Final report

Energy consumption expert group

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By

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Contents

1. Introduction

Current report summarizes the work of energy consumption expert group within the framework of renewing the Estonian long term Energy Development Strategy and gives recommendations on where enhancement of the modeling is required to achieve better results.

1.1. Expert group tasks

The expert group was given the following tasks:

- To perform preliminary analysis on Estonian long term energy consumption projections in the following 4 sectors: households, industry, services and transportation.
- To state and reference all relevant assumptions made for the projections
- To document all results in the Energiatalgud wiki platform and to summarize the findings in a final report

In order to complete the work the following side-tasks were also assumed as part of the work:

- Description of the past trends of sector-specific energy consumption
- Definition of two sets of assumptions leading to two different consumption scenario: EE-energy efficiency scenario and BAAS-base case business as usual scenario

1.2. Expert group members

The consumption expert group came together in three meetings (14/11/2012; 6/12/2012; 7/01/2013). The following experts took part in one or more of these meetings:

- Ahto Oja – Estonian Biogas Association
- Alvar Soesoo – Tallinn Technical University (TTU)
- Siim Meeliste – Ministry of Economic Affairs and Communication
- Kristiina Rebane – Tartu University masters student
- Andre Lindvest - 4E Tehnoinvest OÜ
- Uku Sukles- Estonian Geothermal Association
- Mihkel Härm - WEC Estonia
- Madis Org – Estonian Development Fund
- Arvi Hamburg - TTU
- Argo Rosin - TTU
- Moonika Kukke - Glimstedt
- Mari Jüssi - SEI
- Alan Rood - Harju County
- Pille Arjakas - Ministry of Economic Affairs and Communication
- Madis Laaniste - Ministry of Economic Affairs and Communication
- Jarek Kurnitski - TTU
- Priit Värk - Estonian Owners Association
- Indrek Raide - Estonian Owners Association

- Marek Muiste - Tartu Regional Energy Agency
- Urmas Raudsaar - Ministry of Economic Affairs and Communication
- Imre Drovtar - Elering
- Jaanus Uiga - Tartu Regional Energy Agency
- Tiit Kallaste - SEI
- Teet Eelmere - Estonian Gas

2. Household sector

The projections in this sector follow two different approaches: top-down approach in the case of electricity demand and bottom-up approach in the case of heat demand projection.

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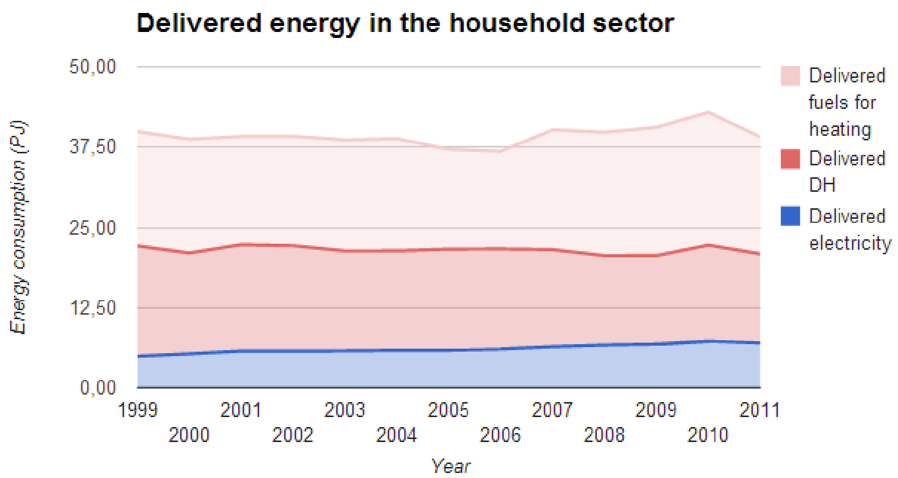
2.1. Development of the sector from 2000-2010



Source: Statistikaamet (2012)

More detailed graphs of electricity, district heating and fuel consumption demands can be seen on [Google Spreadsheets->Households->Current energy consumption](#).

2.2. Modeling of electricity demand

Currently no bottom-up analysis for the electricity projection in the household sector exists. As an alternative, an estimate based on an expert group decision was made on the growth rate of electricity consumption in the period 2012-2050.

Table 1: Annual electricity consumption growth rates for non-heating purposes

	2010-2020	2020-2030	2030-2040	2040-2050	Source
BAAS	1,75%	1,75%	1,75%	1,75%	Workgroup “best guess”

EE	1,5%	0,5%	-0,5%	-1,5%	Workgroup “best guess”

As the figures for electricity consumption also include the electricity requirement for direct heating and heating via heat pumps, this portion of electricity demand is expected to behave differently from the rest of the electricity demand. Based on the estimates from Elektrilevi, roughly 20% of total electricity consumption can be accounted for heating purposes. From this 20%, according to the Estonian Association for Heat Pumps, about 33% is used for heat pumps (rest for direct heating). This percentage is expected to rise to almost 100% by 2050 (as a preliminary guess this number has been set to 90%). Current model hence combines the percentage increase of electricity demand according to Table 1 for the electricity demand for non-heating purposes, and estimates of heat pump capacities and loss of importance of direct heating in the case of electricity demand for heating purposes.

2.3.Modeling of heat demand

As specific targets (EU directive on energy efficiency) exist for heat demand in the household sector, it makes sense to perform a bottom up analysis in this case. According to the data from the Ministry of Communication and Economic Affairs the requirements on heat demand for households (apartment buildings and private households) can be deduced. As these numbers are considered to be relatively ambitious, no significant reduction of heat demand also in the EE case can be foreseen.

Table 2: Projection of the heat demand for new buildings as delivered energy (kWh/m2a)[1]

	2010-2020	2020-2030	2030-2040	2040-2050	Source
BAAS: Heat demand of new apartment buildings	55	30	30	30	MKM
EE: Heat demand of new apartment buildings	55	30	30	20	MKM, Workgroup
BAAS: Heat demand of new detached houses	80	40	40	40	MKM
EE: Heat demand of new detached houses	80	40	30	20	MKM, Workgroup

The figures presented in Table 2 express **delivered energy demand including electricity as a heat source for direct heating and heat pumps**.

In order to arrive at an estimate for the current housing stock the delivered energy for heating from direct heating, fuels and electricity all have to be added. This exercise can be seen in the Google Spreadsheet->Households->HEAT. The calculation yields an estimated energy demand (in delivered energy) for the current housing stock of **272 kWh/m2a** (for the year 2010 based on the average of 2009-2011).

In addition to the new buildings, a large percentage of the buildings will also be renovated. As there are no directives guiding the heat demand of the renovated buildings, simply an estimate by the expert group is used for the calculations.

[1] Heated area (a general assumption is made that ´Heated area´=´net area´*0.9)

Table 3: Projection of the heat demand for renovated buildings as delivered energy (kWh/m2a)

	2010-2020	2020-2030	2030-2040	2040-2050	Source
BAAS: Heat demand of new apartment buildings	120	90	85	80	Workgroup
EE: Heat demand of new apartment buildings	120	80	70	60	Workgroup
BAAS: Heat demand of new detached houses	125	100	95	90	Workgroup
EE: Heat demand of new detached houses	125	95	80	70	Workgroup

Finally, to arrive at the projection of heat demand for the household sector the relevant assumptions in regard to construction and renovation rates have to be made. The following assumptions with corresponding sources are used.

Table 4: Estimated construction, renovation and demolishing rates for the Estonian housing stock

	2010-2020	2020-2030	2030-2040	2040-2050	Source
Annual construction rate of new buildings (base year 2010)	1,0%	1,0%	1,0%	1,0%	Workgroup
Annual rate of buildings falling out of use (base year 2010)	0,3%	0,3%	0,3%	0,3%	Finnish study
BAAS: Annual renovation rate (base year 2010)	1,0%	1,0%	1,0%	1,0%	Workgroup
EE: Annual renovation rate (base year 2010)	1,5%	1,5%	1,5%	1,5%	Estimate based on Kredex experience so far with renovation projects

Based on these estimates and the UN prediction on the population decrease in Estonia the following area requirement can be deduced.

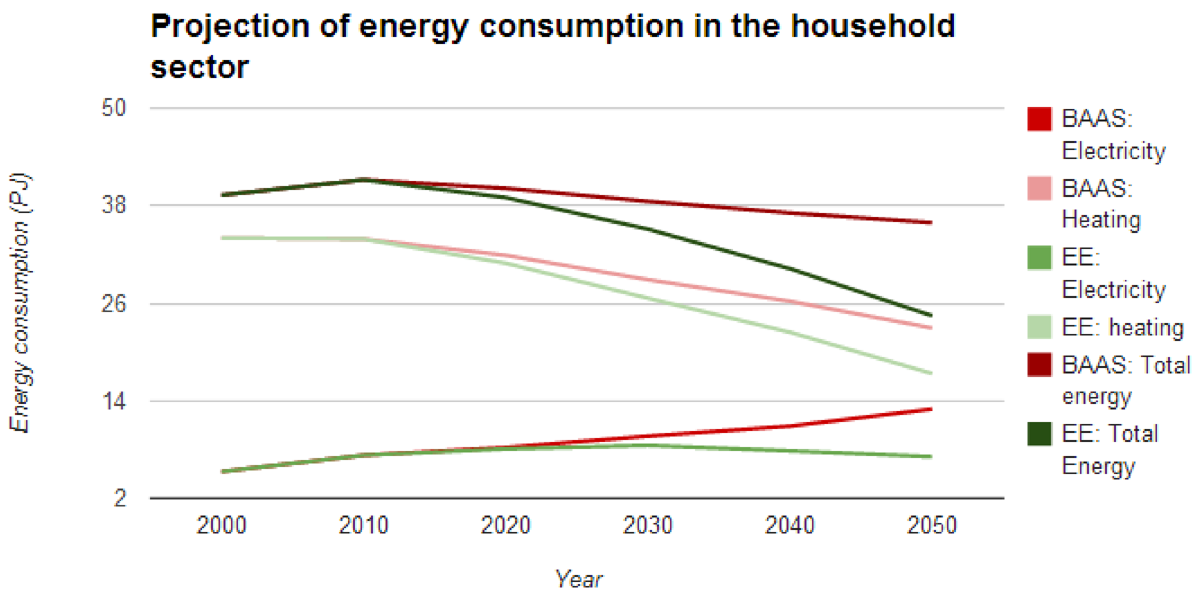
Table 5: Heated area per person

	2000	2010	2020	2030	2040	2050	Source
Heated area per persoon (m2)	24	27	29	32	35	37	Calculation on Google Spreadsheet->households->Summary
Net living area per persoon (m2)	27	30	32	35	39	42	Calculation on Google Spreadsheet->households-

It is important to note that as the numbers in Table 2 and Table 3 include the electricity as a source for final heat demand, yet this quantity is counted for also in the electricity demand for households, attention must be paid to avoid double-counting. For this reason the heating related electricity is included in the calculation of heat demand calculations for the housing stock, however it is then again removed from the heating graphs (heating demand consists only of district heating and local fuels).

2.4.Preliminary results

The assumptions above yield the following demand curves for the household sector



The graph can be seen here and calculations here.

As to the portion of heating energy origination from district heating and local fuels, the input will come from the district heating expert group. Based on the calculations above, the electricity requirement of heat pumps as well as direct heating can be deduced and this is depicted on a graph in Google Spreadsheets->Households->Electricity.

2.5.Recommendation for further analysis

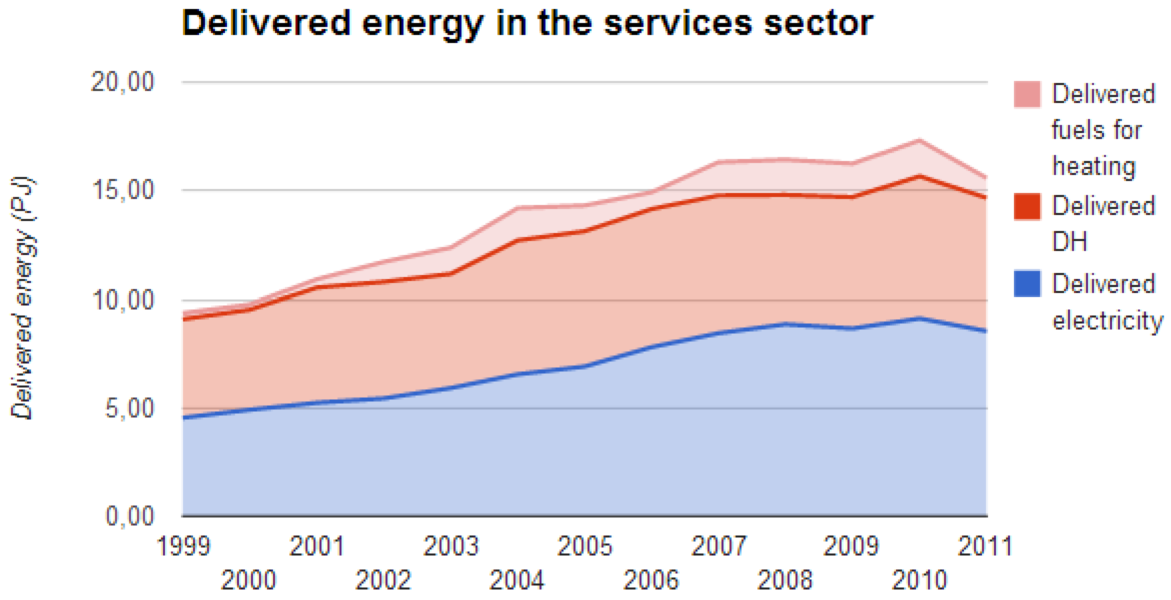
The weakest link in the projection model presented above is certainly the projection of non-heating related electricity demand projection. Given an appropriate bottom-up model, which takes into account the most important variables (certain saturation levels of electronic devices in households, etc.), a better estimate could be deduced.

Also in the case of heat demand projection, all assumptions should be critically assessed and compared with similar figures of other countries for validation. Specifically the following variable is based on "best guess" and has a relatively big impact on the results:

- Renovation levels (kWh/m2a) for apartment buildings as well as for detached houses

3. Service sector

3.1. Development of the sector from 2000-2010



Source: Statistikaamet (2012)

More detailed graphs of electricity, district heating and fuel consumption demands can be seen on [Google Spreadsheets->Service sector->Current energy consumption].

3.2. Modeling of electricity demand

In the service sector the correlation between the GDP growth and sectorial electricity consumption growth is relatively high (R2=0.65). Hence, a modeling based on the projection of the elasticities could be justified. In the expert group the historic trend was analyzed and forecasted into the future.

Table 6: Electricity demand growth projections for the services sector

	2000-2010	2010-2020	2020-2030	2030-2040	2040-2050	Source
Correlation between GDP growth and electricity demand growth: BAAS	0,44	0,37	0,3	0,23	0,16	Workgroup
Correlation between GDP growth and	0,44	0,24	0,04	-0,16	-0,36	Workgroup

electricity demand growth: EE						
Assumed GDP growth		3,48%	2,51%	1,89%	1,15%	Ministry of Finance
Corresponding electricity demand growth: BAAS		1,29%	0,75%	0,43%	0,18%	Calculations on Google Spreadsheet
Corresponding electricity demand growth: EE		0,83%	0,10%	-0,30%	-0,41%	Calculations on Google Spreadsheet

In regard to the electricity used for heating purposes, exactly the same is assumed to hold for the services sector as it is for the household sector. The projection of the installation of heat pumps in the sector was derived from the total projection on the installation of heat pumps multiplied by the share of electricity demand of the sector from the overall electricity demand (for the year 2010).

3.3. Modeling of heat demand

Principally similar analysis is performed for the heat demand in the service sector as it is for the household sector. The difference here is the source of data for describing the building stock of today. The values for the gross area of the service sector buildings in the national statistics database do not distinguish between heated and non-heated areas (using these numbers, one would arrive at a heat demand of roughly 40-50kWh/m2a). As the heat demand numbers derived by the Ministry of Communication and Economic Affairs use a reference area of heated area, these numbers could not be used. Instead, the total area of the sector was derived from the Estonian Building Registry by observing the net area of the service sector buildings that are heated. The net area is then multiplied again by a factor of 0.9 describing the relationship between heated area and net area.

The assumptions above lead to a relatively high delivered energy demand for heating (including electricity as a heating source) of above 400kWh/m2a. This is also very likely to be too high, however as a better estimate could not be made at the moment this number was used to analyze the heat demand projections for the service sector.

Rest of the assumptions, which follow a similar pattern to the household sector, are listed below.

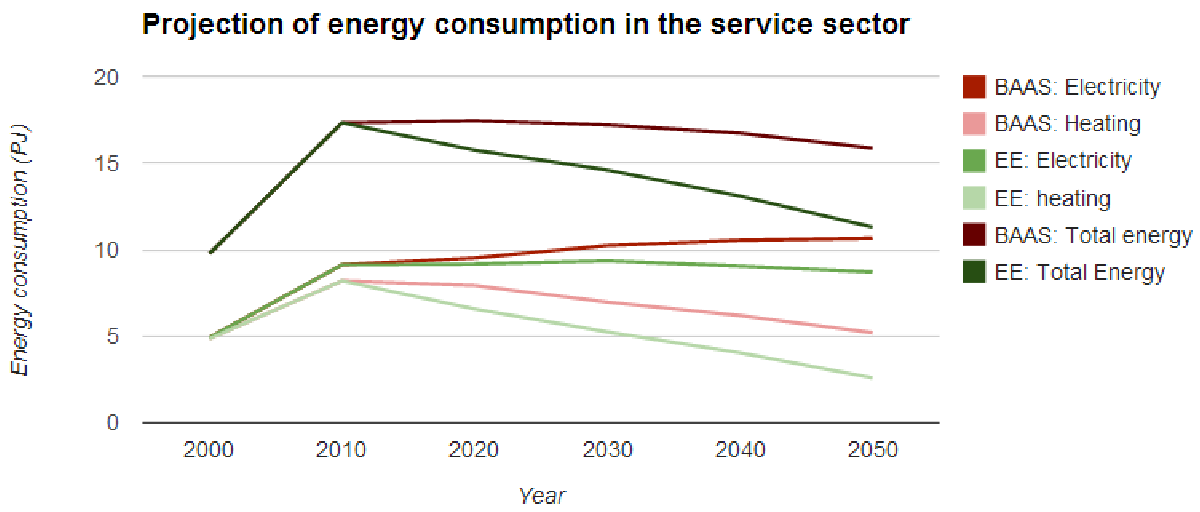
	2010-2020	2020-2030	2030-2040	2040-2050	Source
BAAS: Heat demand of new service sector buildings	45	20	20	20	MKM
EE: Heat demand of new service sector buildings	45	20	17	15	MKM, Workgroup

	2010-2020	2020-2030	2030-2040	2040-2050	Source
BAAS: Heat demand of renovated service sector buildings	90	80	70	60	Workgroup
EE: Heat demand of renovated service sector	80	70	60	50	Workgroup

buildings					

	2010-2020	2020-2030	2030-2040	2040-2050	Source
Annual construction rate of new buildings (base year 2010)	1,5%	1,3%	1,1%	1,0%	Workgroup
Annual rate of buildings falling out of use (base year 2010)	0,3%	0,3%	0,3%	0,3%	Finnish study
BAAS: Annual renovation rate (base year 2010)	1,0%	1,0%	1,0%	1,0%	Workgroup
EE: Annual renovation rate (base year 2010)	1,5%	1,5%	1,5%	1,5%	Workgroup

3.4.Preliminary results



The assumptions above yield the following demand curves for the service sector.

As to the portion of heating energy origination from district heating and local fuels, the input will come from the district heating expert group. Based on the calculations above, the electricity requirement of heat pumps as well as direct heating can be deduced and this is depicted on a graph in Google Spreadsheets->Service sector->Electricity.

3.5.Recommendation for further analysis

In this sector many assumptions were made that should be critically reviewed or replaced by opting for a more accurate methodology for the projections. The following is a list of the most critical aspects:

- Heat demand projections for the renovated buildings
- Elasticities for the electricity demand projection (at the minimum these numbers should be compared with other countries)
- Heat demand of the building stock of today – 400 kWh/m2a is certainly an overestimate. A recent PhD study by A. Hani reports (based on a sample) that schools in Estonia have about

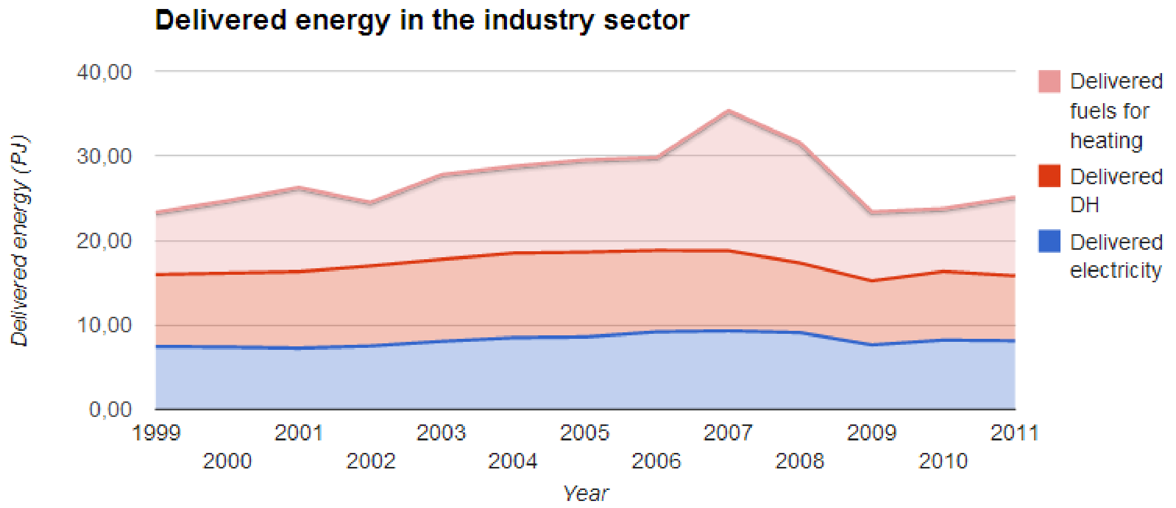
125kWh/m2a, office buildings, court houses and police departments 223-331kWh/m2a. Another assessment of a set of 10 office buildings by an Estonian energy service company suggests an average heat demand of 150kWh/m2a.

One alternative projection method for the electricity demand in this sector would be to divide the sector into sub-sectors and assess the change of energy intensities of each of the subsectors as well as the sub-sector GDP development in the future.

4. Industry sector

In this sector due to the lack of one obvious data source for bottom up method for the heat demand, both heat and electricity demand are projected based on a top-down method relying on GDP elasticities.

4.1. Development of the sector from 2000-2010



4.2. Modeling of electricity demand

Electricity is projected here similarly to the service sector – by first observing the dependence of electricity demand change to GDP change over 2000-2010. This correlation yields a relatively high dependence described by an R2=0,63. The elasticity for 2000-2010 as well as the projected elasticities by the expert group are listed in the table below.

Table 7: Electricity demand growth projections for the industry sector

	2000-2010	2010-2020	2020-2030	2030-2040	2040-2050	Source
Correlation between GDP growth and electricity demand growth: BAAS	0,74	0,74	0,74	0,74	0,74	Workgroup
Correlation between GDP growth and electricity demand growth: EE	0,74	0,52	0,3	0,08	-0,14	Workgroup
Assumed GDP growth		3,48%	2,51%	1,89%	1,15%	Ministry of

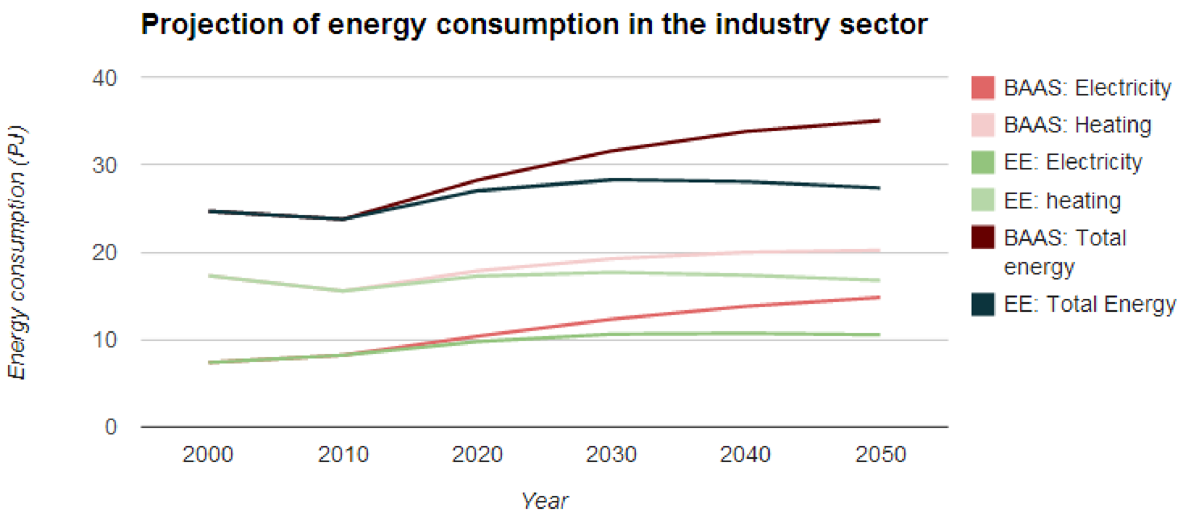
(over all sectors)						Finance
Corresponding electricity demand growth: BAAS		2,57%	1,86%	1,40%	0,85%	Calculations on Google Spreadsheet
Corresponding electricity demand growth: EE		1,81%	0,75%	0,15%	-0,16%	Calculations on Google Spreadsheet

4.3.Modeling of heat demand

Here, also the heat demand is projected based on the GDP elasticities. As the R2 for the linear regression in the period 2000-2010for heat demand in the industry sector is only 0,23, this method could certainly be improved upon.

	2000-2010	2010-2020	2020-2030	2030-2040	2040-2050	Source
Correlation between GDP growth and electricity demand growth: BAAS	0,49	0,4	0,3	0,2	0,1	Workgroup
Correlation between GDP growth and electricity demand growth: EE	0,49	0,3	0,1	-0,1	-0,3	Workgroup
Assumed GDP growth (over all sectors)		3,48%	2,51%	1,89%	1,15%	Ministry of Finance
Corresponding electricity demand growth: BAAS		1,39%	0,75%	0,38%	0,11%	Calculations on Google Spreadsheet
Corresponding electricity demand growth: EE		1,04%	0,25%	-0,19%	-0,34%	Calculations on Google Spreadsheet

4.4.Preliminary results



4.5.Recommendation for further analysis

The following could be undertaken to improve the methodology of projecting the energy consumption in the industry sector

- Here an analysis based on energy intensities of the subsectors would make sense for both electricity and heat demand. This could be undertaken given the existence of good quality data for the subsectors. One alternative to the national database here could be an environmental database on the emissions of mid- to large size industrial enterprises. To proceed, an inquiry should be made in the relevant institution.
- One of the aspects brought out by the expert group was the need to give an estimate on the volatility of energy demand in the industry sector as a large part of the demand is caused by a handful of companies. This estimate could be a very valuable piece of information for the assessment of the future scenarios in terms of their sensitivity to sudden changes in demand.
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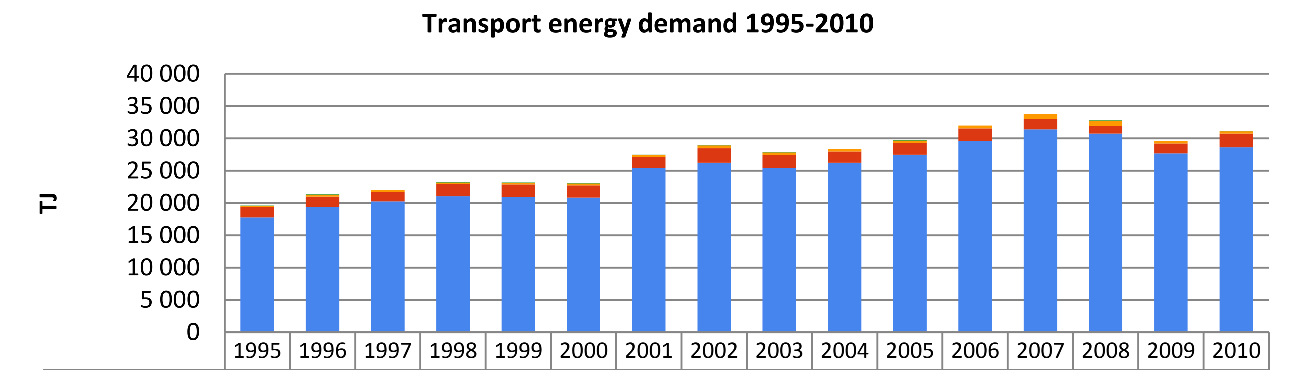
5. Transport sector

5.1.Development of the sector from 2000-2010

Energy consumption in transport sector

A quarter of Estonia's final energy demand comes from the transport sector (of which 94% are cars and trucks). Energy consumption in transport has grown close to 35% during the last 10 years. Fastest growth in fuel consumption was from 2004-2007. The potential for energy savings in transport is not widely recognised or debated. Measures for better planning and the influencing of consumers' choices towards more fuel-efficient cars and sustainable modes of transport are generally absent.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Lennuk/Air	44	44	44	44	44	44	44	43	44	44	44	0	0	44	43	43
Laev/Sea	170	298	256	256	213	298	298	469	383	341	341	469	724	852	341	341
Raudtee/Rail	1 634	1 671	1 505	1 889	2 021	1 889	1 765	2 234	1 982	1 712	1 840	1 925	1 623	1 154	1 534	2 148
Maantee/Road	17 77	19 34	20 23	21 02	20 87	20 83	25 38	26 24	25 45	26 25	27 49	29 61	31 42	30 73	27 67	28 62

Source: Eurostat

Tabel Transport energy consumption by fuel 2010

	2010, TJ
Gasoline	12 099 852
Diesel	19 008 072
Electricity	138
CNG	1
LPG	6
Kerosene	44

Source: http://ec.europa.eu/transport/facts-fundings/statistics/doc/2012/pb_2012_3_env-ener.xlsx

The share of biofuels in transport in 2010 was marginal (ca 0,17%) and there is no data yet weather this fuel corresponds to sustainability criteria of biofuels.

Tabel Energy demand by International Marine Bunkers, TJ (not included national energy or GHG balance)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
International Marine Bunkers	4 197	4 927	4 674	6 250	4 997	8 797	10 201	10 372	9 239	9 095

Transport Green House Gas emissions in Estonia 2000-2010, million tons

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total	1,684	2,003	2,112	2,024	2,069	2,149	2,350	2,474	2,316	2,154	2,260
Road	1,522	1,852	1,914	1,855	1,916	2,009	2,178	2,306	2,172	2,021	2,078
Rail	0,136	0,126	0,162	0,141	0,124	0,113	0,136	0,112	0,083	0,108	0,156
Boat	0,023	0,022	0,033	0,026	0,026	0,026	0,034	0,054	0,060	0,024	0,023
Air	0,003	0,002	0,003	0,002	0,002	0,002	0,001	0,001	0,002	0,002	0,002
Car	*0,93*	*1,18*	*1,19*	*1,21*	*1,23*	*1,32*	*1,48*	*1,59*	*1,55*		
HGV	*0,40*	*0,48*	*0,54*	*0,45*	*0,50*	*0,50*	*0,50*	*0,51*	*0,48*		
Bus	*0,15*	*0,15*	*0,15*	*0,16*	*0,16*	*0,15*	*0,15*	*0,16*	*0,15*		

Source: EEA, *Figures per road transport mode SEI-Tallinn, Jüssi et al 2010
http://dataservice.eea.europa.eu/pivotapp/pivot.aspx?pivotid=475

Fleet Average CO2 ekv per vehicle-km (notice that the figures are for VEHICLE-km, not passenger-km nor ton-km)

		1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Car	**sõiduauto**	212,9	210,0	208,4	206,6	205,0	205,3	203,7	203,8	203,9	204,0	202,5
HGV	**veoauto**	560,8	594,2	574,2	571,1	610,7	619,2	640,3	675,9	671,0	664,5	627,0
Bus	**buss**	909,7	906,4	884,5	883,5	879,0	879,8	877,2	882,1	879,1	871,9	865,1

Source: SEI-Tallinn, Jüssi et al 2010

Average carbon dioxide emissions per km from new passenger cars g/km

	2004	2005	2006	2007	2008	2009	2010	2011
EU average	163,4	162,4	161,3	158,7	153,5	145,7	140,3	135,7
Estonia	179	183,7	182,7	181,6	177,4	170,3	162	156,9

Source: Eurostat

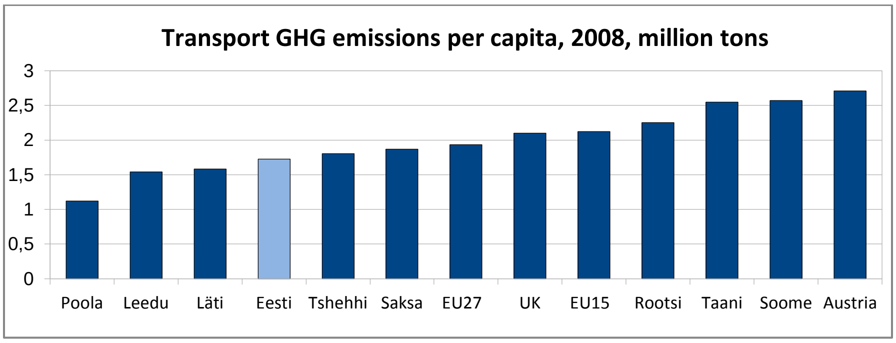


Figure Transport GHG emissions per capita in selected countries 2008, million tons
Source Eurostat

Transport demand and mobility patterns

Table Freight volume (million tonn-km)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rail	3,85	4,20	5,10	6,08	7,30	8,10	8,56	9,70	9,67	10,49	10,64	10,42	8,43	5,94	5,95	6,64	6,27
Road	1,55	1,90	2,77	3,79	3,98	3,93	4,68	4,39	3,97	5,10	5,82	5,55	6,42	7,35	5,34	5,61	5,91
Total	5,39	6,10	7,88	9,87	11,27	12,03	13,23	14,08	13,64	15,59	16,46	15,97	14,85	13,30	11,29	12,25	12,18

Source: Eurostat

Table Passenger transport volume (billion passenger-km)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Car	5,1	5,5	5,8	6,2	6,4	6,7	6,8	7,1	7,7	7,8	9,9	9,9	10,0	10,5	10,5	10,1
Bus/Trolley	2,0	2,1	2,2	2,3	2,2	2,6	2,5	2,3	2,3	2,5	2,7	2,9	2,7	2,5	2,1	2,1
Tram	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Rail	0,4	0,3	0,3	0,2	0,2	0,3	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,3	0,25	0,25
Total	7,7	8,0	8,4	8,8	8,9	9,7	9,5	9,7	10,2	10,6	13,0	13,2	13,0	13,3	12,9	12,5

Source: Eurostat http://ec.europa.eu/transport/facts-fundings/statistics/doc/2012/pocketbook2012.pdf

Car use in Estonia has increased in line with economic growth. Road freight has even increased more than GDP, while rail freight has decreased considerably. Transport energy demands and GHG emissions from transport have increased at a similar pace. The Estonian economy is transport-intensive. The poor fuel economy of new cars and rapid growth of public transport prices compared to car price indexes are indicative of inefficient energy use and a non-sustainable transport policy.

Although the rate of motorisation has increased rapidly, transport energy demand per capita in Estonia is still relatively modest compared to the EU average. Also, GHG emission levels per capita are lower than the EU average. Mobility patterns are still more diverse than the European average: public transport use in daily commuting is higher than the EU average (the share of walking and public transport in Estonian cities is around two-thirds of total trips.

However, several indicators indicate unsustainable trends in relation to the EU average: for example, the Estonian economy is more transport- and energy-intensive. For example, Estonia uses twice as much transport fuel per unit of GDP than average EU Member States.

5.2.Modelling of transport energy demand 2010-2050

As a quick way of getting preliminary result a top-down transport energy demand forecast was made with current GDP/transport energy demand elasticity and the following assumptions for changes in elasticity for BAAS and EE scenarios

Table Assumptions for GDP and transport energy demand elasticity for a top-down energy demand forecast. Annual change

	2000-2010	*2010-2020*	*2020-2030*	*2030-2040*	*2040-2050*
GDP/transport energy demand **BAAS**	0,68	0,65	0,5	0,4	0,3
GDP/transport energy demand **EE**		0,45	0,25	0,1	-0,1
GDP forecast		3,48%	2,51%	1,89%	1,15%
Transport energy demand change, **BAAS**		2,26%	1,26%	0,75%	0,34%
Transport energy demand change, **EE**		1,56%	0,63%	0,19%	-0,11%

Source: GDP forecast – MoFin; other figures based on authors calculations

In order to get an overview of possible energy sources that have to cover the future energy demand – shares of different transport energy carriers were defined. The share of different renewables/biofuels is not indicated separately – possible fuels have to come out from production scenarios. The shares of aircraft kerosene and LPG where not included due to marginal shares.

BAAS – current trends continue with slowly increasing shares of gaseous fuels (CNG, including biomethane) and a modest increase in the share of renewables as the development of new generation biofuels is relatively low. Electrification of railways due to Rail Baltic development by 2050. Otherwise slow electrification as the price of EVs and PEVs remains high.

EE – Electrification and share of renewable in line with EU Transport White Paper and EU Roadmap for Low-Carbon Economy projections. Take up of electrification slowest in trucks.

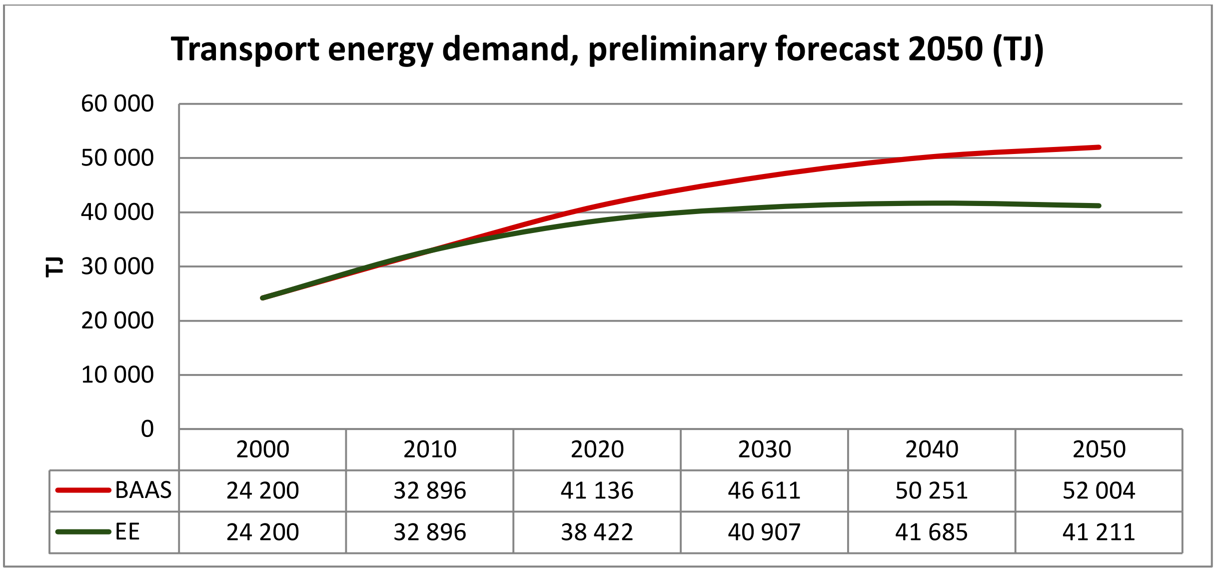
Table Assumptions for shares of transport energy sources/carriers

BAAS	**2010**	**2020**	**2030**	**2040**	**2050**
Gasoline	39%	38%	37%	35%	33%
Diesel	61%	60%	59%	57%	55%
Electricity	0,50%	0,75%	1%	1,50%	2%
CNG/gaseouos	0,00%	0,10%	3%	6%	10%
LPG	*0,02%*				
Kerosene	*0,13%*				
Incl renewables		*10,00%*	*11,00%*	*12,00%*	*13,00%*

EE	**2010**	**2020**	**2030**	**2040**	**2050**
Gasoline	38,90%	36,50%	25%	15%	10%

Diesel	61,00%	58,00%	55%	45%	30%
Electricity	0,50%	1,50%	10%	25%	40%
CNG	0,00%	5,00%	10%	15%	20%
Incl renewables		*10,00%*	*15,00%*	*20,00%*	*25,00%*

5.3.Preliminary results



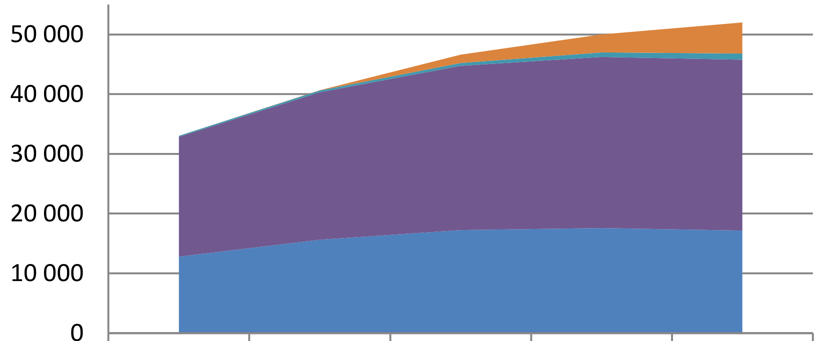
	2000	2010	2020	2030	2040	2050
BAAS	24 200	32 896	41 136	46 611	50 251	52 004
EE	24 200	32 896	38 422	40 907	41 685	41 211

Table Transport energy consumption scenarios by type of fuel (TJ)

BAAS	**2010**	**2020**	**2030**	**2040**	**2050**
Gasoline	12 797	15 632	17 246	17 588	17 161
Diesel	20 067	24 681	27 500	28 643	28 602
Electricity	164	309	466	754	1 040
CNG	1	41	1 398	3 015	5 200
Incl renewables		*4 114*	*5 127*	*6 030*	*6 761*

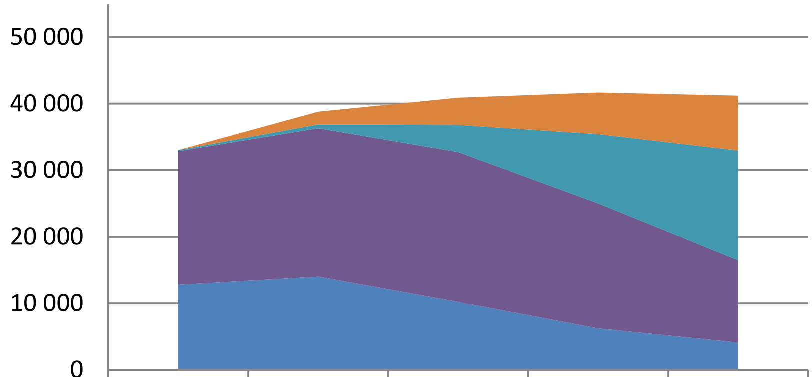
EE	**2010**	**2020**	**2030**	**2040**	**2050**
Gasoline	12 797	14 024	10 227	6 253	4 121
Diesel	20 067	22 285	22 499	18 758	12 363
Electricity	164	576	4 091	10 421	16 484
CNG	1	1 921	4 091	6 253	8 242
Incl renewables		*3 842*	*6 136*	*8 337*	*10 303*

Transport energy consumption by type of fuel: BAAS



	2010	2020	2030	2040	2050
Sh taastuv/biokütus		4 114	5 127	6 030	6 761
CNG	1	41	1 398	3 015	5 200
Elekter	164	309	466	754	1 040
Diislikütus	20 067	24 681	27 500	28 643	28 602
Bensiin	12 797	15 632	17 246	17 588	17 161

Transport energy consumption by type of fuel: EE



	2010	2020	2030	2040	2050
Sh taastuv/biokütus		3 842	6 136	8 337	10 303
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5.4. Recommendation for further analysis

Transport energy demand scenarios need bottom-up and EE scenario approach also checking with back-casting technique to ensure that the EE scenario corresponds to goals stated in EU White Paper and EU Roadmap for Low-Carbon Economy.

Current Transport Policies

Sustainable transport report 2010 (Jüssi et al 2010) showed that prices related to car use have increased more slowly than public transport ticket prices. Average prices for purchasing cars decreased by 30% from 2004-2009. The fuel excise duty has not proven to be a sufficient measure to achieve a modal shift and reduce the environmental impact of transport. Although the duty has been raised nine times in the last 15 years in Estonia, it has not guided consumers towards more efficient cars or tackled increasing energy demand in transport (gasoline excise tax almost doubled from 2000-2010, but in real terms fuel prices have remained at the 2000 level).

New cars registered in Estonia consume app. 20% more fuel than the average for new cars in the EU. More than half (51%) of these new cars fall in the E-G energy classes, showing no improvement in fuel efficiency compared to the cars sold in Estonia 15 years ago. The EU's 2010 report on the monitoring of CO_2 from new cars showed that 65% of new cars in the EU already fall in the A-C energy classes i.e. they are relatively fuel-efficient.

Transport related taxation

- Fuel excise duty (annual income ca 240 MEUR). 75% of fuel duty is earmarked for the maintenance and building of national road network. Biofuels are not exempt from fuel duty since July 2011 and currently there is no blending obligation for biofuels.
- Currently there is no registration (was abolished in 2003) nor annual ownership tax (existed as a local tax in Tallinn 1996-2003) for cars in Estonia. The government has stated that there will be no additional taxation on cars.
- HGV tax (annual income 3,5-4 MEUR)

Public transport policies

- Renewal of all passenger train fleet in Estonia in 2013-2014. Reconstruction of railway network enables to increase top speeds up to 140 km/h . The number of train departures is planned to double from a relatively low service level (currently only one daily departure between Narva and Tallinn, two daily express trains between Tallinn-Tartu.
- Reconstruction and minor extension of tram network in Tallinn.
- More focus on integrated mobility, better connections between railway stations, common ticketing system

Some benchmarks for bottom-up and back-casting scenario modelling

	BAAS/BAU	**EE**	**Source for assumptions/targets**
GHG trend, Decarbonization target	Current trends will continue with less GHG intensive development after 2020 as fuel prices rise and car manufactures offer more fuel efficient car models	Max 11% growth cap on transport GHG emissions compared to 2005. Ca 65% lower total CO_2 emissions from transport 2005. Preliminary forecast should be checked with these targets	2020 target from EU and national policies. Decision 406/2009/EC 2050 target from EULowCO2RM
Share of renewables in transport fuel	2020 – 10%, 2050 – 13%	2020 – 10% 2050 – 25%	
Electrification level	Ca 2% by 2050	40% by 2050	EU Transport White paper
Use of unconventional oil (diesel from oil shale)	All diesel replaced with oil shale diesel? Would increase diesel GHG	Not used due to energy efficiency and CO_2 concern	New Fuel Quality Directive, draft

	footprint 30-50%.		proposal, (6% CO_2 WTW reduction for fossil fuels.
Energy efficiency of passenger cars	New cars ca 20% less fuel efficient compared to EU average 2015 - 150 g CO_2/km 2020 - 114 g CO_2/km Vans: 2017 - 210 g CO_2/km 2020- 176 g 2050 – average energy consumption of cars: 28,9 toe/Million-passenger-km	Similar trend like BAU for 2020 – then quicker take-up of more fuel efficient cars. Conventionally fuelled cars in urban areas: -50% 2030 -100% 2050 2050 – average energy consumption of cars: 16,3-19,2 toe/Million-passenger-km depending on the shift potential to other modes	Expert estimate based on current trends, EU Transport White Paper and Low Carbon Economy Roadmap targets. Regulation EC/443/2009
Car Mileage, Peak Car use	Also BAU trends should be analysed critically and at certain GDP or motorization level – car use will level up or at least not grow as intensely as 2000-2010	Peak Car ca 2025 – Travel demand will shift to public transport, especially rail, locally also cycling (at least 20% of daily trips in cities by 2030.)	

BAU-scenario assumptions:

The BASE-scenario draws on assumptions that road transport in Estonia will continue to increase in a similar way as in the last 10 years, being directly linked to the rate of economic growth. A number of current road construction plans are based on such outlooks and encourage such trends in the country. No major changes in fiscal measures is assumed.

Transport activity and GDP elasticity until 2020 can be drawn from the previous trends at least for road freight and car mileage. Rail freight has been highly sensitive to Russian oil freight that is increasingly serviced by Russian ports and less freight volume is anticipated for Estonian ports. At least 2010 level is assumed for 2020, after that modest growth due to improved rail infrastructure, EU policies, shift from road to rail.

Bus is expected to stabilize on 2010 level as public transport growth will be absorbed by new train services – at least 30% growth in rail passenger-km by 2020.

Further assumptions should be drawn along STREAM modelling work together with Danish and Estonian experts.

Table GDP/transport demand elasticity trend 1999-2011[2]

Road	**tonn-km**	0,912788
Rail	**tonn-km**	0,062683
Car	**vehicle-km**	1,080136
Car	**passenger-km**	1,006982
Bus	**passenger-km**	-0,15173

[2] Elasticities here are calculated using a different methodology (not linear regressioon) than for in the ohter sectors. Before using these number in further analysis, this isuse should be assessed.

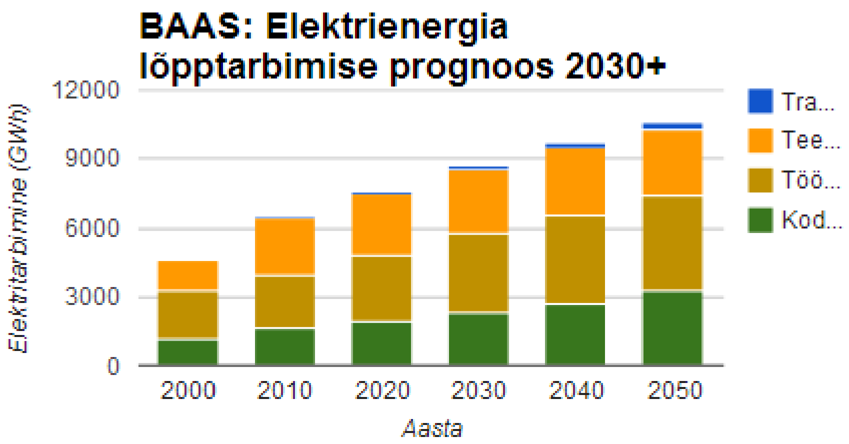
2020 targets

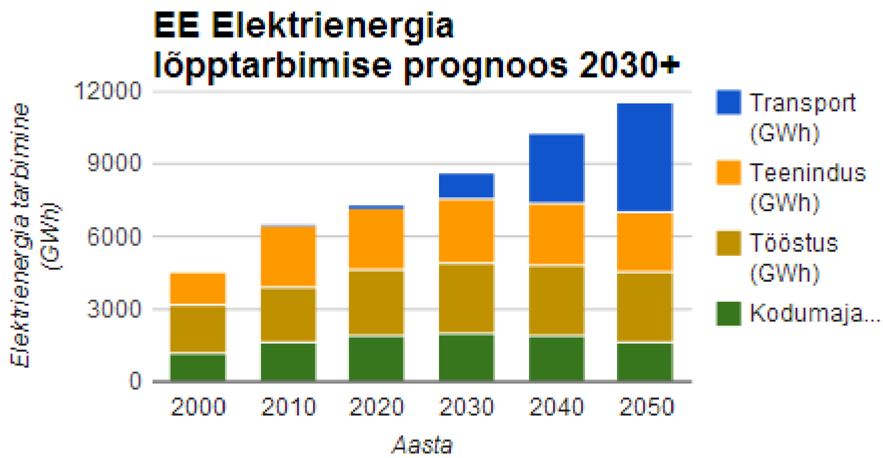
The European Parliament's so called GHG Effort Sharing Decision (Decision 406/2009/EC) sets individual growth limits and reduction targets for non-ETS sector (including transport sector) GHG levels for all EU member states. The 'cap' for GHGs from these sectors in Estonia for 2020 was set at a maximum of 11% growth compared to 2005 levels. This means that he consumption of conventional fossil fuels in 2020 should stabilize on the level of ca 35 547 TJ – to meet the targets of so called effort sharing decision and cap the emissions of GHG. The rest of transport energy demand must be met either with renewable (including electricity produced from renewable resources) or the demand must be reduced by other measures (increased fuel efficiency, modal shift towards more energy efficient transport modes including walking and cycling, better urban planning to reduce travel demand, car dependency and the length of trips). This means that the EE scenario can be reached with different policy packages not only technological or fuel related measures.

6. Summary of all sectors

6.1. Electricity demand

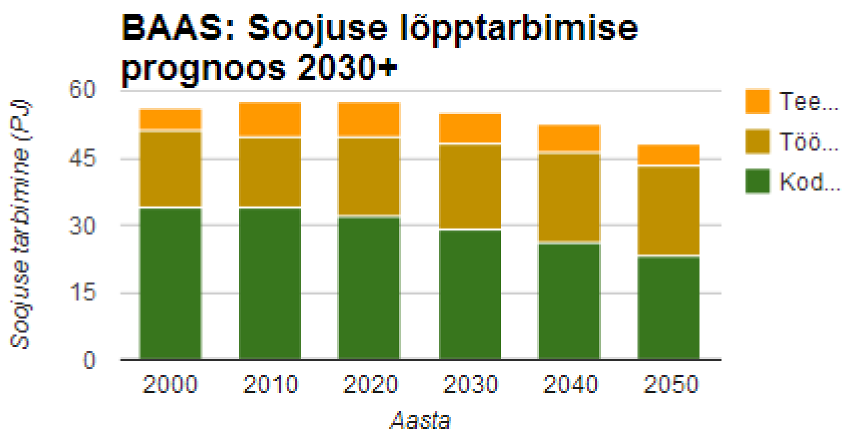
Electricity demand across all sectors (Households, Industry, Services, Transport)

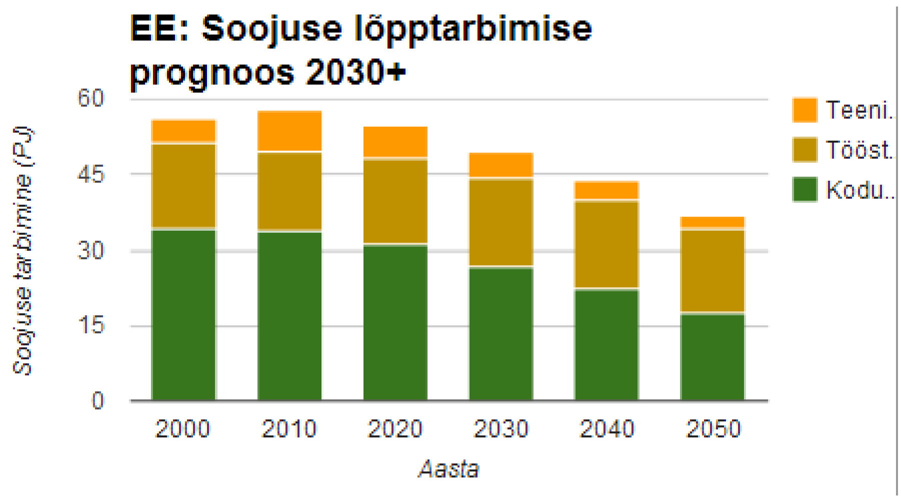




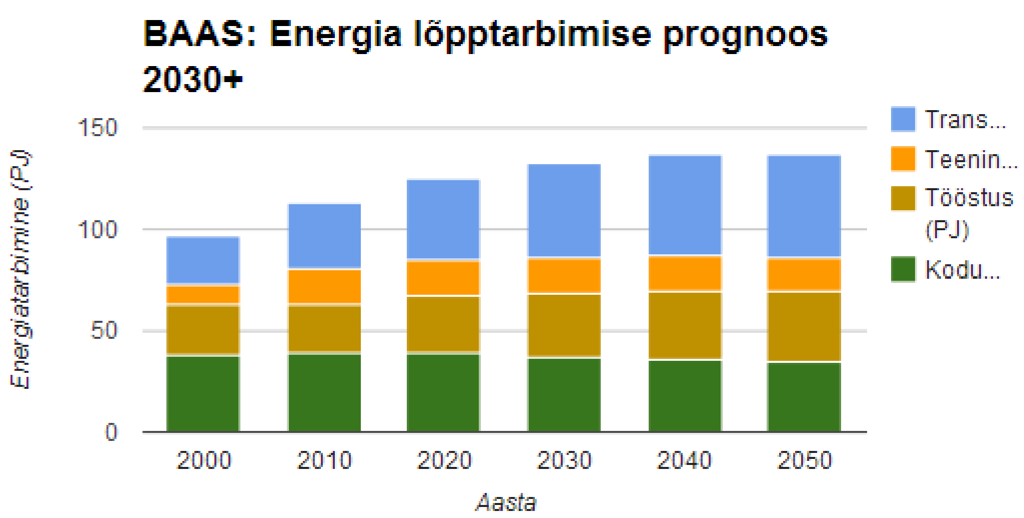
6.2.Heat demand

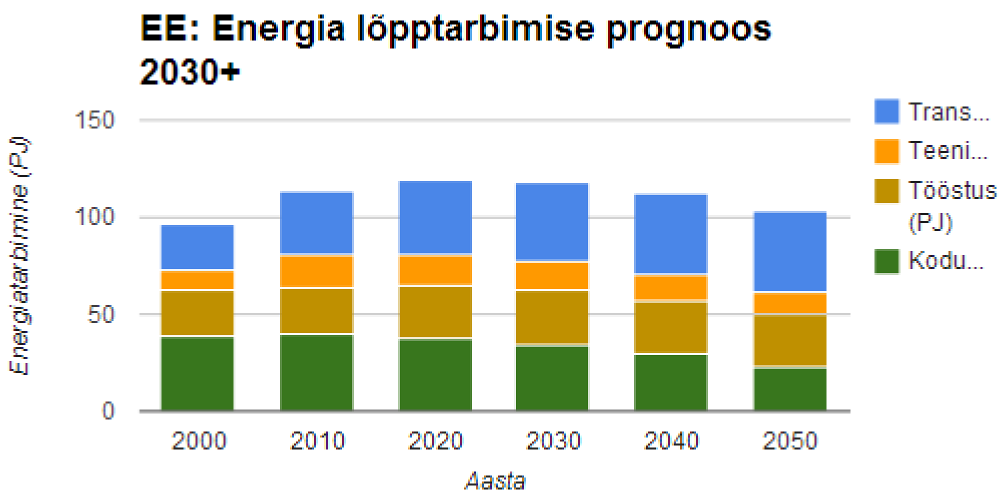
Heat demand across all sectors (Households, Industry, Services, Transport)





6.3.Total energy demand

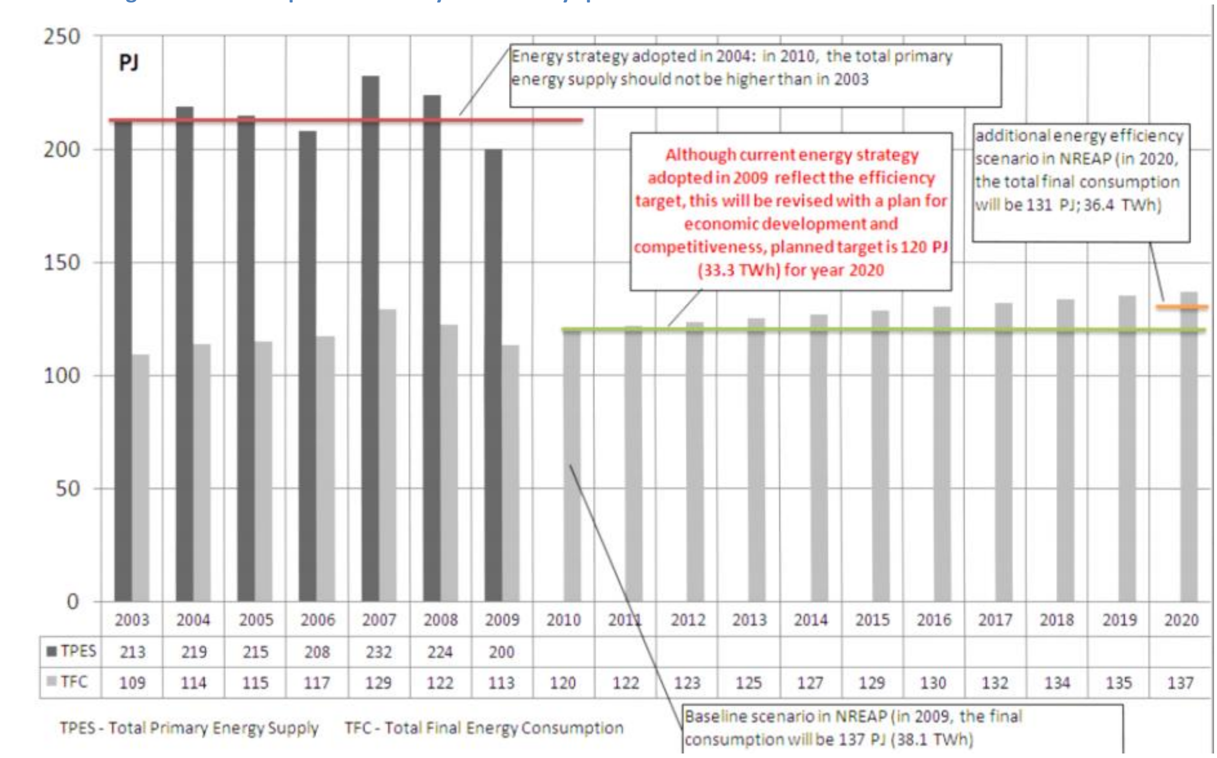




6.4.Final comments

- As part of the Estonian Competitiveness Plan (2011) Estonia is set to keep its final energy demand in 2020 at the level of 2010. Current projections for neither BAAS nor EE achieve this target. In the final consumption scenarios

Table 8: Image taken from a presentation by the ministry:.pdf



http://www.bfee-online.de/bfee/informationsangebote/veranstaltungen/praesentationen/praesentationen_dritter/annika_paesik_neeap2

- Currenttly no estimates on the peak demand nor the monthly variance of heat demand have been made.