C and held by the level 3 setting. To that valve the air should freely flow through (similar to S-SHA Tip: 10). Each degree Celsius less will save about 6% of heating energy. Therefore a selection on appropriate clothing must be next to the correct temperature, especially in winter.

The distribution pipes from the heater to the individual radiators have also to be insulated. In addition, the transfer of heat should be done in the premises on a demand-oriented temperature level with the appropriate technology (panel radiators, surfaces heating). By means of a hydraulic balancing of the heating system a uniform distribution of heat can be achieved in the building. The heating water in the system takes the path of least resistance, thus heating surfaces in remote areas sometimes are insufficiently warm. To correct the situation partly stronger circulation pumps can be used, but this increases the power consumption to pump the water to the heating surfaces in remote areas. In a hydraulic balancing the heating system is adjusted in a way that the whole system of pumps, pipes and radiator valves to the circulating heating water opposes the lowest possible resistance and thus all the radiators are traversed with the same amount of water. In addition, a non-hydraulically balanced heating system reduces the efficiency of equipment clearly with condensing technology. By oversupplied heating surfaces, the return temperature of the heating system increases. The vaporous water contained in the exhaust gases cannot condense only in part or at all. Consequently, the condensation heat of the water cannot longer be used and the savings which a fuel value device to other techniques contained in the exhaust gas condensation heat of the water usually exhibit, do not come to fruition (see BDH, 2014).

To get an overview about the energy performance of a building, an energy performance certificate of the building must be submitted in the future in sale or rental of buildings prospects without being prompted. Also in real estate ads, the information is obligation to ensure the necessary transparency on the energy consumption of a building.

Impact on the heat range of the households in the LK SHA

The useful life of a house can be estimated at over 60 to 100 years. Within this time, there should be a remediation measure around every 30 years for the building as well as for economic reasons every 20 to 25 years a replacement of the heating equipment (cf. JOCHUM, PEHNT, 2010, p.198). In the future, according to REU, KRAUSS (2013, p.10) a decline of the housing demand is expected due to the declining population number. This is derived from the annual demand for new buildings as well as the annual apartment replacement needs in the context of remediation. It is generally assumed that the need in new living space falls off rapidly and by 2030 it's almost virtually zero, the amounts of the number of buildings which needs to be renovated will greatly increase.

The current rate of renovation of existing buildings is about 1% per year, which corresponds to approximately 306 energy retrofits in LK SHA in the year. The federal government has issued the aim to double the renovation rate to 2% per year (BMWi, 2012, p.1). Applied to the LK SHA this results the rehabilitation of 612 buildings a year. If there are renovations planned for a building, this must be carried out in future increases in terms of the energy-efficient renovation.

year	number of existing buildings	number renovated	stake renovated in %
2010	30613		
2020	24490	6123	20%
2030	18368	12245	40%

Table 18: effect rate of redevelopment about 2% in LK SHA

In Table 18, the extrapolation is shown within the viewing frame of this work. By the year 2020, compared to 2010, approximately 6,132 buildings by the year 2030 approximately 12,245 buildings are renovated. Therefore, approximately 20% of today's existing building will be renovated which were built before 1978 and around 40% of the consistent implementation by the year 2030.

The following table shows the calculation of the future primary energy consumption for heating of private households considering the renovation rate of 2% in the LK SHA. It was distinguished in buildings which were built before and after 1978. The development of the total primary energy consumption for heating is shown by the year 2030 in dark grey.

year	primary energy consumption in GWh/year for buldings before 1978	primary energy consumption in GWh/year for buildings after 1978	primary energy consumption for heat in GWh/year in total	Savings compared 2010 in %
2010	703	209	912	
2020	603	220	823	10%
2030	503	224	727	20%

Table 19: private households' primary energy consumption heat and conservation

To imply on the expected future primary energy consumption, the following assumptions were made: As calculated, the primary energy consumption for heating in 2010 to over 77% is caused by buildings which were built before 1978 (see first line of the calculation).

In 2020, as already mentioned, around 20% of existing buildings of the year 2010 will be renovated taking into account the doubled rate of remediation. Each remediation produce a saving on space heating consumption by up to 71% by the insulation of the entire building envelope, combined with the replacement of heating. Thus, the primary energy consumption of the buildings prior 1978 decreased in 2020 to 603 GWh / year. The primary energy consumption of the buildings which were built after 1978 will increase by the existing demand of new living space by 5%, to 220 GWh / year in 2020. In sum, the primary energy consumption for space heating up to 2020 will decrease by a total of 10% (to 823 GWh / year) under the assumptions made.

In 2030, as already explained, around 40% of the buildings are build before 1978 will be renovated. The primary energy consumption of these buildings is thus reduced to 503 GWh / year. The primary energy consumption of the buildings build after 1978 will increase by 2030 due to the reduced demand of new living space, which is almost zero by 2030, only 2% to 224 GWh / year. In sum, the primary energy consumption for space heating from the year 2010 compared to the year 2030 will be reduced by a total of 20% (727 GWh / year) under the assumptions made.

5.3.2 Current range private households

The electricity consumption varies according to household size, number of people and the age and number of household appliances. Nevertheless, there is a uniform approach to reduce power consumption in households sustainable: This includes a first comprehensive actual analysis on the type of loads and their power consumption. On the electricity bill or by reading the electricity meter of the home owner can realize their own annual or monthly power consumption of all devices. In order to assess their own electricity consumption this should be compared with other households with the same number of people and similar floor space. The appendix contains a comparison table of a consumer information from the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety building. The comparison of the table value with the own, actual consumption gives an indication of how big the potential savings is approximately (see Appendix p.6).

In general, care should be taken in purchasing to buy efficient appliances. In the consumption-relevant household appliances this is implemented in Germany transparent to the end user by the Eco design Directive and the Directive on energy labeling (based on BDEW, 2013, p.24 ff.) It should primarily apply to products newly placed on the market by the requirements for eco minimum. These ensure that fuel-efficient products are available on the market and at the same time that inefficient equipment may no longer be sold. On many devices, the costs of their operation during the years are much higher than their purchase price. Energy-efficient appliances save therefore during the years much more electricity costs, as they are more expensive in procurement.

At European level, an energy label was introduced to make products on the market more transparent with respect to their energy consumption under the energy labeling. The terms referred to energy efficiency classes range from D to A + + +. The need for the energy of the most efficient unit A + + +, as shown in Figure 10, is approximately five times less than the energy requirement of a device of the class D. It is important that for each group of devices (fridge, dishwasher, and washing machine) different product-specific requirements existing and they may differ from each other. So in Europe, for example, only refrigerators and freezers are sold which have at least the Class A + at the EU label.

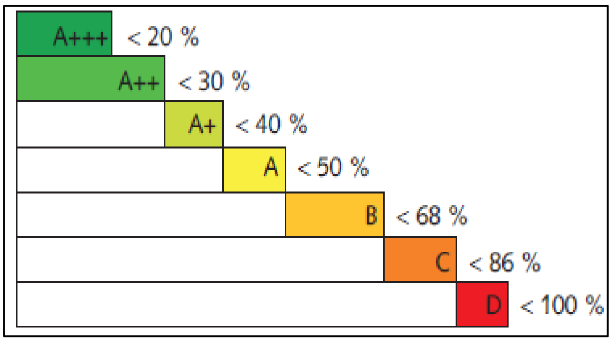


Figure 10: energy demand due to energy efficiency category, (EK-CO2, 2012, S.16)

The sale of other classes (A, B, C, D) is already no longer allowed. More labels, which should achieve a similar effect, are, for example, the Blue Angel, Energy Star, and the Eco-label. A brief description can be found in the appendix (see Appendix page 7 +8). Is a new acquisition not possible, the focus should be on the efficient use of the equipment.

At the beginning of this fifth chapter, the general division of the primary energy consumption of households was determined on the individual areas. The share of electricity of 46% is divided up as shown in the following figure 11. The information BDEW (2010, p.10) no longer refer to the total primary energy consumption of a household, but partial on the power consumption. Furthermore, the various current applications, each with a number of devices which are assigned to these applications, are listed in Table 20:

Stromanwendungen Private Haushalte	
mechanical energy	circulation pump for heating and warm water
	compressors in cool application
	engine for dishwasher and washing machine
process heat	stove
	oven
	dryer
hot water	electric water heating
	diswasher
	washing machine
information and communication	Computer
	Laptop
	tv
	telephone
lightening	lamp

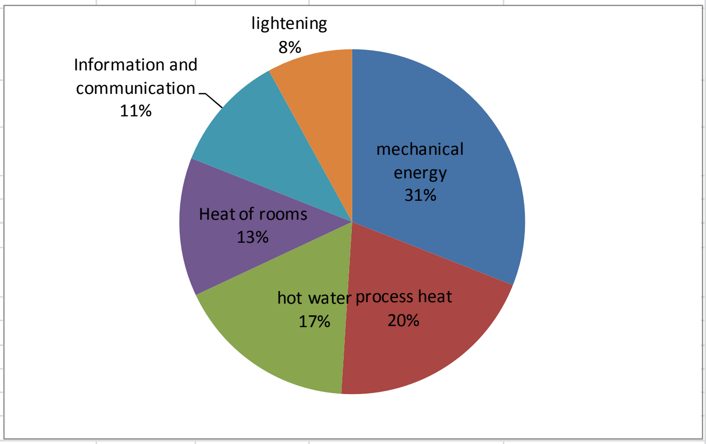


Table 20: utilization of energy in private households

Figure 11: utilization amount on energy consumption, (BDEW, 2010, S.10)

After BDEW applications for mechanical power cause in households the largest share of electricity consumption (31%). Therein cooling and freezing equipment are taken account, they can represent alone up to 20% on energy consumption of a household. Old circulation pumps for heating or the distribution of hot water make up to 10% of electricity consumption in this application. Furthermore, stove, oven and dryer are available in the form of process heat for about a fifth of the electricity consumption (20%), electric water heating, including the provision of warm water for washing machines and dishwashers, accounting for approximately 17% of the power consumption. In general, the provision of electric space heating in households is still responsible for around 13% of electricity consumption. Other applications such as devices for information and communication (11%) and lighting equipment (8%) make up the remaining 19% of electricity consumption.

In the following, there are given brief information on procurement and the efficient use of equipment for the individual areas of the budget. Following from this, the savings potential is determined in the electricity sector of the households. Basics are mainly a study of the BDEW to energy consumption and energy saving in the household in 2013 (BDEW, 2013, p.11 ff), an information brochure consumers of North Rhine-Westphalia (VZ NRW, 2013) and the information brochure of energy consensus-CO2 (EK-CO2, 2012) to save energy in the home. The thereby generated results mostly refer to whole Germany, but are transferable due to a large number of households and electric appliances, with basically similar distributions of the areas of the budget to the LK SHA. In the following, only the most important information from these booklets will be collected in each case.

Mechanical energy:

Circulation pump: Unregulated pump with constant displacement volume and manual step control are still widely used in houses, but they no longer reflect the state of the art. Most older pumps have adjustable levels for controlling the flow rate. If possible, they should be set at the lowest level. Newer pump models (high-efficiency pumps) compared with a conventional pump save up to 80% of the electricity (cf. VZ NRW, 2013, p.11). This can be achieved through an optimized impeller design, control of power due to the heat demand and the installation of frequency converters to control the pump speed. In use, it must to be ensuring that the heating pump is switched off in the summer by an installer. For new heating systems this is required and deposited in the scheme (see VZ NRW, 2013, p.11).

Refrigeration applications: These are mostly large household appliances, such as refrigerators and freezers. These large units are often used only once or twice per household. Refrigerators and freezers usually run it in continuous operation, 24 hours a day, 365 days a year. Basically the replacement of old equipment towards newer worth much, because the resulting of high acquisition costs are offset over the energy-efficient operation. According to BDEW a cooling-device which was bought before 2000 can, if it´s exchanged, save electricity to 70% over the year (see BDEW, 2013, p.16). Temperatures of -18 ° C in a freezer and of +7 ° C in a cooling unit are optimal. In a one degree lower ambient temperature the power consumption in cooling devices is up to 6% lower and freezers up to 3% (see VZ NRW, 2013, p.8). Thus, you have to make sure that the devices are not installed, for example next to the stove or other heat sources. Furthermore, it should be as much space on the back to allow air to circulate to the grids and the waste heat can be dissipated. An accumulation of heat at the back of the heat exchanger can increase power consumption by up to 10%.

Process heat: More than 80% of all households nationwide uses electric cookers and ovens, with the average age of equipment between four to eleven years (HEA, 2008). According to a study of the energy consensus-CO2 (cf. EK-CO2, 2012, p 20) electric cookers are only used for cooking about a third of the primary energy, the rest gets lost for the heating of the hot plates and pots to a large extent. The latest types of electric cookers are induction hobs. At this current is generated in the pot bottom by means of a changing magnetic field, which heats the pot. The power consumption by induction ovens is up to 30% less than in conventional techniques (see, EK-CO2, 2012 p.20). Similar magnitude apply for ovens: convection ovens are generally more economical than other techniques. Generally an oven used in the conventional oven heating needs up to 25% more power than in the recirculation function. Continue long preheating results in large power consumption. The use of the oven without preheating saves up to 20% energy (similar to S-SHA, 2014 Tip: 4). In addition, microwave ovens heat up smaller portions energetically economical than a stove or oven. If smaller portions become frequently heated, the purchase of a microwave oven is worth, also only for reasons of comfort. The heating of food is usually faster and simultaneously saves energy. The same is true for example for the heating of small amounts of water by means of a kettle.

According BDEW the power consumption is also caused by electric clothes dryer in the process heat of households. To throw the laundry after washing instead of dry with a dryer saves energy. After an investigation of the energy consensus CO2 the removal of moisture by heat consumes 100 times much energy than by spinning in a washing machine (based on EK-CO2, 2012, p.14). If possible, you should entirely dispense of these devices. Drying clothes should best happen in the open air or in a drying room. Nevertheless, such a tumble dryer is needed, focus should be placed on energy labeling especially when buying a new emphasis.

Hot water: (according to S-SHA, 2014 Tip: 2) In addition to providing hot water for everyday use, for example for washing and showers, this application also includes the provision of hot water for washing machines and dishwashers.

As already mentioned, the hot water supply can be centrally controlled by heating or decentrally and thus by electricity. Both possibilities are briefly considered. The circulation is often responsible for large power consumption, a loop which returns from the hot water tank to the delivery points, for example in the kitchen or bathroom. Using a circulating pump the warm water is constantly circulating. In this process, it cools down and needs to be reheated (potential for circulation pumps see mechanical energy). With the help of electric boilers and water heaters the circulation can be dispensed when the distance to the delivery points in the kitchen or bathroom is not too far. Electric boilers should be provided with a timer and thereby turned off at night. Thereby unnecessary standby losses are avoided when caching of warm water. For electric water heaters, cold water is heated electrically at the time of acceptance, i.e. only if it is needed. A standby loss thus does not apply. However, the devices must have high electrical power to heat the water quickly. It is important to adjust the temperature which is actually needed. This eliminates unnecessary admixing cold water to the valve at high temperatures, and energy can be saved. Regardless of the type of domestic hot water, it is useful to install fuel-efficient shower heads and faucets. This can reduce hot water consumption by up to 50% and also save energy which is used to heat the water.

The share of electricity consumption for washing machines and dishwashers is rising slightly, according to BDEW, since the increase in the efficiency with new devices by low demand has too little impact on consumption as a whole. Dishwashers have an estimated life expectancy of around 13 years, washing machines due to the high mechanical load with about eleven years are somewhat lower (cf. EK-CO2, 2012, p.5). Buying a washing machine or dishwasher the energy label is to observe. A device with efficiency class A + + + requires about 30% less energy than a comparable device with Class A (see VZ NRW, 2013, p.7).

Space heating: After REU, KRAUSS (2013, p.7) in LK SHA around 8% of the employed heat generator are power heaters. Electric heating systems allocate heat directly in a rooms. This is done firstly by the use of direct heating current, a current flow generated by a resistance heat, which can be used directly. On the other hand, with the help of electric current heat in insulated material, e.g. rock is saved and emitted (storage heaters). Electricity in terms of its ability to work (energy) is one of the highest quality energy carriers as these can be converted into any other form of energy. The working capacity of space heating, however, tends to zero. One speaks of a devaluation of the quality stream for heating purposes (similar to KEA, 2012, p.1 and EEP, 2013, p.22). Heating with electricity should only be used in houses with a very good thermal insulation standard in the future (at least passive house standard), for example, in the form of heat pumps.

Information and Communication: The Information and Communication Technology (ICT) generally includes devices for voice, data and image communications (see LAQUA, summer term 2012, OE, Cape 4b, p.15.). The number of devices and thus their significance for energy consumption has increased greatly in recent years. For computers, the acquisition of an efficient laptop or netbook saves up to 70% of the power opposed to an old desktop computer (see VZ NRW, 2013, p.13). In use, make sure to use the energy-saving options. How much power a computer with the connected peripheral devices actually consumed, is hence also part of the decision the user can make. Thus, for example printers and scanners are usually not constantly needed, they can be disabled. Often these external components of computers have their own power supply with electric power to be supplied. These power supplies usually do not have a power switch. Therefore, it is recommended to install a power strip with power button to ensure that all components, including the computer itself are able to disconnect from the network (cf. EK-CO2, 2012, p.22).

In addition energy also can be saved in the use of wireless phones and other devices such as smartphones. The procurement should be done with the rethinking of the necessary functions of the device: Who wants to use a mobile phone just for making calls, accordingly, should buy a simple, user-friendly device with manageable functions. In use, it is recommended that unnecessary functions, for example the internet, are connecting off. Modern batteries are usually very robust, but they should be used until they are fully discharged. At least once a month, it is recommended that you fully charge a battery. Also, some chargers continue to use power when they are not disconnected from the mains after charging. This should also be avoided (see EK-CO2, 2012, p.22).

It´s not always a good idea to buy a TV with as a large screen as possible. The larger the unit, the greater the energy consumption. Furthermore, a great device is not suitable for any living room. As a general rule: The screen size should be approximately 30% of the distance to the unit. Depending on the technique and model the power consumption will be different. Thus, information from independent sources are particularly important, for example the targeted energy labels. For televisions also efficiency classes were introduced. By 2020, the classes are adapted in the division of large household appliances (thus to the efficiency class A + + +) (cf. EK-CO2, 2012, p.25).

Lighting: The power consumption in the field of lighting is generally slighting. This is responsible by all the stages exclusion of non-efficient light sources (such as light bulbs or halogen lamps) under the Eco design Directive. Those lighting techniques are no longer on sale on the market and were replaced by energy-saving lamps and light-emitting diode (LED) having up to 80% lower power consumption and a significantly longer life (cf., VZ NRW, 2013, p.10). In replacing the lighting system the following things should be considered in general: The needs and opportunities in lightning are to be considered depending on the room. For example, make sure the light intensity or brightness. In addition to energy consumption quality characteristics in lamp-light combinations should be taken further. For example electronic ballasts compared to conventional ballasts can reduce the consumption up to 25% (based on LAQUA, summer term 2012, OE, chap. 4a, p 26). In use, the most effective way to save power is to turn off the lights in unused rooms. For special areas of a home, such as entrances, it makes sense to use lamps with a quick start function and switching capability and to provide them with automated systems, such as occupancy sensors or timers.

General: Each unit in standby mode (e.g. stand-by or off-mode operation) requires power. In total, these can account for a share of up to 10% of total electricity consumption. In normal operation, a device performs its usual function, whereas a subset of the functionality is turned off during standby operation. The power consumption in stand-by is rather low compared to the actual operation, however, this adds up to the number of devices and over the year. At the European level it was decided last year that manufacturers sell devices with very low stand-by power consumption is only allowed up to one watt (cf. EK-CO2, 2012, p.7). However, equipment should be unplugged from AC power in standby mode. It recommended once to use sockets with power switches, with which it is possible to separate multiple devices simultaneously from the mains. With consistent implementation up to 10% of the electricity consumption can be saved.

year	primary energy consumption for electricity in GWh/year	Savings compared to 2010 in %
2010	762	
2020	686	10%
2030	610	20%

Table 21: private household primary energy consumption in electricity and savings

Impact on the current range of private households in LK SHA

The power savings in the budgets of the LK SHA can be determined only in moderate impact due to the many different households with different number of devices, many applications and types of use. The Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety Construction estimates the technical potential for savings in the electricity sector across all areas of the budget of time generally around 30% (cf. BMUB, 2013).

Due to the increased purchase of new household appliances and longer useful lives, it may be possible that the technical potential savings is not achieved. The products are used more frequently and more intensively and thus rise to power requirements and power consumptions, although it has been investing in more efficient equipment (rebound effect). This effect will be exacerbated by the acquisition of new, more powerful consumers with more features and extras. In LK SHA electricity consumption of households between 2006 and 2010 has thus declined by only 3% (see REU, KRAUSS, 2013, p 6).

In LK SHA, as shown in Table 21, in comparison to 2010 short by 2020 up to 10% can be reduced (to 686 GWh / year) and 2030 by up to 20% (610 GWh / year). Requirements are the optimal conditions with a corresponding new purchase efficient appliances, the attention of the Eco design Directive and the Energy Label, a sensible use of the equipment as well as taking into account the rebound effect of the power consumption of households.

5.3.3 Summary of the contemplation of potentials in private households:

Under the given assumptions in the heat and electricity sector the primary energy consumption is reduced in the consumer group households by 2020 a total of up to 10% to 1,508 GWh / year and up to 2030 by 20% to 1,337 GWh / year. In general, the greatest impact on the savings has thereby improving the energy efficiency of existing buildings. The potentials determined already in the fields of heat and electricity is shown in the following Table 22 and Figure 12 once more at a glance.

	consideration of potential private households					
year	primary energy consumption for heat in GWh/Jahr	Savings in energy to 2010 in %	primary enrgy consumption in electricity in GWh/Jahr	Savings in electricity to 2010 in %	primary energy consumption private households in GWh/Jahr	Savings to 2010 in %
2010	912		762		1674	
2020	823	10%	686	10%	1508	10%
2030	727	20%	610	20%	1337	20%

Table 22: summary of the potentials in private households LK SHA

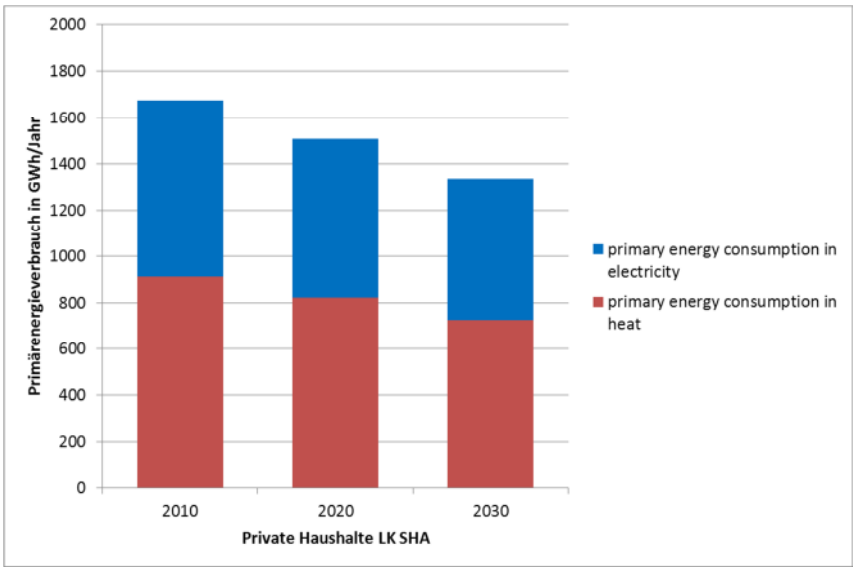


Figure 12: summary of the potentials in private households LK SHA

5.4 Contemplation of potentials in trade/industry

In the following the potential savings due to energy efficiency measures in the area of the sector of trade and industry are examined in LK SHA.

The consumer group Commercial in the district of SHA comprises, according to the definition in this work in addition to the industry, also the service sector and agriculture and forestry. The industry is responsible for about two-thirds of the primary energy consumption per year in LK SHA. The main industry-specific application areas are very different. To determine the total primary energy efficiency potential for the commercial in the administrative SHA, it is important to take the structure of holdings into account: The number of establishments is divided, as already shown in the Brief information about LK SHA to 40% each in industrial and service companies, as well as to 20% in agricultural holdings. The industry has the largest share of energy consumption in this case compared to the other sectors of the economy. Strongly represented in the industry in addition to the engineering are companies from the fields of electrical engineering, iron, sheet metal and metal processing, automotive suppliers, wood processing, food industry, paper and printing industry. In general the LK SHA is characterized more by small and medium-sized enterprises (SMEs).

Each factory is set up differently by the size, number of employees or industry affiliation. To uncover sustainable energy efficiency potentials in business, an actual state analysis is required. In the following the general procedure is described in the context of a actual state analysis (based on FfE, 1997 and LAQUA, summer term 2012, LM, Kap.4a, p.8): In addition to the structure and the structure of energy supply while the energy consumption, the local conditions, as well as the establishment of the production process are observed. It is important that the level of detail depending on the size of the business, the processes but also on the fraction of energy can differ in the total cost.

In general, the following six steps for the description of an energetic current state will be developed in a trade or business:

1. presentation of the establishment
2. Description of the energy supply structure
3. Protection of energy suppliing contracts and energy costs
4. Analysis of Energy Consumers
5. Collection of energy consumption of the factory, of departments, investment groups and individual investments
6. preparation of data

In the appendix the points are explained in more detail (see Annex p.9). With the comprehensive actual analysis on the one hand the largest consumers of energy in factories are shown and other measures can be generated, which reduce energy consumption.

For the analysis of potential in the business of LK SHA, the areas with the largest energy consumption were determined on the one hand with the distribution of farms from the brief information of the LK SHA (see p.5) and with the help of a study by the Agency for Energy Balances (AGEB, 2011), in which energy consumption of various economic sectors in Germany (eg industry, the service sector) were analyzed by use (eg space heating, process heat, electricity for lighting). According to AGEB industrial enterprises are mainly characterized by large energy consumption in the areas of process heat and mechanical energy in the form of electric drives. Companies of the service sector consume the most energy in the fields of space heating, lighting and ICT. In farms mainly drives for fans and cooling energy techniques are consuming energy. Thus, in the framework on an energy efficiency analysis should be placed on these applications particularly value.

5.4.1 Heat sector in trade/industry

In principle, the approach to make savings in the heating sector is to achieve the following: Based on the actual analysis of the heat consumers, the heat demand and the individual system components, the heat generation, distribution and submission are to be investigated. The largest increases in efficiency can be successively through the coordination of all components, in combination with an intelligent control reach.

Space heat: The energy efficiency of non-residential buildings considers in turn, the potential savings in space heating. The procedure is similar to the households with the aim to reduce the heating demand and the resulting primary energy consumption. The efficiency measures to be combined for a need-based heat supply are only represented once again at a quick glance:

- insulation of the building envelope
    - Roof
    - Exterior wall
    - Basement ceiling
    - Substitute of doors and windows
- Substitute of the heating system
    - Modernisation of the heating system via improved utilization ratio
    - Optimization of the regulation and control
    - Insulation conduction lines
    - modern heat surrender station on adequate level of temperature
    - hydraulic reconcilation

In LK SHA are around 34,000 non-residential buildings in the year 2010 (see REU, KRAUSS, 2013, p 6). The majority of these are commercial buildings or industrial buildings and in these there are other life cycles than in residential buildings before. The non-residential buildings are retreaded after an average of around 35 to 40 years. (See PEHNT, 2011, p.53). The rehabilitation rate is due to the shortened useful life estimate higher than the private-use in residential buildings. In this view of the LK SHA a renovation rate of 3% for non-residential buildings is assumed, which corresponds to approximately 1,000 renovated buildings per year. In general, the age structure of non-residential buildings due to the shorter life cycles of buildings and higher rehabilitation rate is generally less influenced by loading of constituent buildings. Thus, it is concluded that energy upgrades only have few savings of up to 71%, as in the household sector, the consequence and the general potential savings in remedial measures are smaller.

Process-related heating applications: heat is used in the commercial not only for space heating, but also in processes, for example in production. These processes are drying processes, for example smelting, forging or welding. Depending on the application, the heat is at a different temperature level, and in another form, for example as hot water, steam or hot air before. According to the German Energy Agency (DENA) make 30% of the industrial process heat demand solely from the hot water and steam generation. The plants are rare on the cutting edge of technology; over 80% are 10 years or older (see DENA, 2011, p.2). Old components of heat production, distribution, and handover should be exchanged and replaced by newer, more efficient once. In addition, there are heat applications which run using electric power. These are for example melting, welding, drying, firing or heat treatments in the commercial. Reasons for these applications/Usage, are a higher flexibility, better controllability and, consequently, a higher quality product at the end of the processes. General measures which are able to save energy in the process heat, are the thermal insulation of thermal systems, avoidance of idle, part load or holding companies as well, depending on the possibility of heat recovery and utilization of waste heat (based on LAQUA, summer term 2012, OE , chap. 4c, p.7).

Waste heat arises in most factories and an intelligent use of these caused an energy saving of energy consumption for the same useful energy, as shown in the following Figure 13:

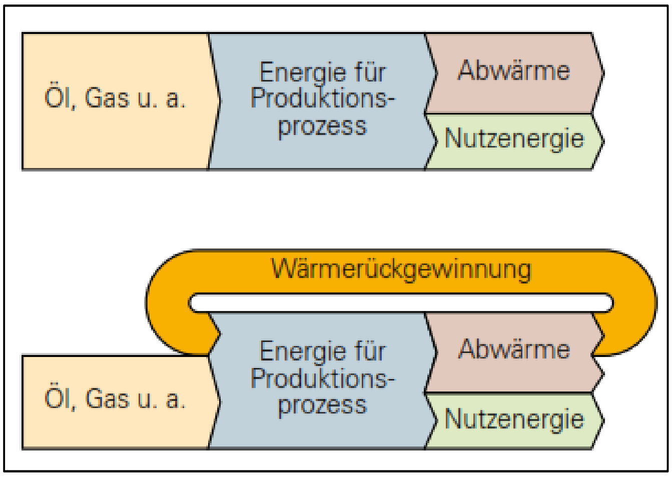


Figure 13: utilization of waste heat, (BA-LA, 2009, S.28)

The temperature ranges can vary greatly. Of 20 ° C in the exhaust air to 450 ° C with waste gases from combustion processes (see BA LA, 2009, p.28). However, the waste heat has to be used directly or as close as possible at the source to avoid long transport routes, which have a cooling result. Furthermore, it is possible to enhance the exhaust heat by the addition of energy, and to use it at a higher temperature level. About 20 to 30% of the total employed electricity and fuel energy can be obtained back according to experience, on average, by using waste heat (see BA-LA, 2008).

Moreover, the use of district heating in the commercial area of the heat LK SHA comes to a significant proportion. With around 20% of the total heat consumption of the city's district heating SHA is for example already well established (according to SHA, 2013, p.8). This percentage is to be expanded in the future throughout the LK. About 70% of the mentioned district heating is produced in combined heat and power plants. Heat and electricity is generated in parallel, with the aid of a combined heat and power CHP. A separate CHP compared with the central electricity and heat generation saves up to 40% of primary energy. The effort is worth especially in companies which need heat and electricity every day around the year, for example, dairies, bakeries or larger commercial buildings (based on LAQUA, summer term 2012, LM, Chap. 3, p.25). If in addition refrigeration is required all year, the installation of a combined heat, cooling and power plant can be worthwhile.

5.4.2 Current range trade/industry

Basically, improvements in efficiency in the electricity sector in both the optimization of the individual components, as well as in interaction throughout the process are possible (referring to LAQUA, summer term 2012, OE, chap. 4a, p.9). As already mentioned briefly in the heating sector, electrical energy is used in trade even with heat applications. In the following, further applications of the electric current are listed.

Electric Drives: Electric Drives are almost exclusively in the commercial three-phase motors. More than half of the applications are made by pumps, fans and compressors, for example, for compressing air or cold applications. Looking at the entire life cycle of motors, more than 95% of the cost arises in the operation and thus the energy consumption. The acquisition and maintenance costs are very low by comparison (see LAQUA, summer term 2012, LM, Chap. 3, p.20). It is therefore important to pay attention to the use of efficient motors with low power consumption. Through a customized sizing and speed control, for example, with frequency for synchronous motors or variable transmissions for induction motors, an additionally exploit of power can be saved. In general, electric motors are divided into different energy efficiency classes:

- IE1= Standard Efficiency
- IE2= High Efficiency
- IE3= Premium Efficiency

The Ecodesign Directive requires in this case that from 2015 the IE3 requirements or the IE2 efficiency in combination with a speed control must be present (rated power from 7.5 to 375 kilowatts (kW)). From 1 January 2017, this regulation is also extended to motors from 0.75 to 7.5 kW (based on kabus, 2010, p.1).

According to research by the Institute for Energy Efficiency in the production of the University of Stuttgart and a study by the Fraunhofer Institute for Systems and Innovation Research an exchange from old to new actuators can expect to increase efficiency by more than 30% (cf. SCHRÖTER, Weißflog, BUSCHAK, 2009). Only the use of a variable speed, electronic unit of the engine turns up to 25%. A complete optimization of all components involved with intelligent control and regulation technology can pull an efficiency increase of up to 60% according to you.

Electric drives for pumps and pump systems: Similar to the households pumps make a large share of energy consumption of the industry. These are used primarily for the transportation of liquids. In the commercial sector there should be more attention to a need-based dimensioning, for one of the pumps and also to the piping system. Due to the longer transport distances, the distribution pipes must be dimensioned properly and the pressure loss should be kept to a minimum. With the help of a customized, flexible control, for example by the use of frequency, the mechanical flow control is replaced by a frequency-controlled, this has big savings especially at part-load operation of the device (see LAQUA, summer term 2012, LM, Ch 3, S .21) The combination of highly efficient drives with a flexible control and optimization of the complete pump system can be up to 70% savings in electricity consumption (DENA, 2010 (2), p.2).

Electric drives for fans: For mechanical ventilation in the commercial sector, among other fans are used with heavy conditional influence of the ambient air and high demands on the supply air. The purpose of HVAC systems is to dissipate internal heat loads as well as to ensure a desired temperature, humidity and air quality (according to Bohm, 2013). Considerations are also requirements for thermal comfort (air temperature and movement) in the living areas. In farms with farm animals, for example, a large proportion of electricity consumption accounts for the ventilation of the stables.

HVAC systems are mainly responsible because of the long lead times for a large consumption of the fan in the business. Therefore it makes sense to take the equipment to a time switch program and take it only in operation when needed. It is important to make sure that the fan is speed controlled by a control system, so that the required power can apply variable and has a high degree of utilization. The desired value for temperature, humidity, and air quality should be adjusted depending on the requirement. Some areas with different use, such as in a building, should be separated from each other as required variable. In addition, refinements to the sewer network and the use of heat recovery units can save potentials. A reasonable time to optimize HVAC system is finally about a year after commissioning, if sufficient operating and user experiences have been collected. The parameters to be set, such as running time or temperature, can be adapted by means of the control and regulation. Studies have shown that the energy consumption can be reduced simply by up to 10% (based on LAQUA, summer term 2012, OE, chap. 4b, p 13). The energy consumption of a complete HVAC system can be reduced by up to 25% in total (cf. DENA, 2013 (2), p 14).

Electric drives for compressors with compressed air: Compressed air systems are mainly used in industrial plants with pneumatic drives and conveyor systems or in cleaning with compressed air guns. In this case, ambient air is compressed to a certain pressure level and distributed over the compressed air network of the consumer. To compress air to a certain pressure level a lot of energy is necessary. In this field compressed air systems exhibit considerable savings, depending on the application, up to 50% of energy can be saved. With the help of efficient engines, the installation of frequency converters for speed control, the use of a need-based compressor and the use of intelligent airflow, to avoid pressure losses, this can be achieved. Large savings are further in tracking down and the simultaneous elimination of air leakage. Regular maintenance of the compressed air system is therefore essential. The leaks should be tracked not only with the help of human hearing, in a simple way, these can also be found by ultrasonic instrumentation. In this case, background noise does not disturb the identification of leaks. Often half of the compressed air gets lost on the way to the tool, due to leakage losses. Leakage may occur, especially at the following locations: (based on BA-LA, 2012)

- leaking pipes
- Leaking Quick Couplings
- leaky connection hoses to the respective consumer
- outdated consumer
- Seals of pneumatic control units

Electric drives for refrigeration plants: The refrigeration is a widely used technology in the industry. In this area considerable potential to increase energy efficiency are existing. Most of the power consumption can be reduced in the plants by 30 to 50% (see DENA, IEE, p.6). In general: To use cold, heat energy must be converted. In an active cooling, this is done by a cooling process with the supply of electrical energy. There are various methods; the compression refrigerating machine is at least widely used.

In the summer months it is often necessary to dissipate heat loads in commercial buildings. These are, for example, sun radiation through the window or internal heat loads by machines, lighting or persons. Compression chillers drives require electrical energy and are responsible for a proportionate share of the power consumption. Therefore, it is useful to minimize heat loads. In existing buildings these may be a sun protection in the form of awnings and efficient lighting techniques and equipment. In new buildings, make sure that there's only a small proportion of the windows and a proper alignment of the floor plan. Other methods for refrigeration plants are, for example, sorption, which use waste heat to the drive of thermal compressor. In addition, the waste heat from the refrigerating machine itself can be used permanently if heat is required at a low temperature level. If the temperature which is to be cooled, is only slightly below the ambient temperature, one evaporative cooling can be used in addition (in accordance with DENA, IEE, p.5). As cold sources can also be used for example, well water or the cool night air. Is heat, cold and electricity required all over the year, it is possible to install a combined heat and power plant cooling in one operation.

Lighting: Basically savings of up to 80% are possible in lighting technology, similar to private households. However, the lighting is also crucial for the quality of the workplace; therefore, the illumination cannot always be reduced. The illumination system comprised in addition to the lamps of ballast, wiring, a light, as well as control possibilities. All of these components have an effect on the power consumption of the whole system. In addition to the increase in the proportion of efficient lamps therefore power consumption can be reduced by the use of electronic ballasts, as well as a need-based regulation and control of the lighting system. The replacement of conventional ballasts to electronic reduces power consumption by up to 20% (based on LAQUA, summer term 2012, LM, Chap. 3, p.22). In addition, timers or occupancy sensor can be used in commercial. Just these two measures can reduce power consumption by up to 30%. Another option, which can bring up to 13% savings, is the increased use of daylight in industrial halls, in the substituted sensors shut dimmed the electric light by day-light (similar to LAQUA, summer term 2012, OE, chap. 4a, p 26).

In the following Figure 14, according to the above-illustrated DENA savings in cross-industry the applications are shown again:

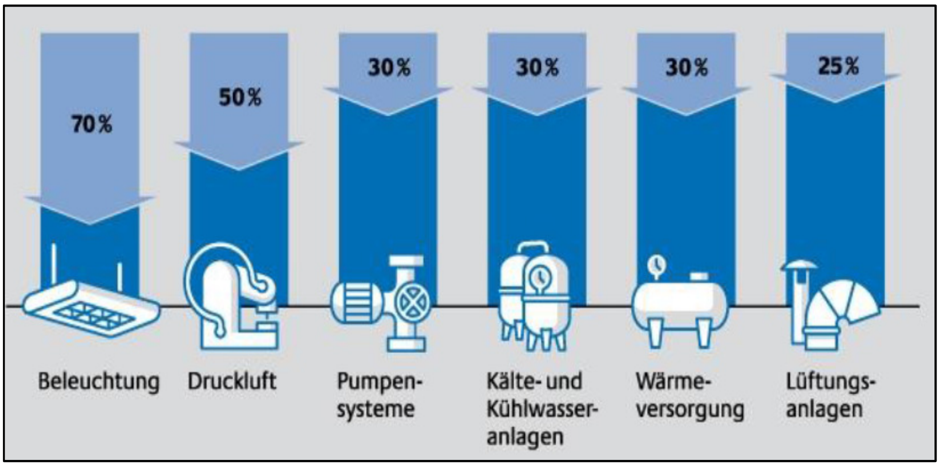


Figure 14: Potentials of different application, (DENA, 2013 (3), S.22)

Due to the significant proportion of firms of the service sector in the LK SHA also information and communications technology (ICT) in the identification of efficiency potential value are appreciated. Similar to the household sector the ICT technologies include voice, data and image communications. Contents are the processing, storage, transmission and output of data. Trend analyzes have shown that the power consumption in Germany in the field of ICT by 2020 may increase by up to 20%. This is mainly due to the purchase of new equipment and their operation causes (see LAQUA, summer term 2012, OE, chap. 4b, p.15).

Counteract the approaches and to reduce power consumption, can be reached, especially in the following four areas within the ICT (cf. LAQUA, summer term 2012, OE, Cape 4b, p.16.):

- Green Components: using the most efficient and best available technology
- Green Computing: System solutions for energy-efficient and high-performance servers and data centers
- Green Networks: Energy-efficient and high-speed broadband connections and infrastructures
- Green Procurement: Including sustainability and environmental aspects in the purchasing and procurement process

Off-mode losses have increased demands on energy consumption in the future only a subordinate role. However, idle farms holdings in the worst case cause all year energy consumption, which should be prevented as far as possible by separating the equipment from the mains. But what we shall pay particular, the consumption in the operation of the equipment (see LAQUA, summer term 2012, OE, chap. 4b, p.16 f.) Although most devices are equipped with energy saving features, but these are not always automatically activated. Thus, energy-saving options, such as operating systems of computers, should be properly configured and enabled. Through organizational and behavior-related measures savings in electricity consumption can be made in the ICT field, depending on the application, up to 14%. In order to realize greater potential, for example, thin client solutions called for computer can be used. This new, high-performance servers handle all applications centrally, which would otherwise run on each workstation computers. In the traditional workplace, only keyboard, mouse and monitor as well as a thin client are required. These small computers need less office space and consume up to 50% less energy than desktop computers (based on DENA, IEE, 2009, p.13).

After the savings appeared in the main applications of the industry, in the following order it goes to the potential savings in a company as a whole. In any operating potentials for saving energy are generally available. This potential can (EnMS) be used (based on LAQUA, summer term 2012, LM, Chap. 8, p.10 f) most effectively through the introduction of a corporate energy management system. The basis for EnMS is the collection, analysis and presentation of the energy status of a company as part of the aforementioned actual analysis. Based on this analysis by defining goals and processes in combination with the adoption of measures to improve the operational the energy efficiency is achieved. In addition, an energy policy for the company is developed, which is implemented by the EnMS firstly but also constantly monitored and adjusted if necessary. In the following Figure 15 the expected result after the introduction of a EnMS is shown in a company. The consideration ranges from the implementation of the investment decisions for more efficient machines to the improvement of facilities, for example by the adjustments to the rules. Depending on the industry affiliation energy, and cost savings of up to 25% can be expected already by the third year after implementation. By continuing implementation of measures for saving energy is a part of the corporate culture.

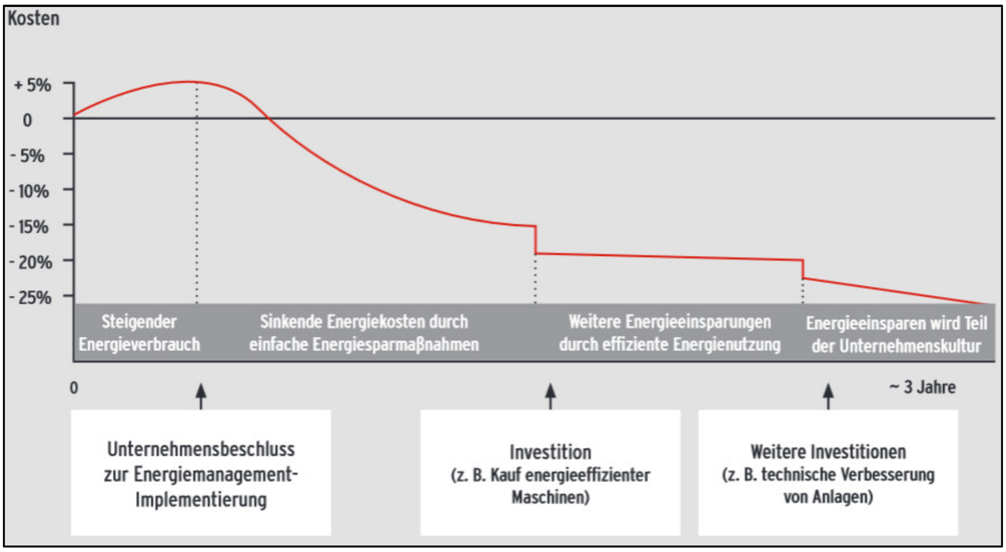


Figure 15: continual cost cutting with a EnMS, (UBA, 2012, S.21)

The benefit for the companies in introducing a EnMS addition to the savings in energy costs, are guaranteed reductions in energy tax by the federal government (f based on LAQUA, summer term 2012, LM, chapter 8, page 10). Through the energy savings and associated cost savings the competitiveness of enterprises is also strengthened. In the current implementation of energy management after the introduction of EnMS the ostensible difference about for example an energy consultancy, which includes a generally unique inventory analysis, upon with recommendations for efficiency measures. Studies have shown that savings of up to 50% are available for long-term transformations in almost every company. According to a study by SCHRÖTER, BUSCHAK, Weißflog (2009, p.3), in which different companies by assessing their potential energy savings were interviewed, approximately half of the companies appreciate their potential up to 10%, and about a third up to 20 %. Only a few companies (3%) believe that they can´t achieve savings, 16% are of the opinion that the potential savings through consistent implementation is over 20%.

Applied to the LK SHA, the potential savings for all companies can be determined together only about estimation. The energy consumption of the sector in LK SHA decreased slightly (see REU, KRAUSS, 2013, p.6) in the years 2006 to 2010 by 8%. The energy consumption is highly dependent on the quantity of production. As already mentioned in the brief information of the LK SHA in Chapter 3, the gross value added at basic prices of all businesses rises. Between the years 2005 and 2010 by about 6% (based on LA-SHA, WFG Ltd., 2012, p 40). Thus, the generated output value of the industry could be increased with decreasing energy consumption at the same time. This already speaks for efficient use of energy in the industrial LK SHA. The author of this work assume that for the future development in the LK the increased use of EnMS in the premises of the industry means that the energy consumption will decline at an elevated gross value added at similar parts as in the last few years. Thus, by 2020 savings up to 20% and by 2030 up to 40% expected in relation to 2010. The summary of the potential viewing of the sector in LK SHA is shown on the following page.

5.4.3 Summary potential consideration in trade/industry in LK SHA

consideration of potential in industry		
year	primary energy consumption in GWh/Jahr	Savings to 2010 in %
2010	3027	
2020	2422	20%
2030	1816	40%

Table 23: result consideration of potential in Trade/industry

The primary energy consumption of the industry is reduced in LK SHA, under the given assumptions as in Table 23 and Figure 16 are shown, by 2020 compared to 2010 by approximately 20% from 3,027 GWh / year to 2,422 GWh / year. By 2030, this reduces compared to the year 2010 by around 40% to 1,816 GWh / year.

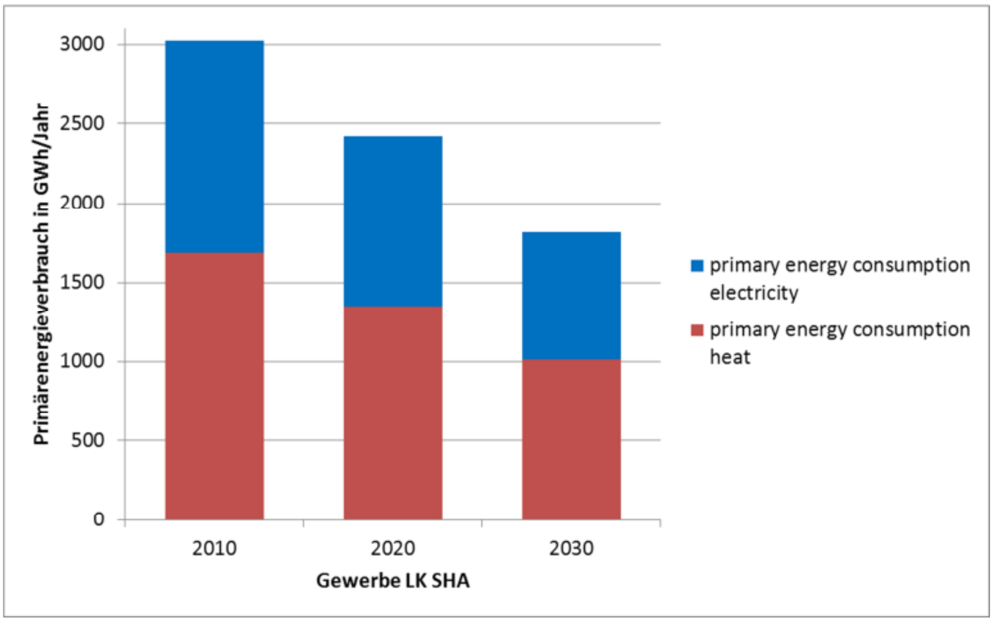


Figure 16: result consideration of potential in Trade/industry

5.5 Consideration of potential in transport

The traffic in the LK SHA is basically responsible for about one third of the primary energy consumption in charge in 2010. Cars and SNF records the largest share of consumption together in total 93%. The share of cars is 62% compared to the SNF with 31% exactly twice as much. The remaining fractions of 7% are caused of the LNF and motorcycles.

The internal combustion engines vehicles remain as the dominant vehicle in the transport sector by 2030 within the underlying view frame in this work. Alternative drive systems are including, for example, electric motors, fuel cells and hybrid technologies. However, despite decades of research and development of these technologies they are only at the beginning. It is not yet possible to give a clear outlook on the further development, which will be the dominant technology in the future (in the presence refusal to EEP, 2013, p.31). Generally, new technologies are in contrast to conventional techniques often obstacles of the market in the form of high cost, limited range exposed by memory problems, security problems, high fuel costs and a limited number, infrastructure of filling stations and strong competition with the conventional drive technologies (based on LAQUA, summer term 2012, OE, Ch.9, p.18).

The **energy efficiency of motor vehicle use** is the product of the efficiency of the supply chain (from primary energy to the provision of end-use energy in the form of fuel, well-to-tank) and the efficiency of the vehicle (tank-to-wheel) (see UBA, 2013 (2), p.16). The efficiency of the vehicle is considered in this work. This depends both on the efficiency of the drive, as well as the size, shape, weight and other components of the vehicle. In addition, the driving behavior (e.g., speed, acceleration) and area (e.g. city, highway, and country road) has a great influence. In this study, energy savings can be achieved in the transport sector mainly through the introduction of efficient vehicles, making efficient vehicle use and redistribution of traffic. In the following different possibilities are presented to save energy in these areas:

Introduction of efficient vehicles: The introduction of efficient vehicles provides the greatest leverage for potential savings in the transport sector. A crucial strategy to increase the energy efficiency of road transport and to reduce fuel consumption, is located in engine technology. According to the Federal Ministry of Economics and Technology (BMWi, 2010, p.47) engines with direct injection uses already about 20% less energy than with conventional technology engines. Further savings in gasoline as well as diesel engines result from the so-called downsizing. The motors are generally equipped with a smaller engine displacement; the emerging power loss is compensated by a so-called charging. In this case more air, thus more oxygen is pumped into the cylinder. By this method, a quarter less engine displacement leads to 10% less energy consumption (see ADAC, 2009, p.9). In addition, start-stop-automatics are already standard in many new cars. The motor is switched off automatically while stopping, by a regulation with actuation of the clutch the motor range again in milliseconds. This is, for example, in city traffic very efficiently and can reduce fuel consumption by up to 15% (see ADAC, 2009, p.9).

Besides efficient engines and their equipment, there are other ways to reduce energy consumption of new vehicles on the road. Great potential lies for example in the aerodynamically design of the car body. The worth of aerodynamic drag (Cd value) is reduced by measures of drag coefficient. The value indicates how much resistance the vehicle brings to the airflow while driving. With the help of intelligent solutions to improve the aerodynamics of the car, the consumption can be reduced, for example, SNF up to four liters per 100 km (in accordance with BMWi, 2010, p 48). In the construction in new vehicles lightweight components were used increasingly in recent years. These can be, for example, aluminum or carbon fiber components or composites. The incorporation of these elements results in a lower weight and thereby lower fuel consumption. Together, these options (improved aerodynamics, lightweight) enable a fuel saving of up to 8% (in line with ADAC, 2009, p.9).

Efficient car use: The efficient use of vehicles is in addition to the initial purchase of fuel-efficient vehicles another great lever for savings. First and foremost part is to ensure efficient use of vehicles in forward-looking and fuel-efficient driving. In the following, a few brief points are mentioned, which can reduce fuel consumption when driving (similar to S-SHA, tip: 13 and ADAC, 2014):

- Approach: fast acceleration up to the speed which is allowed with early upshift at 2000 engine speed / minute in a passage allowing a stable driving at low speed of the motor
- Driving generally:
  - forward-looking and resistant driving, to avoid unnecessary braking and acceleration processes
  - driving with a higher tire pressure for low rolling resistance
  - use of engine braking: Do not remove the gear when approaching castors at a traffic light, often cars with a so-called fuel cut are fitted, which blocks the fuel supply in this situation
  - pay attention to the gear choice: This has a direct impact on fuel consumption, always drive in the highest gear which is possible
  - Carrying of extensions, constructions and weight, for example, Porter, only when it´s necessary
- stopping:
  - backspace is not required as long as the motor (without jerking) takes gas
  - Let car roll in gear
  - Switch off the motor during longer periods of stops

Even with these measures, prepared by ADAC (2014), savings in fuel can be made by 10 to 20%.

Redistribution of traffic: The redistribution of traffic means that road users reconsider their choice of transport and public transport (PT), on non-motorized transport, for example the bike, or make chassis communities. The DENA describes the promotion of redistribution of traffic as a so-called mobility management. Mobility management starts in the transport demand: Transport users are targeted options offered for a shift from motorized individual transport to other means (public transport, non-motorized means of transport, carpooling) (based on DENA, 2013 (4), S. 21 et seq.) In order to save energy sustainably over the redistribution of traffic, the driving habits of the vehicle owner should be changed. The average degree of car passengers in Germany is in accord with DENA (2013 (4), p.21) at 1.4 persons, on the way to work this is even located just 1.1. Therefore, an important strategy for reducing transport energy consumption via a modal shift to more energy-efficient transport or increasing the degree of passengers as a result of carpooling. From 2008 to 2010, DENA has conducted a nation-wide program for mobility management under funding from the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. A total of around

100 companies and municipalities were advised and supported. The subsequent analysis and evaluation of these discussions has the following average potentials:

- Reduction of trips by up to 19%
- Reduction of energy consumption per employee by an average of 700 kWh per year

The average of 700 kWh per employee per year were projected in the adjacent table 24 to all employees of the district of SHA already in the actual analysis of traffic addressed primary energy factor of the fuels. In the total respect of district, this mobility management would mean in comparison to 2010, a saving of around 4% of the primary energy consumption for transport in LK SHA.

management in mobility	
employees in LK SHA	100000
reduction in end energy consumptions per employee in kWh/year	700
primary energy factor of fuels	1,25
reduction primary energy consumption for all employees in GWh/year	87,5
primary energy consumption traffic LK SHA 2010 in GWh	2430
Savings in primary energy consumption in traffic because of management in mobility	4%

Table 24: effects management of mobility in traffic in LK SHA

Potential effects on the transport/traffic sector in LK SHA

In the following the options listed to reduce energy consumption in the transport sector to the LK SHA are transferred. The procedure for this is shown within the viewing frame of this work in the following Table 25. The compiled findings were allocated to all vehicle types in the LK SHA:

2010

Fahrzeug	motorcycles	car	LNF (till 3,5 Tonnen)	SNF,Busses (till 38 Tonnen)	Sum
annual mileage in million kilometers	40,1	1654,7	73,7	251,4	2019,9
average of consumption in liters of 100km	5	7,5	15	25	
liters fuel/year	2.005.000	124.102.500	11.055.000	62.850.000	
end energy consumption in GWh/year*	19	1.206	107	611	1.944
primary energy consumption GWh/year	24	1.508	134	764	**2.430**

2020 Assumption 2010-2020 fuel consumption 10% less, annual mileage 1,5% less

vehicle	motorcycles	cars	LNF (till 3,5 Tonnen)	SNF,Busses (till 38 Tonnen)	Sum
annual mileage in million kilometers	39,5	1629,9	72,6	247,6	1989,6
average of consumption in liters of 100km	4,5	6,75	13,5	22,5	
liters fuel/year	1.777.433	110.016.866	9.800.258	55.716.525	
end energy consumption in GWh/year*	17	1.069	95	542	1.723
primary energy consumption GWh/year	22	1.337	119	677	**2.154**

2030 Assumption 2020 - 2030 fuel consumption 15% less, annual mileage 3,5% less

vehicle	motorcycles	cars	LNF (till3,5 Tonnen)	SNF,Busses (till 38 Tonnen)	Sum
annual mileage in million kilometers	54,6	1572,8	70,1	239,0	1936,5
average of consumption in liters of 100km	3,825	5,7375	11,475	19,125	
liters fuel/year	2.088.626	90.241.335	8.038.661	45.701.480	
end energy consumption in GWh/year*	20	877	78	444	1.420
primary energy consumption GWh/year	25	1.096	98	555	**1.775**

Table 25: approach in consideration of potential in traffic LK SHA

According to the car portal KFZ.de today's vehicles have a useful life of up to 15 years (see Auto-portal Cars, 2014). Therefore all vehicles on the LK SHA are replaced at least once in the underlying consideration scope of this work from 2010 to 2030. According GEGE, HEIB (2013, p.100) the average of fuel of all cars in Germany dropped between 2000 and 2008 from 8.3 liters to 7.6 liters per 100 km. In general it is therefore assumed that the average fuel consumption is reduced by 10% per decade. In the actual analysis of transport in LK SHA for 2010 different average fuel consumptions were adopted according to vehicle types. In the following consideration the fuel consumption drops from 2010 to 2020, for example by purchasing new efficient vehicles or intelligent driving behavior by 10% of each vehicle type. Taking into account the demographics of the population in Section 5.2 (p.18) and measures to reduce mobility management the annual mileage in LK SHA in 2020 compared to 1.5% in 2010 of each vehicle type are reduced.

Based on the assumption that in 2020 and 2030, more efficient vehicles will be developed by the years on the market and put the vehicle users more emphasis on fuel-efficient cars and a corresponding control strategy, the author of this work assumes that the fuel consumption between the years 2020 and 2030 will reduce by a further 15% of each vehicle type. Taking into account the demographic development of the population and measures for mobility management, the annual performance between 2020 and 2030 decrease in this consideration by another 3.5%.

This comprises, within the period of observation, as shown in Table 26 and Figure 17, savings of primary energy consumption in the transport of LK SHA compared to the 2010:

consideration of potential in transport		
year	primary energy consumption in GWh/year	Saving to 2010 in %
2010	2430	0%
2020	2154	11%
2030	1775	27%

Table 26: result consideration of potential in traffic LK SHA

Compared to 2010, with 2,430 GWh, the primary energy consumption in transport decreased by 2020 to 2,154 GWh / year (savings of 11%) and in 2030 to 1,775 GWh / year (27%).

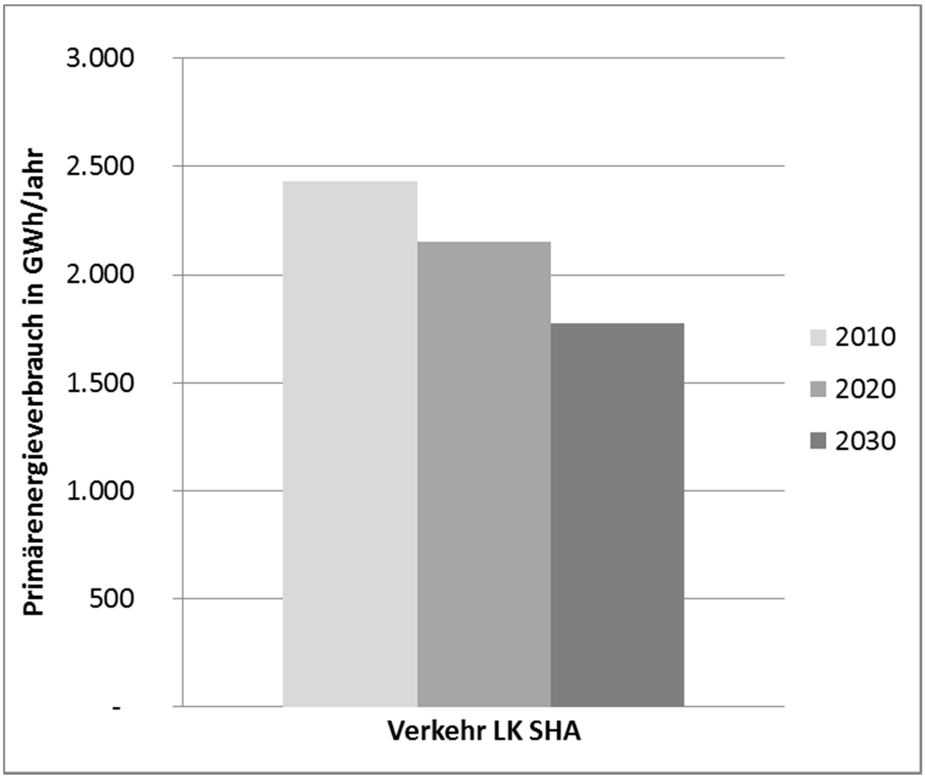


Figure 17: result consideration of potential

5.6 Consideration of potential in the public sector

The public consumer group causes, such as it was described in the actual analysis of the LK SHA in Chapter 4, only 1% of primary energy consumption. Thus increasing efficiency in this class of consumers has only a very small effect on the development of total energy consumption. However, institutions of the public sector, for example, town halls, schools, colleges and other state facilities occupy a special position to meet climate protection objectives: In paragraph 7 of the climate change bill BW the special position of the public sector is mentioned (see KSG BW, 2013, § 7): The public sector plays a general role model on climate change in the organizational area. Among other things the issue of climate change should be exemplary ahead for all citizens and businesses through energy-saving measures as well as the efficient use of energy. The communities and local authorities fulfill the exemplary function in own responsibility, the state government supports this case. Overall, it is the general target to empower the comprehension of citizens in understanding by encouraging and supporting in climate protection. A basic concept for climate protection, according to the Ministry of Environment BW (UM BW, 2014) is a bundled energy management, which is exemplified by the public authorities in the municipalities and counties. In the following, this concept is briefly explained:

Content is first and foremost the definition of an energy guideline, which provides direction for the activities in the framework of an energy management. The meaning and the importance of energy management for the LK have to be clear. In these energy guideline responsibilities, planning rules and operating instructions are recorded. Similar to the households and the industry an analysis of the stock should also be performed in the public institutions for example by a qualified energy consultant. In order to determine priorities, energy consumption is recorded and evaluated. As part of celebrations of the building technical and organizational deficiencies are identified and causes their elimination. The inspections, on the inventory analysis, serve to generate energy efficiency measures to the respective institution (according to UM BW, p.5 ff.) Those responsible building operators, e.g. caretakers are trained individually for the operation optimization in the use of installed plant systems in order to operate them optimally. Saving measures in public buildings are, as already mentioned, and carried out with the backdrop of a model for the LK. In the heating sector, for example, it is given by the EU Energy Efficiency Directive that a renovation rate for public buildings is to be sought by 3% per year (BMWi, 2013). Similar to households, this potential wasn´t exhausted in the heat sector in public buildings in the LK SHA.

Many of the efficiency measures already listed in this work in the electricity sector, for example lighting system with LED, high efficiency pumps, also apply to the public sector. The aim should be to implement all measures to fulfill the mentioned role models and to select the most efficient techniques. In the decision the measures of climate change must therefore be implemented. The subject has to be taken into account and play an important role (according to UM BW, p.11). To serve as a model for climate protection, the savings achieved will be published in accordance and should be transparent and made visible for the citizens, for example by an annual energy report of the district. Both in the cities and in the communities, it is also necessary to clarify the citizens that the respective efficiency measures in the building contribute to climate protection for example by marking the entrance of public buildings.

In the district of LK SHA climate protection is already a priority issue in policy. In district-owned buildings, great emphasis is already placed on energetically sensible renovations. In addition to that, old heating techniques that were previously fired with fossil fuels are replaced by environmentally friendly heating technologies based on renewable energies. The energy consumption of public institutions in the LK SHA dropped between 2006 and 2010 by about 7% (see REU, KRAUSS, p 6).

The authors of this work consider in short to medium term on the assumption that within the county policy, the issue of climate change and thus the efficiency-enhancing measures continue and the energy consumption in public areas with similar parts will continue to fall further (see Table 27 and Figure 18):

consideration of potential public sector		
year	primary energy consumption in GWh/year	Savings to 2010 in %
2010	86	
2020	73	15%
2030	60	30%

Table 27: result consideration of potential in public sector

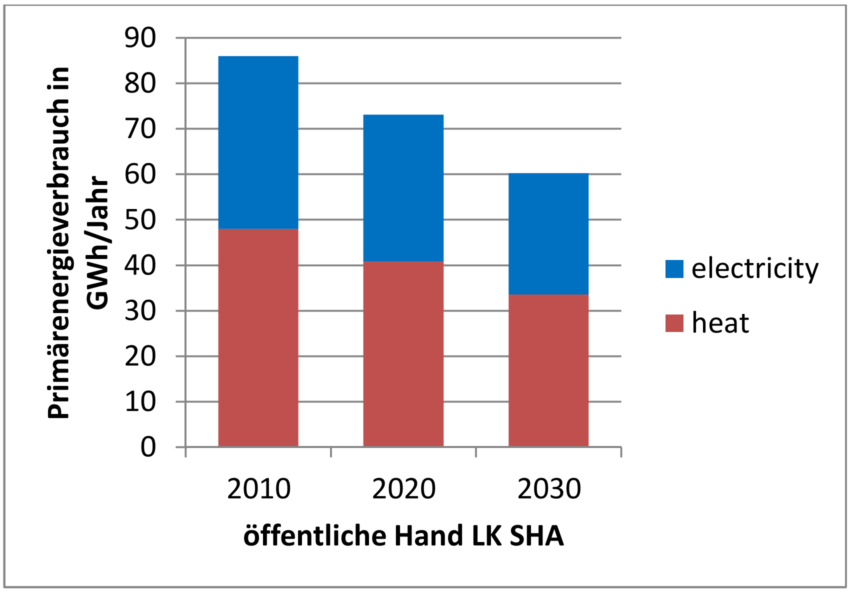


Figure 18: result consideration of potential in public sector

On the following pages the results of the potential considerations for energy efficiency in the various consumer groups in this chapter are summarized once again.

5.7 Summarie considerations of potential in energy efficiency

In the following Table 28 and in Figure 19 the results of the potential considerations in the different consumer groups of LK SHA are shown in an overview:

	primary energy consumption to consumer groups and type of use in GWh/year							
	private households		industry		public sector		traffic	
year	heat	electricity	heat	electricity	heat	electricity		
2010	912	762	1687	1340	48	38		**in total**
	1674		**3027**		**86**		**2430**	**7217**

	primary energy consumption to consumer groups and type of use in GWh/year							
	private households		industry		publis sector		traffic	
year	heat	electricity	heat	electricity	heat	electricity		
2020	823	686	1350	1072	41	32		**in total**
	1509		**2422**		**73**		**2154**	**6158**

	primary energy consumption to consumer groups and type of use in GWh/year							
	private households		industry		public sector		traffic	
year	heat	electricity	heat	electricity	heat	electricity		
2030	727	610	1012	804	34	27		**in total**
	1337		**1816**		**61**		**1175**	**4389**

Table 28: result consideration of potentials in LK SHA

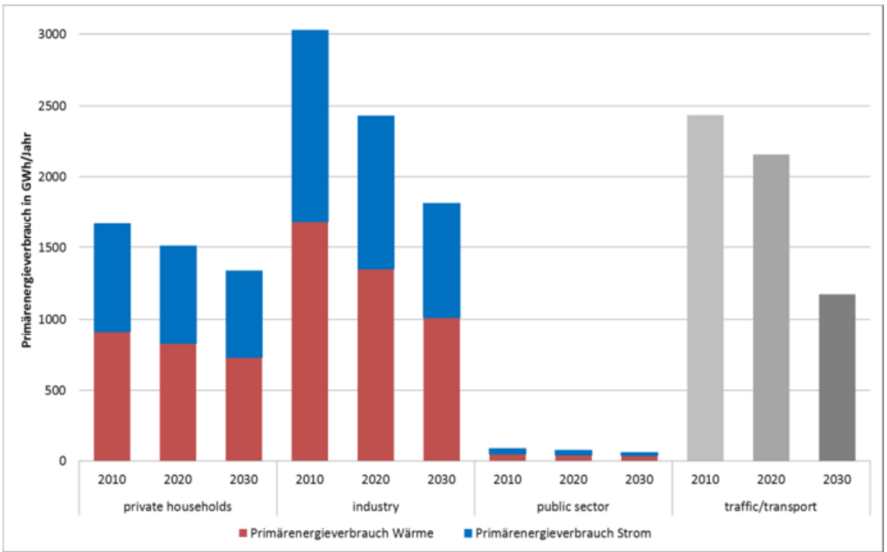


Figure 19: result consideration of potential LK SHA

Potenzialbetrachtung LK SHA		
Jahr	**Primärenergieverbrauch insgesamt in GWh/Jahr**	**Einsparung gegenüber 2010 in %**
2010	7217	
2020	6158	15%
2030	4389	39%

Table 29: result consideration of potential LK SHA

The primary energy consumption in LK SHA is thereby reduced, as shown in Table 29, compared to 2010 with around 15% of 7,217 GWh / year to 2020 with 6,158 GWh / year. Till 2030 the consumption will be reduced by about 39% to 4,389 GWh / year over 2010.

In the consumer group of households savings are provided mainly by energy saving measures of existing buildings. In addition to the building envelope, the technical building equipment, particularly the renovation and operational optimization of heat generation, distribution, and handing providing power savings. In the electricity sector potentials are available, especially in cold-and heat applications. Further potential offers circulation pumps, appliances, consumer electronics and ICT. Especially the procurement of energy-efficient appliances and a corresponding use with the avoidance of unnecessary consumption bring energy savings in households. In the commercial potential firstly by the operational optimization of existing plants, beyond the replacement of old equipment and the procurement of energy-efficient new plants will lead to a decrease in consumption. Especially the consistent introduction of EnMS in industrial companies' specific savings can be uncovered and developed through rigorous application of the system. In this study, energy savings in the transport are mainly achieved through the introduction of efficient vehicles with conventional technologies (gasoline and diesel vehicles), making efficient use of vehicles and the redistribution of traffic. In the public sector there are, as in the households and the industries, particularly potentials in the implementation of the following measures: Energy efficient refurbishment of buildings, optimization of existing facilities, and replacement of obsolete equipment. In addition, the public sector plays an exemplary role in the LK SHA for the implementation of energy efficiency measures.

5.8 Consideration of potential in CO_2

As already included in the actual analysis of the LK SHA at the end of Chapter 4 of this work, the different emission groups following shares of CO2 emissions in 2010 are: Households/GHD/other consumers 29%, industry/firebox 19% and transport 52%.

According to the stat. LA-BW (based on stat. LA-BW, 2014 (2)), the source-related CO2 emissions in the LK SHA from 1995 to 2010 have decreased overall by 10%. The comparison of 1995 was chosen here because the objectives of the State Government refer in the context of CO2 considerations to values of 1990. Taking the fundamental development of the emissions in LK SHA as basis, the values of 1990 and 1995 differ only slightly. Thus, this work can use the carbon footprint as the comparative year in the frame. In the individual consumer groups, emissions have developed differently from 1995 to 2010:

- **Private households, GHD, other consumers:** savings of 33%
- **Industry/firerings:** surge of 42%
- **Transport:** savings of 4%

Basically, the various potential considerations have shown that savings on energy consumption and thus also for the emissions of CO2 are present in the individual groups of consumers. It's at the potential consideration in this section ostensibly to avoid or limit CO2 emissions from the combustion of fossil fuels. The authors of this work assuming that in the future the Carbone footprint within the viewing frame that the already told development of CO2 emissions in the consumer groups in LK SHA between 1995 and 2010 continue over the next two decades. In the group households/GHD/other consumers, this trend will be maintained mainly by the increase in remediation rates in the building sector, with the simultaneous replacement of the heating technologies under the Energy Saving Ordinance and by the Renewable Energies Heat Act. Due to the assumptions made in this group it´s expected with a reduction in CO2 emissions compared to 1995 by up to 55% by 2020 and up to 77% by 2030.

The transport sector will be discussed in more detail due to its proportion of 52% of the CO2 emissions in the LK SHA. The previously mentioned average of the useful life of a vehicle of around 15 years produces the result that all vehicles in the LK SHA are replaced at least once in the period between 2010 and 2030. Thus the more efficient techniques of new vehicles in addition to the reduced energy consumption also have a positive influence on the reduction of CO2 emissions. The EU Parliament has adopted stricter CO2 emission values for new cars in the future. In 2015, new cars are only allowed to cause 130 and in 2020 only 95 grams of CO2 per km. This means a reduction of the maximum CO2 emissions from new cars by 25% every five years (according to Spiegel, 2014).

Whereas not all vehicles are replaced at the same time, these rules have no immediate but delayed impact on the development of CO2 emissions in the transport sector of the LK SHA. For the circulation the author accepted that by the more stringent limits for new cars and slightly declining annual mileage of the potential consideration of traffic in 2020 up to 16% less CO2 is emitted than in 1995. Through the further stringent requirements on new cars from 2020 and the declining annual mileage, a CO2 saving is expected by 2030 with up to 36% compared to 1995.

In the trade/industry of the LK SHA emissions of CO2 rose between 1995 and 2010 by 42%. The number of establishments in the industry as well as the number of employees rose only slightly. Rather, the CO2 emissions developed similar as the volume. However between the years 2001 and 2010, the turnover of the industry increased by 35% (see LA-SHA, WFG Ltd., 2012, p.46). At similar rates the CO2 emissions thus directly depends on production volume. Therefore, within the viewing frame, a further increase in CO2 emissions unchanged at increasing sales would be accepted. However, the authors of this paper believe that the demonstrated efficiency measures in non-residential buildings as well as in the production processes of the industry mean that due revenue increased emissions of CO2 between 2010 and 2020 stop increasing and 2030 by 4 % slightly reduced.

The curves for the individual consumer groups and the course overall are shown in Table 30 and in Figure 20:

year	Private household, GHD and other consumer groups	Savings private households to 1995 in %	Industry, firings	Savings industry to 1995 in %	transport / traffic	savings transport to 1995 in %	total Sum in 1000 Ton/year	Einsparungen ggü. 1995 insgesamt in %
1995	445		134		556		1135	
2005	395	11%	182	-36%	552	1%	1129	1%
2010	298	33%	190	-42%	531	4%	1019	10%
2020	200	55%	185	-38%	465	16%	850	25%
2030	101	77%	180	-34%	358	36%	639	44%

Table 30: progress of CO2 emissions from 1995 to 2030

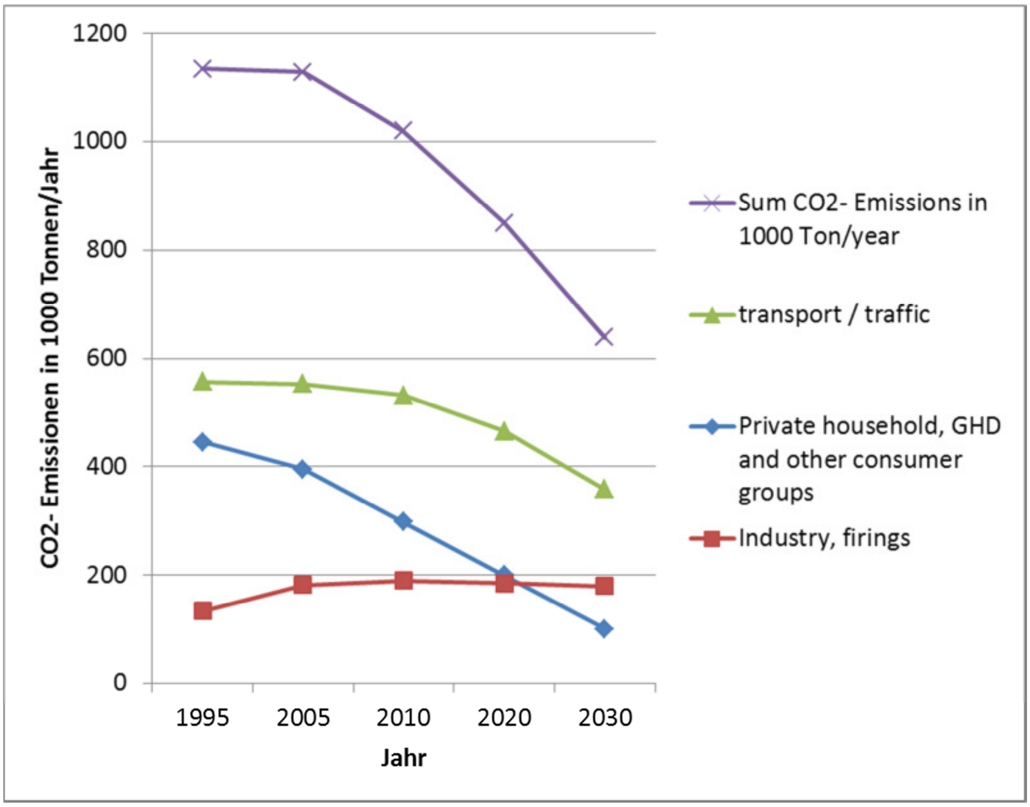


Figure 20: progress of CO2 emissions from 1995 to 2030

The individual considerations have the consequence that the CO2 emissions in LK SHA will be reduced compared to 1995 by 2020 by 25% and 2030 by 44%.

In the introduction to this work, the goal of reducing greenhouse gas emissions by 2020 compared to 1990 by 25% as part of the Baden-Württemberg Climate Change Act has already been mentioned. Thus, under the given assumptions, the climate protection goal of the LK SHA can be reached.

6. Market recognition and regional added value

In order to open up the potentials in the different consumer groups which were issued in the previous chapter, comprehensive organizational and financial measures and corresponding market approaches are necessary. If this is consistently implemented a regional value in LK SHA will be generated.

For tapping the potential there is no fixed path, but for each viewing space an individual collection of thoughtful actions and activities is needed to realize the goals. For the Federal Ministry of Economics and Technology (BMWi, 2012) this has to follow this steps: information and advice as well as promoting.

Information and advice: By providing information and advice to individuals, companies and municipalities they should receive ideas and information for the responsible use of energy. In the climate change bill BW this is defined as follows: The state, municipal and private education, as well as training or information carrier should in accordance to their opportunities explain the causes and the importance as well as the tasks of climate change and improve the awareness of an economical use of energy. The aim must be that every citizen and every business contributes to the respective options for achieving climate protection goals, including energy conservation and the efficient use of energy (according to KSG BW, 2013, § 8).

In LK SHA the Energy Agency of the LK has a special role for the information and guidance.

The energy center is an expertise and advisory center for citizens, communities, businesses and farms and promotes the efficient use of energy. The economy Promotion Agency of the LK SHA is responsible for the operation of the energy center and accompanied and supported among others by the German Federal Ministry for the Environment, the climate and energy. The offer ranges from independent, commercial cross-consultations, from the initial idea through to the implementation. The energy center offers additional to the alongside aforementioned consultation the following: lectures and training on the subject of energy conservation, use of environmentally friendly energy, modernization of old buildings, and other topics. The collaboration is closely connected to the craftsman of the district, the craft guilds, with the Chamber of Architects, the utilities, the development banks, the companies in the energy sector and the colleges and has to be promoted even more in the next few years (according to EZ, 2014).

Grants: Comprehensive modernization measures are associated with high costs. Individuals, companies but also public institutions often have limited financial means, for example, to invest in remedial measures. Thereby energy efficiency measures are generally implemented very slowly both in the private, commercial and public sector.

To solve the backlog of investment in efficiency measures, federal, state and local governments have a variety of **financial promotions**. In the context of new buildings and energy modernization, there are already some programs designed to facilitate the implementation of measures to reduce energy consumption and CO2 emissions in the form of grants and loans. The Federal Government promotes for example with the help of the Reconstruction Loan Corporation (KfW) and the Federal Office of Economics and Export Control (BAFA) single- and complete measures.

Private: Since March 2013 house and apartment owners can expect higher subsidies and improved credit conditions for energy renovations. About the KfW promotion program `Energy efficient ', both individual measures, such as better insulation, new windows or modernizing heating, as well as a complete renovation of the entire house according to specified KfW standards can be supported. The grant for individual measures increased from 7.5 to 10% of the eligible costs. An upper limit of 5,000 euros, depending to the remodeled residential unit, still applies. With complete renovation the promotion can be up to 15,000 euros. Furthermore, credit programs with the installation of modern heating systems based on renewable energy such as solar thermal, biomass or heat pumps are promoted. Especially for owners of private household's energy rehabilitation measures are thus even more worthwhile. Due to the higher funding the investment costs decreases, so that an increase in efficiency is expected even faster than before (cf. DENA, 2013 (5)).

Commercial: Especially in the commercial there are delays due to long payback periods of the efficiency measures of often more than two years. The temporal limit of acceptance is limited: investments, which are characterized by medium to long payback periods, are not realized because companies behold ostensibly on short payback periods, efficient production and high product quality value. A study of Danfoss Solutions (see GRONBEAK, 2012) shows that especially investments in efficiency measures with longer payback periods often lead to higher energy savings as investments with shorter payback periods. Rising energy prices make the difference that projects which nowadays have payback periods of five years, already in 2020 need only three years to recoup around. Thus, they are more attractive for companies. To use the advantages of long-term energy efficiency measures, it is crucial to combine the entrepreneurial short-term goals from the daily operations with long-term management techniques as well as a forward-looking energy management, for a specific control, influence and optimization of energy consumption on a long term basis. The energy consumption or energy costs are a strategic factor (based on GRONBEAK, 2012). In combination with the training of staff for a more conscious use of energy annual potential savings of 10 to 20% are provided. These long-term decisions can be transmitted, and also made in private households and in public areas. Investments that will lead to significant energy savings, such as machinery and equipment are encouraged since April 2012 in the support program `energy efficiency financing SME 'of the country. This is intended to increase the financial incentives for energy efficiency measures in small and medium enterprises through the provision of funds from the budget.

Transport: (see UBA, 2013 (2), p.24 f) in the transport market incentives are set by the so-called limit regulation. This affects directly to vehicle manufacturers and committed this single vehicles or the entire fleet to keep in a certain range of requirements in the context of CO2 emissions. If the applicable standards are missed, the vehicles are not admitted or penalties are to be pay abled. Furthermore, under the tax legislation, for example, energy tax, motor vehicle tax, effects could be promoted for efficient and smaller vehicles with lower energy consumption. An important component may be the conversion of motor vehicle tax on CO2. Furthermore, consumers nowadays have many possibilities to compare the vehicles in terms of fuel consumption and emissions with each other. This includes the statutory car label, which classifies cars according to their weight-specific CO2 emissions in efficiency classes and this label must be visible on purchases for the customer.

Public: In the energy concept of the federal government as well as in Baden-Württembergs Climate Change Bill, it was decided that future new buildings and existing buildings of the public sector are set as an example in the reduction of energy consumption. In those legally defined points by the Federal Ministry of Economy and Energy vertices on energy efficiency (BMWi, 2012, p.6 f) it´s definded that the issue of energy efficiency has also to take greater account of public procurement. In general, most products and services are procured based on their energy efficiency have the highest demands and belong to the highest energy efficiency class.

To get an overview of the support in the different areas, the Federal Office of Economics and Technology provides an overview of programs and financial assistance of the European Union, the Federation and the countries (www.foerderdatenbank.de).

Contracting (vgl. BDEW, 2010 (2), S. 5 ff.): In addition, increasingly so-called contracting solutions are offered, what energy savings in existing or new construction of buildings and properties in the form of an energy service tap, without the respective owner needs to make the necessary investments. The Contracting represents a financing model: A specialized service company implements energy efficiency measures to ensure this service, it´s named as Contractor. The contracting buyer receives and utilizes the technical, financial, human and informational possibilities of Contractors in the measures which have to be implemented. Within a contract between the contractor and the contracting borrower, the debtor has to pay a so-called solid contracting rate for the received service during the term.

Benefits of contracting measures are on the one hand a professional planning and providing advice on the measures to be implemented, and further the use of modern techniques. These techniques ensure optimized operation for energy savings and at the same time relieve the environment. Secondly, the Contractor is responsible, thus an outsourced operational risk ensures that the contracting borrower can concentrate on the actual task. An overview of various contracting types is found in the appendix (see Appendix p.10). Energy companies are particularly suitable for offering contracting measures, as these can show a lot of experience in dealing with energy and other related areas. The necessary technical, economic and legal expertise is therefore available; in addition, the energy providers have the knowledge of the participating market actors as well as the customers themselves. Generally, it is possible, to offer a wide field in contracting services with partners from the industry and the craft. Contracting solutions are in the bid and project engineering phase still often more complex and thus more difficult to see through, as for example, a purchased system with subsequently operation by investors' own. This is especially true for small and medium-sized enterprises of the industry as well as private customers.

Market approach in LK SHA: The two major district towns in the LK SHA, Schwäbisch Hall and Crailsheim, have already developed climate change policies and measures for their districts which have to be generated (see KSI, 2013, p.103 ff and SHA, 2013): In January this year a funding proposal for an integrated energy and climate protection concept (IEKK) was provided for the whole LK SHA. A Climate Action Plan represents therein a basis for calculating the energy and climate policy (based on KSG BW, 2013, § 6 IEKK) and serves as a basis for future action in the context of climate change.

Smaller communities also have the opportunity to participate in a coaching program for local climate protection. The program is sponsored by the federal government and supports the communities in a structured approach to climate protection.

The topic of energy-efficient construction and renovation should be further promoted in factories with the expansion and the coordination of energy advisory services and support. For example, the city council of SHA should coordinate the offers of different actors stronger. In the field of heat supply, the district heating and combined heat and power will be further expanded. The preparation of plans, such as heat registers (cadaster), plays a crucial role. The energieZENTRUM works closely with the State Institute for Environment, Measurements and Nature Conservation in BW and has had already create a corresponding heat register. The district heating network for example, is already well developed in SHA and Crailsheim. In the future they want to compress and expand these networks yet by citywide strategies. If a district heating connection cannot be realized, but large consumers such as apartment buildings, large public buildings or a trade or business exists, the use of heat islands should be implemented and the structured.

In addition to operations in the issue of energy efficiency, for example, the theme should be promoted by networks of companies and with the support of energy management. Pioneer in the LK SHA is the model of "Hohenlohe eV". Already since 2001, in various corporate networks they are working for economic solutions in energy efficiency. The aim of the network is to help people to help themselves. In working groups, for example, new legal requirements or operational efficiency measures are presented and discussed. Participating in the projects so far companies have increased their energy efficiency within three years by up to 15% (based on MH, 2014). For operations of the electrical and heating plumbing air-craft from SHA and the surrounding area there are special institutions, such as the energy community of SHA. Around 80 companies have come together to form this club, with the tasks of promoting sustainable and economical use of energy and the promotion of energy efficiency (based on EC-SHA, 2014). In addition, both the (municipal utilities) Stadtwerke SHA GmbH and Stadtwerke Crailsheim GmbH have already contracting solutions for commercial businesses. The offer ranges from contracting solutions in refrigeration, or compressed air, to the heat range.

In addition to the aggregate at least two employees are located in a center of expertise for energy efficiency in 2014 for the region Heilbronn-Franken. Their task should be to look for companies in the region in an outreach Initial consultation and to point out the efficiency opportunities within the company. The offer for the plants will be free, neutral and independent.

Regional value added: According to the Federal Ministry of Economics and Energy, energy efficiency measures already have a very great importance in the European energy policy. Improving in the energy efficiency reduces the energy costs, the dependence on export markets and triggers for significant investment in the domestic economy (based on BMWi, 2013).

In the LK SHA the more efficient use of energy makes an important contribution to security of energy supply, competitiveness of the stakeholders and to climate protection. Investments in comprehensive energy-saving measures are generally necessary. These investments are doing mainly at local or regional companies, such planning office or craft, which implements the measures to increase efficiency. The improved order situation of regional business leads in the LK SHA to an added value. Therefore, the climate protection measures provide beyond the actual task of climate change, a strengthening of the regional industry. An improved order situation of the companies' involves new jobs which will be created. In addition, the public sector generates due to rising sales of farms, more tax revenue and also profits from them.

The current energy supply in LK SHA is mainly based on conventional energy sources, which are obtained abroad. In consequence of the extraction and transport of payment, funds flow partly back abroad, in the opposite direction to the energy flow. Due to a reduced energy consumption in the long term cost can be saved. These funds can be invested elsewhere. One option would be to invest in the expansion of renewable energies. Over long term decreases the dependence on other countries in the context of energy supply and its own security of supply increases. In addition, the quality of life for all citizens by the aforementioned mitigation measures as well as the medium-to long-term supply hundred percent of the district will be improved from renewable energy. This also leads to an improved image of the LK SHA.

A sound assessment of the regional value added in LK SHA is only possible if the measures to increase energy efficiency in the context of IEKK can be substantiated. This was mainly important due to the scope of the measures, the associated costs and the actors involved. What part of the investment costs for measures regionally anchored, and is not used for the purchase of material, for example, for ‚material or for the appointment of companies outside of the district can be drawn up only in taking into account the conditions in LK SHA with the help of an analysis of all involved actors. The value chain is to be observed throughout the entire life cycle of an action or investment (see KSI, 2013, p.104 f.) This chain includes the process of

- planning / initiation of the action, for example by engineering or citizens
- production, for example, producers of insulating materials and systems
- implementation, for example, by craft and building Contractors
- the operation and maintenance, for example, by the end user or service provider

7. Monitoring

In the following, a concept for the monitoring of the actual development within the viewing frame in the LK SHA is briefly presented: Through the implementation of efficiency measures the energy consumption in the various consumer groups will change. Therefore, this must be determined and controlled in specified time intervals. The structure of the tables below should help to understand the future annual energy consumption on the one hand and to be able to assign the various consumer groups on the other hand. Moreover, it should thus be possible to its effect to review the measures to identify trends or new developments and, where appropriate, to deduce options for action derive from it. The following two tables presents, which provide for annual collection of energy consumption in the various consumer groups should exist (Table 31):

Jahr: 2030

energy consumption in GWh	energy carrier	Private households	industry	public sector
heat	fossil energy carrier			
	district heating			
	renewable energy			
	sum heat	0	0	0
electricity	other e-carrier			
	renewable energy			
	sum electricity	0	0	0
total sum		0	0	0

Verkehr
Jahr: 2030

vehicle	motorcycles	car	truck (bis 3,5 Tonnen)	truck, bus (bis 38 Tonnen)	SUM
annual mileage in Million km	0,0	0,0	0,0	0,0	0,0
average of cunsumption in liter per 100 km	0	0	0	0	
Liter fuel/year	-	-	-	-	
end energy consumption GWh/year	-	-	-	-	-
primary energy consumption GWh/year	-	-	-	-	-

Table 31: Monitoring particular consumer groups

In the consumer groups private households, businesses and public sector it is intended to differentiate into a heat-and electricity sector. Because the district wants to its own for a long-term aim by 100% renewable energy, the share of renewable energies on the energy consumption should be detected. The detection range to the sector of traffic/transport is closely based on the detection in this work and is based on the annual performance and fuel consumption for the various vehicles.

In general, this annual energy consumption should then be entered in a superior table to determine the mentioned trends and developments (Table 32):

	Primärenergieverbrauch nach Verbrauchergruppen und Nutzungsarten in GWh/a							
	private Haushalte		**Gewerbe**		**öffentliche Hand**		**Verkehr**	
Jahr	Wärme	Strom	Wärme	Strom	Wärme	Strom		**Gesamt**
2014								
2015								
2016								
2017								
2018								
2019								
...	...	...	...	...	...	...	...	**...**

Table 32: Monitoring in total

This annual accounting of consumption can be used to make statements about the development of the energy consumption in different sectors of the LK SHA. Similarly, as by the stat. LA-BW in this work, it can be concluded with the corresponding emission factors on the CO2 emissions of the consumer groups.

8. Summary and outlook

Summary: The actual analysis of the LK SHA in chapter four of this thesis has shown that the primary energy consumption of all consumer groups in the comparative year 2010 amounted to 7,217 GWh. The Commercial consumed with a share of around 42% most of the energy. The traffic at around 34% and households with around 23% continue to represent a large part of the primary energy consumption. The public sector has only a very small share of around 1%.

The co2-Emissions resulting from the consumption amount to approximately 1,000,000 tons in 2010. Most emissions cause in the district of traffic (52%), followed by the group of households, GHD and other consumers (29%) and industrial furnaces (19%).

In the LK SHA there are generally a variety of ways available to save energy with the help of energy efficiency measures in the different groups of consumers. In the consumer group of households savings are provided mainly by the energy efficiency of existing buildings. In addition to the building envelope the technical building equipment, particularly the renovation and operational optimization of heat generation, distribution, and handing provides power savings. In the electricity sector potential are especially available in cold-and heat applications. Further potential offer circulation pumps, appliances, consumer electronics and ICT. Especially the procurement of energy-efficient appliances and a corresponding use with the avoidance of unnecessary consumption bring energy savings in household. In the commercial potential appeared firstly by the operational optimization of existing plants, beyond, the replacement of old equipment and the procurement of energy-efficient new plants lead to a decrease in consumption. Especially the consistent introduction of EnMS in industrial employment company-specific savings can be uncovered and developed through rigorous application of the system. In this study, energy savings in the transport are mainly achieved through the introduction of efficient vehicles with conventional technologies (gasoline and diesel vehicles), making efficient use of vehicles and the redistribution of traffic. In the public sector there are, as in the households and the industries, particularly in the potential implementation of the following measures: Energy efficient refurbishment of buildings, optimization of existing facilities, and replacement of obsolete equipment. In addition, the public sector plays an exemplary role in the LK for the implementation of energy efficiency measures.

The **primary energy consumption in the LK SHA** can be lowered in chapter five of this thesis for comparison of 2010 and 2020 15% and 39% by 2030 under the assumptions made in the context of potential considerations. Due to the large share of primary energy consumption efficiency measures mainly have impact on the future primary energy consumption in the areas of trade, transport, and in the residential sector. The savings in energy have the effect that the CO2 emissions in the LK SHA will fall by 2020 by 25% and by 2030 to 44% compared to 1995. Thus, under the given assumptions the LK SHA can achieve the climate protection target of Baden-Württemberg Climate Change Act, which wants districts to save 25% of the CO2 emissions compared to the reference year.

The potentials listed in chapter five must be used even more in the future as part of a comprehensive view of the economic and technical possibilities. The federal government relies, as listed in chapter six, in addition to a balance of challenge and support, especially on reasons and ownerships of businesses and citizens. Incentives should thereby be created mainly through increased funding, improved information and advices.

For this reason, the energieZENTRUM is involved as a regional energy agency and internal service of the district on numerous projects that pursue these goals. Special mention should be doing by the coaching project “Local Climate Protection”; smaller towns are supported on the way to structured climate protection. The public sector is supported in terms of energy efficiency. Also the participating in the project to strengthen the country's electric mobility in rural areas aimed at increasing efficiency in the transport sector. The sector of the industry is supported with the competence centers for energy efficiency in companies. Here, the energieZENTRUM is active in cooperation with the energy agencies of the district of Main-Tauber, the district of Hohenlohe and the IHK Heilbronn-Franken.

Households are informed and advised for years by the free initiative of the eZ and the Consumer counseling. In addition to expert advice in terms of renovating and the efficient new way also public funding is presented. The aim is to enable businesses and citizens in a position to open up previously untapped efficiency potentials of self-paced incentive.

The measures to increase efficiency lead alongside cost savings to a regional value added in LK SHA while a decreasing dependence on energy exporting countries. Due to an improved order situation of the companies’ new jobs will be created. In addition, the quality of life for all citizens by the aforementioned mitigation measures as well as the medium-to long-term supply of the district will be improved by hundred percent from renewable energy. This leads also to an improved image of LK SHA.

Outlook: The viewing scope of this work is compiled till 2030. A Long-term goal, as part of the district policy of LK SHA is to provide them by 100% renewable energy.

In 2010, the installed technologies of renewable energies in the LK SHA covered about 32% of the total electricity demand and 12% of the total heat demand. This corresponds to a share of renewable energy in total energy consumption by around 14%. The potential of the various energy sources are exhausted very different. The use of energy from wood and biogas in 2010 was already very widespread, on the other hand, for example, the wind power and heat pumps still have a great potential for expansion. If all the existing potentials of renewable energy in the LK SHA are exhausted, the demand for electricity can be met from renewable sources by 181% and 123% of the heat demand. Thus, the energy demand in the LK SHA is covered not only by 100% renewable energy, but the district in addition, can also be completely independent in supply (see EZ, 2012, p.5 f).

To achieve this, the increase in energy efficiency is essential and is a key issue for a future environmentally friendly and reliable supply of energy. Through efficiency measures less energy is required in the future to meet the needs of the various consumer groups and applications. The energy that is still needed in the LK SHA should be originated as soon as possible by 100% from renewable sources.