**HERON project (No: 649690)**

# TECHNOLOGICAL TRENDS

## D.1.4

### PART OF WORK PACKAGE 1: MAPPING OF ENERGY EFFICIENCY POLICY INSTRUMENTS AND AVAILABLE TECHNOLOGIES IN BUILDINGS AND TRANSPORT

# NATIONAL REPORT FOR ESTONIA

## DATE: 12.AUGUST 2015

**Partner:** ***Stockholm Environment Institute Tallinn Centre***

## HERON project

"Forward-looking socio-economic research on Energy Efficiency in EU countries"

**This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 649690**

***Institution: Stockholm Environment Institute Tallinn Centre***
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***Prepared by: Valdur Lahtvee, Mari Jüssi, Tiit Kallaste***

*(1) The Steering Committee member has the responsibility for ensuring the quality of the report.*

**HERON: Forward – looking socio-economic research on Energy Efficiency in EU countries**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649690. The content of this document reflects only the authors' views and the EASME is not responsible for any use that may be made of the information it contains

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# ACRONYMS

AAU - Assigned Amount Units under UN FCCC

EIC - Environmental Investment Centre

ELMO - Estonian Electro-Mobility Programme

ENMAK - Estonian National Energy Sector Development Plan

EPBD - Energy Performance of Buildings

EPD - Energy Performance Directive

EV - Electric Vehicle

GIS - Green Investment Scheme

KredEx - Credit and Export Guarantee Fund

LEB - Low-Energy Building

LED - Light Emitting Diode

MEUR - Million Euros

MiEV - Mitsubishi innovative Electric Vehicle

nZEB - nearly Zero-Energy Buildings

ODEX - Energy efficiency index of industry

# Executive Summary

Estonian buildings sector (without industrial buildings) consumes approximately 16-17 TWh annually, which constitutes to 50% of total final energy use of the country. From the overall buildings stock, majority (31%) are multi-store apartment buildings and 1-2 floor detached houses (24%), followed by the industrial buildings (15%). Rest of the buildings stock are the buildings used by service sector and other type of dwellings. The technical energy saving potential of the Estonia's buildings sector has been calculated to be 9.3 TWh heat and ca 0.2 TWh electricity annually. The economic energy efficiency potential of the buildings sector in Estonia would be ca 5 TWh per annum, mostly on reducing heat consumption.

Estonian buildings sector is using only few energy efficiency technologies and lesser number of technologies are supported by the national policy measures. Complex renovation of the multi-store dwellings for increasing energy performance of the buildings, replacement of the heating systems of the detached private houses, installation of the micro-energy production equipment in the private buildings and reconstruction of the street lightning – replacement of the incandescent bulbs with LED lamps are the main energy efficiency technologies and measures supported by the Government. Highest potential for energy efficiency technology market, is for further installation and use of energy efficient (LED) lightning, both street and in-house lightning; further deployment of use of heat-pumps for heating and installation and use of heat-recovering ventilation systems.

Transport sector accounts for a quarter of Estonian final energy demand (8.3 TWh/33 000 TJ) and energy demand has been rising over 33% during the last 15 years primarily due to economic growth, rapid increase in private car use and road freight, urban sprawl and decreasing share of public transport and walking in daily mobility. Road transport has increased at the same pace as economic growth which puts Estonia as one of the most transport and energy intensive economies in the EU. 60% of the energy in road transport is consumed by passenger cars, which has been the fastest growing transport mode in Estonia. Contrary to EU average and most other sectors' trends in Estonia the overall energy efficiency (based on aggregated ODEX indicator) in transport decreased in 1996-2010 by more than 15%.

The high energy efficiency potential of transport sector has been recognized only recently. Background studies commissioned in the framework of preparing new national energy development plan (ENMAK 2030+) concluded that in case all the instruments are implemented, a 40% (-19 000 TJ/a) reduction of energy consumption could be achieved compared to the reference scenario. Ca 20% of the overall energy saving potential until 2030 can be reached with more fuel efficient conventional and hybrid passenger cars, while the role of electric vehicles remains still relatively marginal (175 TJ). Developing public transport (1300 TJ/a), integrated spatial planning (2900 TJ/a), eco-driving (1400 TJ/a), parking management (1100 TJ/a), congestion charging (1300 TJ/a), electrification of railways (450 TJ/a), energy efficient lorries (1000 TJ), developing cycling infrastructure (360 TJ/a) would all contribute substantially to the energy saving. This paper presents the case of Estonian transport sector the Electro-mobility Program, a four year support scheme that has brought more than 1200 EV-s on Estonian roads and covered the whole country with quick EV-charging network. Financially supported purchase of electrical cars have a total annual mileage of 11 million vehicle-km, with an estimated energy saving of ca 25 TJ/y, which, however remains very marginal compared to the overall energy consumption in the transport sector.

Energy-efficiency technologies used in both buildings and transport sectors, are mostly imported. Estonian domestic energy efficiency technology production is concentrated on production and export of construction materials used for renovation of the buildings for increasing energy performance of the buildings. Main products are energy efficient windows, pre-fabricated wall elements and houses and insulation materials.

# CHAPTER 1: TECHNOLOGICAL TRENDS IN THE BUILDING AND TRANSPORT SECTOR

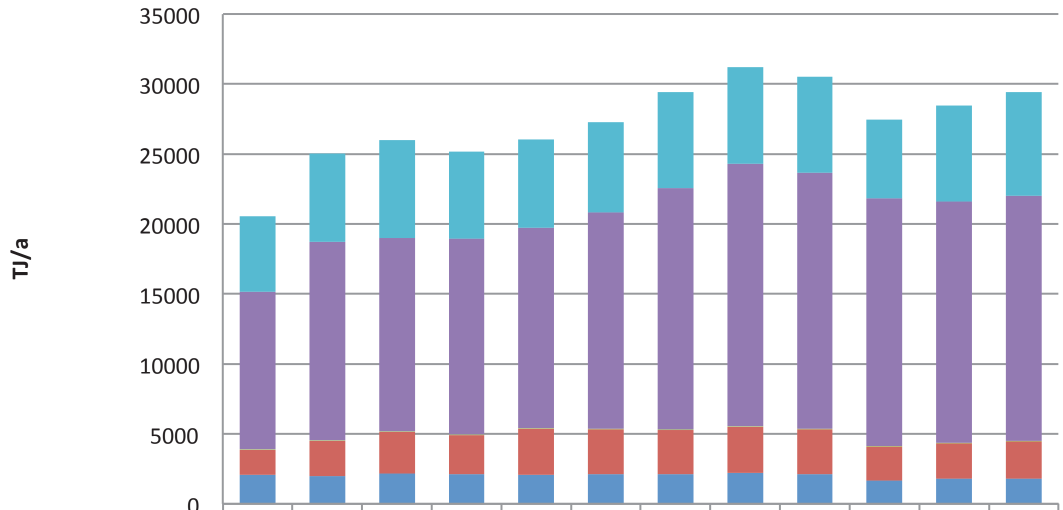
## 1.1 ENERGY EFFICIENCY POTENTIAL

### 1.1.1 Buildings sector

Estonian buildings sector (without industrial buildings) consumes approximately 50% (16-17 TWh annually) of total final energy use of the country (ENMAK 2030). From the overall buildings stock, majority (31%, 27385 units, 34 281 629 $m^2$) are multi-store apartment buildings and 1-2 floor detached houses (24%, 190 460 units, 26 447 774 m2), followed by the industrial buildings (15%, 17 832 units, 4 133 084 $m^2$). Rest of the buildings stock are buildings used by service sector and other type of dwellings. 96% of Estonian housing belongs to private persons. By the National Buildings Register, there is together 3 006 708 buildings with controlled inner climate and with overall floor surface of 110 241 726 $m^2$. 77% of the housing was built before 1992 and 58% during the Soviet period (1946-1990) with relatively low energy standards. Annual energy use of average dwelling house in Estonia is 250 kWh/$m^2$. According to the development plan of Estonian housing sector 2030+, its analysis of current situation, the potential technical energy saving in Estonia is 9.3 TWh of heat annually and ca 0.2 TWh of electricity annually. The potential to save heat as much as ca 10 TWh annually, makes up about one third out of all the final energy consumption in Estonia, being 33-34TWh annually. Energy saving potential for new buildings, if built according to nearly zero energy performance requirements, would be annually 0.5 TWh heat and 0.4 TWh electricity, compared with building by minimum energy efficiency standards. Global cost calculations (EQUA, 2011) for construction concepts from business as usual construction to passive house building envelope level combined with all possible technical systems showed that cost optimal in the reference detached house was between 120-140 kWh/($m^2$ a) primary energy and in reference office buildings about 140 kWh/($m^2$ a) primary energy. Expanding these results to whole building stock, the economic energy efficiency potential of the buildings sector in Estonia would be ca 5 TWh per annum, mostly on reducing heat consumption. The cost of the energy saving in case of complex renovation of the typical multi-store dwellings would be 1290-1340 €/MWh/a. In case of complex renovation (both insulation and renovation of technological systems) of detached house the cost of the energy saving could be between 723-1240 €/MWh/a (ENMAK 2030, 2014).

### 1.1.2 Transport sector

Transport sector accounts for a quarter of Estonian final energy demand (8.3 TWh/33 000 TJ of which 94 per cent is cars and trucks) and energy demand has been rising over 33% during the last 15 years primarily due to economic growth, rapid increase in private car use and road freight, urban sprawl and decreasing share of public transport and walking in daily mobility (Jüssi et al., 2014). Road transport has increased at the same pace as economic growth which puts Estonia as one of the most transport and energy intensive economies in the EU. 60% of the energy in road transport is consumed by passenger cars, which has been the fastest growing transport mode in Estonia. Ca' 44% of the fuel consumed on Estonian roads can be associated with local roads and streets, which shows that the local level plays a big role in energy efficiency policies (Jüssi et al., 2014). Contrary to EU average and most other sectors' trends in Estonia the overall energy efficiency (based on aggregated ODEX indicator) in transport decreased in 1996-2010 by more than 15% (Energy …, 2012). For more detailed overview of Estonian transport sector energy consumption structure and trends, see D.2.1.




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy Duty Vehicle | 5417 | 6312 | 6982 | 6244 | 6304 | 6460 | 6841 | 6878 | 6846 | 5626 | 6889 | 7400 |
| Car | 11242 | 14198 | 13815 | 13984 | 14314 | 15480 | 17258 | 18797 | 18287 | 17683 | 17238 | 17500 |
| Motorcycle | 25 | 26 | 28 | 31 | 54 | 18 | 32 | 47 | 51 | 45 | 46 | 43 |
| Light Duty Vehicle | 1779 | 2512 | 2971 | 2811 | 3264 | 3233 | 3187 | 3272 | 3208 | 2425 | 2504 | 2652 |
| Bus | 2094 | 2006 | 2182 | 2122 | 2097 | 2100 | 2101 | 2210 | 2127 | 1670 | 1796 | 1810 |

**Figure 1 Energy consumption in Estonian road transport by mode 2000-2011**

Source: Jüssi et al., 2014

Two background studies commissioned in the framework of National Energy Development 2030+ (ENMAK 2030+), Jüssi et al., (2014) and Jüssi et Rannala (2014) – assessed the energy saving potential of 24 policy instruments ranging from fiscal measures, public transport development to eco-driving and car-sharing and analyzed the policies and final energy demand in the transport sector in two alternative scenarios. The reports concluded that in case all the instruments are implemented, about 40% (-19 000 TJ/a) reduction of energy consumption could be achieved compared to the reference scenario. Approximately 20% of the overall energy saving potential until 2030 can be reached with more fuel efficient conventional and hybrid passenger cars, while the role of electric vehicles remains still relatively marginal (175 TJ). Developing public transport (1300 TJ/a), integrated spatial planning (2900 TJ/a), eco-driving (1400 TJ/a), parking management (1100 TJ/a), congestion charging (1300 TJ/a), electrification of railways (450 TJ/a), energy efficient lorries (1000 TJ), developing cycling infrastructure (360 TJ/a) would all contribute substantially to the energy saving.

## 1.2 Technologies And Policy Instruments

### 1.2.1 Buildings sector

In the buildings sector the only energy efficiency technologies supported by the relevant national policy instruments are complex energetic renovation of the multi-store dwellings for increasing energy performance of the buildings, replacement of the heating systems of the detached private houses, installation of the micro-energy production equipment in the private buildings and reconstruction of the street lightning – replacement of the incandescent bulbs with LED lamps.

Main national policy instrument has been subsidy (between 17-35 % from renovation costs, depending on expected savings, average 24%) for complex renovation of the multi-store dwellings as well loan guarantees and support to the housing cooperatives for pre renovation audits and on-site inspections of renovation works by the state foundation KREDEX. Complex renovation of typical multi-store dwelling consists the additional insulation of the perimeter of the house, reconstruction and insulation of the roof, replacement of the windows, replacement of heat piping and radiators with thermostats-regulators, installation of the ventilation with heat exchange. Cost of complex renovation of the multi-store dwellings has been as average costing 91 EUR/m$^2$ (highest cost was 382 EUR/m$^2$) and the support for renovation from KREDEX has been as average 23 EUR/m$^2$ (KREDEX, 2014). Progress of the use of subsidies has been moderate as there have been barriers for implementation: main barrier being the difficulties to reach agreement between the members of the housing cooperatives for taking renovation loan and low income of owners. During the period 2010 (first year of implementation)-2014, support has been given for renovation of to 663 housing cooperatives in total amount of 38,0 MEUR. Most actively subsidy has been used in 2 of the biggest cities, where income of inhabitants have been higher than in other regions. Some correlation of renovation activity can be drawn with heat prices in the cities and regions. Number of applicants was peaking in 2012 with 310 renovation projects and has decreased to 57 renovated houses in 2014. With regards to cost-effectiveness, energy savings in Estonian houses in 2013 after the implementation of KredEx investment fund was estimated to be approximately as high as 2,5 MEUR. An overview to energy savings achieved both in kWh-s and euros in 2013 can be seen from the below provided Table 1:

**Table 1. Energy savings in Estonian houses in 2013 after the implementation of KredEx renovation fund**

| | Number of houses | 2013 savings in kWh | Savings in euros |
|---|---|---|---|
| Tallinn | 153 | 18 835 839 | 1 488 031 |
| Tartu | 31 | 4 367 870 | 279 544 |
| Harjumaa | 43 | 3 566 858 | 267 514 |
| Tartumaa | 19 | 1 667 597 | 125 070 |
| Pärnumaa | 20 | 1 288 205 | 96 615 |
| Ida-Virumaa | 6 | 998 427 | 74 882 |
| Lääne-Virumaa | 7 | 895 827 | 67 187 |
| Raplamaa | 10 | 638 517 | 47 889 |
| Valgamaa | 4 | 626 060 | 46 955 |
| Viljandimaa | 6 | 402 608 | 30 196 |
| Jõgevamaa | 5 | 246 233 | 18 467 |
| Saaremaa | 2 | 226 290 | 16 972 |
| Läänemaa | 3 | 197 523 | 14 814 |
| Järvamaa | 2 | 116 447 | 8 734 |
| Põlvamaa | 1 | 65 253 | 8 734 |
| Võrumaa | 1 | 45 793 | 3 434 |
| Hiiumaa | 1 | 22 453 | 1 684 |
| Total | 314 | 34 207 800 | 2 592 882 |

Source: Lauri, M., KredEx, 2014, lk. 21-22.

For detached private houses the policy instrument used in Estonia is subsidy for the renovation of the heating system – switching from oil heated boilers to heat pumps and biomass based boilers. Subsidy has been limited to 40 % of the equipment purchase and installation cost, but not exceeding 4000 EUR per household. Progress cannot be reported jet as measure started rather recently at the end of 2014 and has been more widely in practice since the beginning of 2015. Amount of the subsidy during the period 2015-2017 will be 5 MEUR and from this amount there is expected that oil fueled boilers will be replaced in more than 2000 detached houses. Both above measures are planned to be continued until 2030.

In 2012 KREDEX provided support for renovation of the detached private houses for the purchase and installation of the equipment for local renewable micro-energy supply and replacement of heating systems with heat-pumps and biomass boilers. Amount of the subsidy was 4.5 MEUR and whole amount was earmarked during couple weeks from start of disbursement. Applications exceeded many times the support available. This shows the keen interest of households sector to improve the energy efficiency in a way of using renewable energy sources or alternative possibilities of generating energy. Altogether 212 projects were supported from which 146 were including replacement of the heat supply equipment (50% for earth-heat pumps, 40% for air-heat pumps and 10% for wood use, mainly pellets). Average investment cost per project was 7500-10500 EUR for heat pumps and 6000 EUR for wood based boilers.

Estonian Environmental Investment Centre (EIC) has provided during the period of 2012-2015 support for renovation of street lightning in seven mid-size cities. Support scheme has been based on the bilateral agreement with Estonia and Austria on sales of the Assigned Amount Units (AAU). According to the agreement earnings were allocated in the National Green Investments Scheme (GIS) for the replacement of the old street lamps with modern and energy efficient LED lamps. EIC support covered 90% (16.2 MEUR) and own financing of the local governments was 10% (1.8 MEUR) of the project cost. Altogether 12 253 lightning spots were installed together with control systems renovated and as result 5 GWh electricity saved annually, making about 0.3-0.4 MEUR saved annually.

The "New technology shift" measure, started in 29.06.2015 and managed by the KREDEX, is the support mechanism for renovation of old (3x220V) electrical wiring and control systems to new 3x230/400 V) system in multi-store buildings belonging to housing cooperatives and in private households. Support is given up to 30% of the replacement costs, but not more than 200 EUR by flat of multi-store building and not more than 800 EUR for a private house. Support scheme is limited only to Tallinn City inhabitants. Amount of the subsidy during the initial period (2015) will be 300 000 EUR, and measure is expected to be continuing in 2016. Due to its fresh implementation, it is not possible yet to know the cost-effectiveness of that measure.

### 1.2.2 Transport sector

As to energy efficiency and technology it is the ELMO program, lasting from 2011 until the end of 2014 (described in WP1 deliverable 1.1) that supports the take-up of electric vehicles in Estonia, providing direct support for purchasing electric vehicles (EV-s) and developing a quick-charging network all over Estonia. In total, KredEx has supported 657 (339 for private persons and 318 for company's) car purchase and 350 home chargers. During the program period KredEx has allocated grants in the total amount of EUR 10.5 million; the average grant per car has been EUR 16 500 (Kredex press release, 2014), which represents ca 35-50% of subsidy compared to the full price of an average EV. In addition the government purchased 507 Mitshubishi i-MiEV-s for social workers. According to Kredex ELMO program (Parve, 2015) the reported total annual mileage of the EV-s supported by Kredex were 7.2 million kilometres (2014), and social workers i-MieV 3.8 million (2013) with a total annual mileage of EV-s of 11 million vehicle-km.

As of May, 2015, there were 1221 registered EV-s in Estonia. Coming to the launch of EV- era, one can see that in 2010 there were all in all 8 registered EV-s only in Estonia. Figure 2 shows the yearly registration of EV-s in the period 2011-2015. (Estonian Road Administration, 2015)

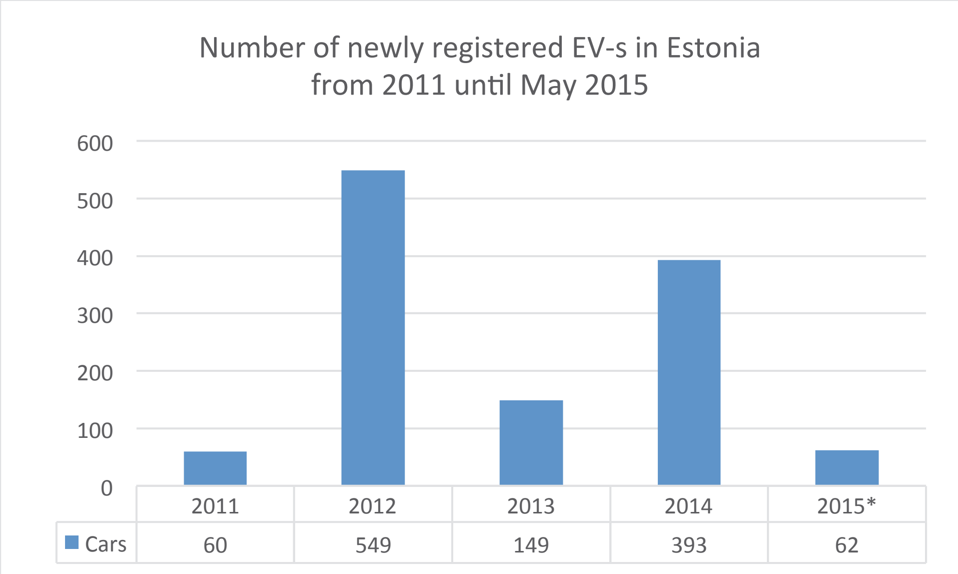



Figure 2. Number of newly registered EV-s in Estonia from 2011-2015.

*Data for 2015 represents first 5 months.

Source: Estonian Road Administration, 2015

The annual energy saving per car (15 000 km) is estimated compared to average car and similar sized car (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). In addition to electricity costs the EV-s need a replacement battery in 5-7 years in use, adding about 5000 € to the 10-15 year lifetime costs and 2000-5000 € additional costs during purchase compared to similar sized average car. Annual energy saving for the consumer is 5800-8400 kWh/y, monetary saving 1100-1500€/y (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). The total annual energy saving with current EV fleet is 4000-6000 MWh/y, remaining marginal compared to the overall energy consumption in the transport sector (8.3 TWh/y, see D.2.1)

**Table 2. Comparison of average energy and fuel costs for Nissan Leaf and average petrol car in Estonia and annual mileage of 15 000 km.**

| | **Energy consumption (kWh/km)** | **Energy consumption (kWh/year)** | **Fuel consumption (l/year)** | **Energy and fuel cost** | **Energy and fuel costs €/year** | **Annual Saving (€)** | **Annual Energy Saving (kWh/y)** | **Retail price (€)** | **Price at 50% support** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **€/kWh** | | | | | |
| **Nissan Leaf** | 0,173-0,212 | 2595 | | 0,0475 | 123 | 1100-1500 | 5800-8400 | 34 000 | 17000 |
| | | | | **€/l** | | | | | |
| **Average petrol car** | 0,77 | 11550 | 1269 | 1,3 | 1650 | 1499 | 8370 | 10-20 000 | - |
| **Similar sized car** | 0,6 | 9000 | 989 | | 1286 | 1135 | 5820 | | - |

Sources: Authors' calculations, Average energy consumption based on: Nissan Europe (2015), Parve (2015), Jüssi et al. (2014).

## 1.3 MARKET PERSPECTIVES DUE TO TECHNOLOGICAL TRENDS

### 1.3.1 Buildings sector

In the Estonian buildings sector, highest potential for energy efficiency technology market, is for further installation and use of energy efficient (LED) lightning, both street and in-house lightning; further deployment of use of heat-pumps for heating and installation and use of heat-recovering ventilation systems. Development and use of above technologies are motivated in order to meet the near-zero energy performance criteria for new buildings in the framework for implementation of the EPD directive of EU.

Energy-efficiency technologies are mostly imported. E.g. from 25 companies, listed as members of the Estonian Heat-pumps Association there is only one company (Movek Ltd) which is producer / compiler of heat-pumps, others are selling and installing imported pumps from international (mostly originated in Nordic Countries, Japan, et al.) producers.

According to the Estonian Heat-pumps Association, heat-pumps have been installed in Estonia since 1992. If in early years heat-pump use was exclusive then during 2005-2007 installed number of heat-pumps already doubled annually. During the period of 1993-2013 there has been installed ca' 88,200 heat-pumps from which ca 78,200 were air heat pumps and ca 10000 earth heat pumps. Total capacity of installed heat pumps in Estonia is about 530 MW. Up to year 2013 there was installed 14,000 heat pumps and in 2015 the overall number of heat-pumps in operation is expected to exceed 100,000 units (Soojuspumpade…, 2014).

As for the energy efficiency materials, the domestic producers are oriented to isolation materials used for renovation of the buildings for increasing energy performance of the buildings. Main products are energy efficient windows, pre-fabricated wall elements and houses and insulation materials. This type of production is also exported in quite a volume.

### 1.3.2 Transport sector

All the cars supported by the ELMO program are imported. Almost half of the EV-s in Estonia are Mitsubishi iMiEV-s, more than 30% are Nissan Leaf. The distribution of EV stock across different car brands is shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

**Table 3. EV brands and units supported by the ELMO program 2011-2014**

| | |
|---|---|
| Mitsubishi i-MiEV | 546* |
| Nissan Leaf | 367 |
| Volkswagen e-Up | 43 |
| Mia Electrics | 36 |
| Tesla S | 32 |
| Polaris Ranger | 30 |
| Tazzari Citysport | 24 |
| Micro-Vett Fiorino | 19 |
| Renault Zoe | 15 |
| Nissan e-NV200 | 13 |
| Opel Ampera | 11 |
| Mitsubishi Outlander PHEV | 10 |

| | |
|---|---|
| BMW i3 | 6 |
| Volkswagen e-Golf | 4 |
| Citroen C-Zero | 3 |
| Peugeot iON | 2 |
| Toyota Prius Plug-In | 2 |
| Porche Panamera e-Hybrid | 1 |

*Including 507 i-MiEVs for social workers all over Estonia
Source: http://elmo.ee/quick-facts/ (02.08.2015)

## 1.4 Data for the Buildings Sector

According to the Estonian Statistics Board in 2010 there were 567 769 households from which 41 152 (72.5 %) were located in urban areas and 156269 (27.5%) were located in rural area. 139 616 households (24.6% from total households) were living in detached (single-family) houses and rest in multi-family houses. From single-family houses, majority (63%; 87817 households) were living in rural areas and rest (37%, 51799 households) were in urban areas. In urban areas, majority (84.7%) of households are living in multi store houses. All data in following tables of technology use is taken from the study of the Estonian Statistics Board on 2012 energy consumption of households (Leibkondade, 2013). There is no data available on the energy consumption of the commercial/public sector buildings.

**Table 4. Use of main technologies in buildings**

| Sector | Buildings |
|---|---|
| Sub-sector | Residential sector:<br>• Space heating<br>• Water heating<br>• Cooking<br>• Lighting<br>• Refrigeration<br>• Washing machines<br><br>Commercial/services sector:<br>• Space heating<br>• Water heating<br>• Cooking<br>• Refrigeration<br>• Lighting<br>• Public street lighting |

### 1.4.1 Residential Sector

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Space Heating</td></tr>
<tr><td>Technology</td><td>Central heating supply (65 % of total households)</td></tr>
<tr><td>Number of technology used</td><td>Single family houses in urban areas
<table><tr><td>Total</td><td>Stock</td><td>New buildings</td></tr><tr><td>51 799</td><td>n.a.</td><td>n.a.</td></tr></table>
Single family houses in rural areas
<table><tr><td>Total</td><td>Stock</td><td>New buildings</td></tr><tr><td>87 817</td><td>n.a.</td><td>n.a.</td></tr></table>
Multi-family houses
<table><tr><td>Total</td><td>Stock</td><td>New buildings</td></tr><tr><td>428 153</td><td>n.a.</td><td>n.a.</td></tr></table></td></tr>
<tr><td>Origin of technology</td><td>Central heating supply differs in size and technologies used and origin cannot be specified, the technology origin can be quoted partly domestic.</td></tr>
<tr><td>Cost of purchase</td><td>EUR 5100 – 6400</td></tr>
<tr><td>Cost per kWh</td><td>EUR 0,052-0,086</td></tr>
<tr><td>Energy consumption per household</td><td>kWh/a 10 608</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>Advantage is easiness of the use/disadvantage - prices cannot be influenced</td></tr>
<tr><td>Easiness to use</td><td>Extremely easy for consumers to use</td></tr>
</table>

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Space Heating</td></tr>
<tr><td>Technology</td><td>Firewood oven (30% from total households)</td></tr>
<tr><td>Number of technology used</td><td>Single family houses in urban areas
<table><tr><td>Total</td><td>Stock</td><td>New buildings</td></tr></table></td></tr>
</table>

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</td></tr>
<tr><td>Origin of technology</td><td>Firewood based ovens are mostly local origin, export share is about 30%</td></tr>
<tr><td>Cost of purchase</td><td>EUR 5 800 – 7 000</td></tr>
<tr><td>Cost per kWh</td><td>EUR 0.046-0.049</td></tr>
<tr><td>Energy consumption per household</td><td>kWh/a 15 960</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>Adv.: availability of suppliers/ Disadv.: needs storage and manual work</td></tr>
<tr><td>Easiness to use</td><td>Use is difficult as lot of logistics and manual work required</td></tr>
</table>

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Space heating</td></tr>
<tr><td>Technology</td><td>Heat pumps (3% of total households)</td></tr>
<tr><td>Number of technology used</td><td>
Single family houses in urban areas
<table><tr><td>Total</td><td>Stock</td><td>New buildings</td></tr><tr><td>51 799</td><td>n.a.</td><td>n.a</td></tr></table>
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</td></tr>
<tr><td>Origin of technology</td><td>Imported 99%</td></tr>
<tr><td>Cost of purchase</td><td>EUR 3 500-15 000</td></tr>
</table>

| | |
|---|---|
| Cost per kWh | EUR 0.045-0.086 |
| Energy consumption per household | kWh/a 7000 |
| Advantages / disadvantages of use | Adv.: easiness of use, automated steering; Disadv.: costly, needs additional heat source for case of power cut. |
| Easiness to use | Extremely easy to use, automated control, maintenance free. |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Water Heating** |
| **Technology** | **Together with central heating** (53.4% of total households) |
| Origin of technology | See Central heating |
| Cost of purchase | See Central heating |
| Cost per kWh | See Central heating |
| Average energy consumption | 2 138 kWh per household/year |
| Advantages / disadvantages of use | Adv.: easy to use; Disadv.: high cost |
| Easiness to use | Extremely easy to use, maintenance free |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Water Heating** |
| **Technology** | **Electric boiler** (35,4 % of total households) |
| Origin of technology | 100 % imported |
| Cost of purchase | EUR 50-2500 |
| Cost per kWh | EUR 0.14-0.12 |
| Average energy consumption | 2 138 kWh per household/year |
| Advantages / disadvantages of use | 10.2% of total households have no hot water supply, in rural areas 22.7% |
| Easiness to use | Easy to use, no extra burden |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Water Heating** |

| **Technology** | **Heat pumps** (1 % of total households) |
|---|---|
| Origin of technology | See heat pumps |
| Cost of purchase | See heat pumps |
| Cost per kWh | See heat pumps |
| Average energy consumption | 2 138 kWh per household/year |
| Advantages / disadvantages of use | Adv.: easy to install and use; Disadv.: high running cost |
| Easiness to use | Extremely easy to use, maintenance free |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Cooking** |
| **Technology** | **Oven, gas or electricity, A+** (72 % households) |
| Origin of technology | 100 % imported |
| Cost of purchase | Range: 600 – 1100 EUR (source: internet search for the products displayed at: www.topten.eu |
| Cost per kWh | EUR 0.10-0.12 |
| Average energy consumption (kWh/a) | Persons per household: 1 – 198; 2 – 396; 3 – 440; 4 – 595; >4 – 595<br>(source: rwi 2013, data for 2011/2012) |
| Advantages / disadvantages of use | Cookers with gas have 50% less conversion losses than cookers with electricity. Cookers with gas are less expensive. (source: www.ecotopten.de) |
| Easiness to use | If there is no gas connection for the cooker available, you have to use gas bottles. (source: www.ecotopten.de) |

Average energy consumption (kWh/a) – Persons per household:

| 1 | 2 | 3 | 4 | >4 |
|---|---|---|---|---|
| 198 | 396 | 440 | 595 | 595 |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Cooking** |
| **Technology** | **Firewood Oven** (28% households) |
| Origin of technology | Both domestic (hand-made) and imported, share |

| | |
|---|---|
| | n.a. |
| Cost of purchase | Range: 300 – 1700 EUR (source: internet research for the products displayed at www.hinnavaatlus.ee ) |
| Cost per kWh | EUR 0,046-0,049 |
| Average energy consumption (kWh/a) | Persons per household<br>1 \| 2 \| 3 \| 4 \| >4<br>198 \| 396 \| 440 \| 595 \| 595<br><br>(source: rwi 2013, data for 2011/2012) |
| Advantages / disadvantages of use | Additional heat supply/ lot of maintenance and hands-on work |
| Easiness to use | Average easiness |

| | |
|---|---|
| **Sector** | **Buildings** |
| **Sub-Sector** | **Residential sector** |
| **Category** | **Cooking** |
| **Technology** | **Microwave oven** (61 % households) |
| Origin of technology | 100 % imported |
| Cost of purchase | Range: 48 – 1020 EUR (source: internet research for the products displayed at www.hinnavaatlus.ee ) |
| Cost per kWh | EUR 0,010-0,012 |
| Average energy consumption (kWh/a) | Persons per household<br>1 \| 2 \| 3 \| 4 \| >4<br>198 \| 396 \| 440 \| 595 \| 595<br><br>(source: rwi 2013, data for 2011/2012) |
| Advantages / disadvantages of use | Cookers with gas have 50% less conversion losses than cookers with electricity. Cookers with gas are less expensive. (source: www.ecotopten.de) |
| Easiness to use | If there is no gas connection for the cooker available, you have to use gas bottles. (source: www.ecotopten.de) |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Lighting** |
| **Technology** | **Incandescent lamps** |
| Origin of technology | 100% imported |
| Cost of purchase | EUR 0.3-0.5 |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption per household | kWh/year 437<br>(source: NEGAVATT, 2013) |
| Advantages / disadvantages of use | D: energy consuming, short lifespan |
| Easiness to use | Easy to use |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Lighting** |
| Technology | CFL lamps |
| Origin of technology | 100% imported |
| Cost of purchase | EUR 2-5 |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption per household | kWh/year 102 |
| Advantages / disadvantages of use | A:Energy effective/ D:light quality |
| Easiness to use | Please describe |

| **Sector** | **Buildings** |
|---|---|
| **Sub-Sector** | **Residential sector** |
| **Category** | **Lighting** |
| Technology | LEDs |
| Origin of technology | 100% imported |
| Cost of purchase | EUR 3.5-20 |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption per household | kWh/year 60 |
| Advantages / disadvantages of use | A:Energy effective, long life span/D: light quality |
| Easiness to use | Easy to use |

| | |
|---|---|
| **Sector** | **Buildings** |
| **Sub-sector** | **Residential sector** |
| Category | **Refrigeration** (average 1 pcs per household) |
| Technology | Single-door refrigerator without freezer, small (156 liters), EU Energy class A+++ |
| Origin of technology | 100% imported |
| Cost of purchase | EUR 125 - 288 |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption | kWh/year 64 |
| Advantages / disadvantages of use | None |
| Easiness to use | Extremely easy to use |

| | |
|---|---|
| **Sector** | **Buildings** |
| **Sub-sector** | **Residential sector** |
| **Category** | **Washing machines** |
| Technology | n.a. |
| Origin of technology | 100% imported |
| Cost of purchase | EUR |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption | kWh/a n.a. |
| Advantages / disadvantages of use | n.a. |
| Easiness to use | n.a. |

| | |
|---|---|
| **Sector** | **Buildings** |
| **Sub-sector** | **Residential sector** |
| **Category** | **Laundry Dryer** |
| Technology | n.a. |
| Origin of technology | 100% imported |
| Cost of purchase | EUR |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption | kWh/a n.a. |
| Advantages / disadvantages of use | n.a. |
| Easiness to use | n.a. |

| | |
|---|---|
| **Sector** | **Buildings** |
| **Sub-sector** | **Residential sector** |
| **Category** | **Dishwasher** |
| Technology | n.a. |
| Origin of technology | 100% imported |
| Cost of purchase | EUR |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption | kWh/a n.a. |
| Advantages / disadvantages of use | n.a. |
| Easiness to use | n.a. |

| | |
|---|---|
| **Sector** | **Buildings** |
| **Sub-sector** | **Residential sector** |
| **Category** | **Other electrics** |
| Technology | n.a. |
| Origin of technology | 100% imported |
| Cost of purchase | EUR |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption | kWh/a n.a. |
| Advantages / disadvantages of use | n.a. |
| Easiness to use | n.a. |

| | |
|---|---|
| **Sector** | **Buildings** |
| **Sub-sector** | **Residential sector** |
| **Category** | **Other energy use** |
| Technology | n.a. |
| Origin of technology | 100% imported |
| Cost of purchase | EUR |
| Cost per kWh | EUR 0.10-0.12 |
| Energy consumption | kWh/a n.a. |
| Advantages / disadvantages of use | n.a. |
| Easiness to use | n.a. |

### 1.4.2 Commercial / services sector

Data on energy technologies use in commercial sector in Estonia is not available. Same data as for technology use in households can be applied.

## 1.5 DATA FOR THE TRANSPORT SECTOR

**Table 5. Overview of EV-s supported by ELMO program**

| Sector | Transport |
|---|---|
| Sub-sector | Passenger transport<br>• Vehicle efficiency<br>• Road transport (cars) |
| Category | Road transport:<br>• passenger transport:<br>  ○ car short distance,<br>  ○ car long distance, |
| Technology | Electric vehicles |
| Number of technology used | 1164 EV-s |
| Origin of technology | Imported, for brands see **Fehler! Verweisquelle konnte nicht gefunden werden.**. |
| Cost of purchase | 34 000 (with 50% support, 17 000) per average EV |
| Cost per kWh | 0.0475 €/kWh, for saving see **Fehler! Verweisquelle konnte nicht gefunden werden.**. |
| Energy consumption | 2 595 kWh/a per car (15000 km) |
| Advantages / disadvantages of use | Advantages: Low operating costs, low noise, 0-emissions, easy to maneuver, compactness, good acceleration.<br>Disadvantages: Short battery life/ short range during winter months, cold and icy during winter months, 30% of users are dissatisfied with the quick charging network (Kredex, 2013). |
| Easiness to use | According to the EV user survey commissioned by Kredex (2013) 73% of users are satisfied or very satisfied with EV-s. |

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