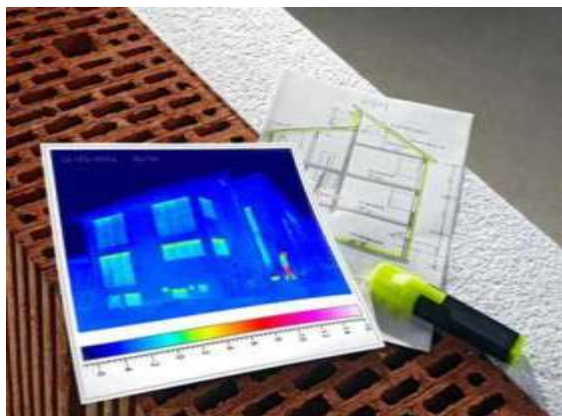




GOVERNMENT
OF THE GRAND DUCHY OF LUXEMBOURG
Ministry of Economy



Fourth National Energy Efficiency Action Plan Luxembourg



In accordance with Directive 2012/27/EU
of the European Parliament and of the
Council of 25 October 2012 on energy
efficiency, amending Directives
2009/125/EC and 2010/30/EU and
repealing Directives 2004/8/EC and
2006/32/EC



Luxembourg, June 2017

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1 Introduction

This report fulfils the reporting requirements pursuant to the Energy Efficiency Directive 2012/27/EU¹ (EED). In accordance with Article 24 Paragraph 2, Member States are required, with effect from 2014 and subsequently every three years, to submit National Energy Efficiency Action Plans (NEEAPs)².

Based on projections from 2007, the European Union (EU) has set itself the target of reducing primary energy by 20 % by 2020 compared to a baseline trend. For this purpose, Luxembourg has defined a corresponding national target and has notified the European Commission of it. The first part of the report (Chapter 2) describes the progress Luxembourg is making towards achieving this target. In this context, it should be noted that it is very difficult to produce reliable energy consumption forecasts for a small, open economic area (on account of long-term population trends, evolving macroeconomic factors, structural changes, influence of individual industrial enterprises etc.).

Chapter 3 describes the policy instruments for implementing the EED and their effects on cross-cutting measures (such as the emerging system of savings obligations) and on sectoral measures corresponding to the requirements of the EED. This chapter contains information on the measures which have been taken or are planned for implementing the main aspects of the Directive and on the savings achieved thereby.

¹ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

² Requirements in accordance with Article 24 Paragraph 2: The National Energy Efficiency Action Plans have to cover significant energy efficiency improvement measures and expected and/or achieved energy savings, including those in the supply, transmission and distribution of energy as well as energy end-use, in view of achieving the national energy efficiency targets referred to in Article 3 Paragraph 1. The National Energy Efficiency Action Plans are complemented with updated estimates of expected overall primary energy consumption in 2020, as well as estimated levels of primary energy consumption in the sectors indicated in Part 1 of Annex XIV.

2 Overview of national energy efficiency targets and energy savings

2.1 National energy efficiency targets for 2020

Article 3 of the EED requires Member States to set an indicative national energy efficiency target for 2020, based on either primary or final energy consumption, primary³ or final⁴ energy savings, or energy intensity. When doing so, they also express those targets in terms of an absolute level of primary energy consumption and final energy consumption in 2020.

In the context of Luxembourg's first annual monitoring report in 2013⁵, Luxembourg set itself, in accordance with Article 3 Paragraph 1 of the EED, a preliminary final energy target for 2020 of:

49 292 GWh or 4 239.2 ktoe (final energy)

Expressed in terms of primary energy, the target is⁶:

52 111 GWh or 4 481.6 ktoe (primary energy)

³ Article 2 Point 2 of the EED defines 'primary energy consumption' as gross inland consumption, excluding non-energy uses. This document uses the term 'primary energy consumption' as in the EED for gross inland consumption without non-energy uses.

⁴ Article 2 Point 3 of the EED defines 'final energy consumption' as all energy supplied to industry, transport, households, services and agriculture. It excludes deliveries to the energy transformation sector and the energy industries themselves.

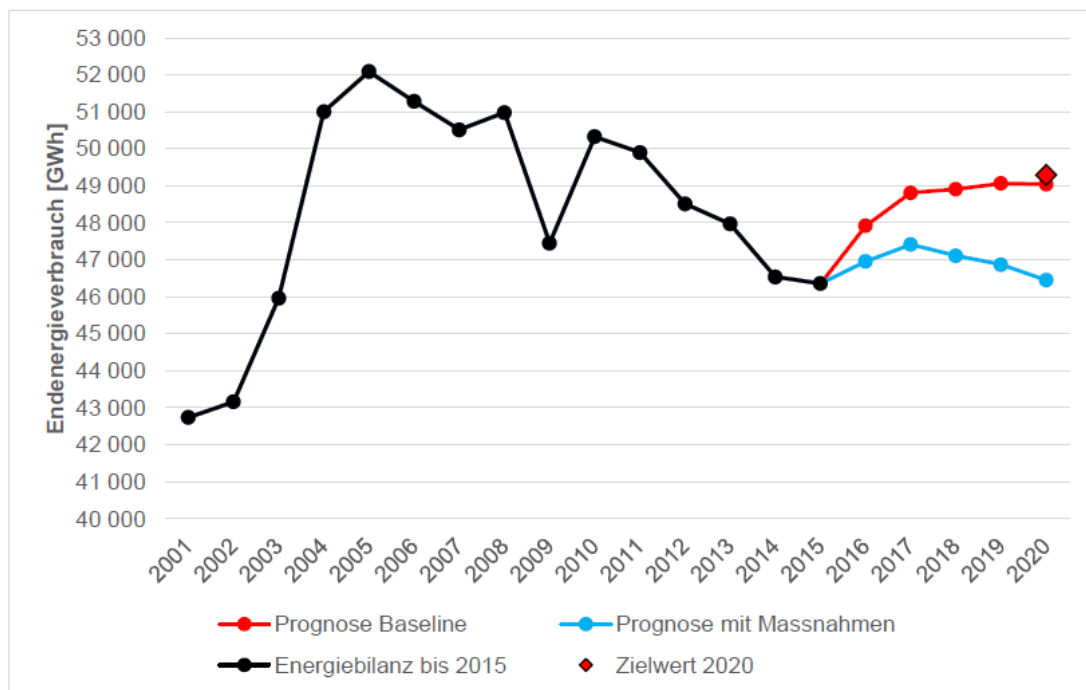
⁵ First annual monitoring report of Luxembourg 2013, *Luxembourg, 2013*, www.gouvernement.lu/4579827/erster-jaehrlicher

⁶ For the conversion to primary energy, a factor of 1.057 was used, corresponding to an average value for recent years.

2.2 Final energy consumption and savings

The following figure shows:

- the statistical development of final energy use in Luxembourg from 2001 to 2015 [source: Statec, energy balance] (black line);
- the national baseline forecast for final energy consumption up to 2020, including energy efficiency measures which had already taken effect by 2012 (red line);
- the national forecast with measures, including the energy efficiency measures taken and currently planned in NEEAP III and in the new NEEAP IV up to 2020, the savings effects of which have been quantified (blue line);
- Luxembourg's energy efficiency target for 2020 in accordance with Article 3 Paragraph 1 of the EED (49 292 GWh final energy).



Final energy consumption [GWh]

Forecast baseline	Forecast with measures
Energy balance up to 2015	Target 2020

Figure 1: Development of final energy consumption in Luxembourg 2001–2020 (2001-2015: historical data [source: Statec] and 2016–2020: national forecast)

With regard to Figure 1, it is essential to bear in mind that the latest available statistical data was used to prepare the baseline forecast. Consequently, the energy efficiency measures which had already taken effect by 2012 are included in the national baseline forecast for final energy consumption. This means that their contribution to the energy efficiency target cannot be seen in this figure. As already

referred to in NEEAP III, these are measures whose effects will continue to be felt up to 2020 and which, overall, will contribute a total savings of 598 GWh to the achievement of the target in 2020.⁷

The effects of the energy efficiency measures taken and planned in the NEAAP III, which took effect up to the end of 2015 are covered by the energy balance (black line). The effects of the same measures, which take effect between 2016 and 2020 are not included in the baseline forecast (red line), but are taken into account in the forecast with measures (blue line).

The historical development of energy consumption shows strong growth in the period 2001–2005 (black line in Figure 1). This increase in energy consumption may primarily be explained by the developments in the transport sector at national and international level. In 2005, final energy consumption reached its peak thus far, with a record high of 52 117 GWh. In the period 2005–2015, a fall in national energy consumption can be seen as a general trend. During this period, the Luxembourg economy faced stagnating energy consumption, both in transport and in industry, largely on account of the global economic crisis that was apparent from 2008 onwards, which also explains the sharp decline in energy consumption in 2009. In the year 2010 energy consumption rose to a high below the levels of 2008, and has been showing a declining trend since. The lowest energy consumption was achieved in 2015 at 46 357 GWh.

The decline in energy consumption since 2005 was also enhanced by the decrease in household consumption. This decrease suggests that the energy efficiency measures taken over a period of more than ten years (in accordance with EU Directive 2006/32/EU on energy services and EU Directive 2010/31/EU on the energy performance of buildings) are yielding tangible results. In particular, it should be taken into account that the population of Luxembourg grew by approximately 23 % in the period 2005 to 2015. The total energy consumption of the households sector in the same period decreased by about 5 %. Based on historical data and various assumptions about future developments in the main sectors of the national economy, the national baseline forecast for final energy consumption in 2020 was prepared (red line in Figure 1). In 2020, final energy consumption (if no further measures are taken) is expected to be 49 043 GWh.

The effects of the measures were assessed against the baseline forecast. The forecast with measures (blue line in Figure 1) should result in a final energy consumption in 2020 of 46 449 GWh [source: Statec]. The energy efficiency target of 49 292 GWh (final energy) would therefore be clearly achieved in 2020.

Table 1: Forecast of final energy consumption in 2020 by sector [GWh]

Sector	Baseline forecast	Forecast with measure
Households	7 311	6 405
Trade, commerce, services	4 782	4 068
Industry	7 861	7 027
Transportation	29 008	28 868
<i>of which transport excluding domestic road transport</i>	23 729	23 729

⁷ In addition, between 1996 and 2007 Luxembourg implemented measures amounting to approximately 1 130 GWh/a, which have significantly contributed to the decoupling of energy consumption from economic growth.

Agriculture	82	82
Result	49 043	46 449

Table 1 shows the energy consumption baseline forecast and the forecast with measures by sector. Overall, without taking account of the measures that came into force between 2008 and 2012 and which will still be having an effect in 2020, savings of 2 594 GWh are planned. The most significant measures include the energy savings obligation scheme.

New measures introduced from 2016 primarily include the new voluntary agreement 'accord volontaire' with a term from 2017 to 2020. For this purpose, the promotion programme PRIME House was extended beyond 2016 and adjusted, and a 'climate bank' was introduced to facilitate the financing of measures.

The measures included in the 'forecast with measures' have no effect on the energy consumption caused by non-domestic transport activities. In fact, it is almost impossible to ensure the effectiveness of such measures, as this is largely dependent on the fiscal decisions of other EU countries.

Table 2: Overview of the expected final energy savings and CO₂ emission reductions in Luxembourg in 2020 as a result of the quantified energy efficiency measures

Measure	Final energy saving in 2020 [GWh]	CO₂ emission reductions in 2020 [kt CO₂]
New builds (housing construction) in accordance with the Energy Efficiency Regulation	355	79
Promotion of energy-efficient new builds	9	2
Promotion of energy renovation	47	11
Support for solar thermal energy and heat pumps	28	6
Total HOUSEHOLDS	439	98
New builds (non-residential construction) in accordance with the Energy Efficiency Regulation	112	20
Renovation in accordance with the Energy Efficiency Regulation	26	5
New builds in accordance with a stricter Energy Efficiency Regulation	30	5

(planned)		
Lighting in new builds in accordance with the Energy Efficiency Regulation	80	0
Total TRADE, COMMERCE AND SERVICES	248	30
Voluntary agreement	368	48
Total INDUSTRY	368	48
Increase in fuel tax	75	20
CO2 vehicle tax	65	17
Total TRANSPORT	140	37
Energy savings obligation scheme	1 394	310
Development bank	6	1
Total HORIZONTAL	1 400	311
Result	2 594	524

Table 3: Overview of the cumulative energy savings expected in the NEEAP III for the years 2013-2015 and the actual energy savings in 2013-2015 [GWh]

Measure	Energy saving expected in the NEEAP III	Energy saving realized in NEEAP IV
New builds (housing construction) in accordance with the Energy Efficiency Regulation	115	125*
Promotion of energy-efficient new builds	48	6
Promotion of energy renovation	18	12
Support for solar thermal energy and heat pumps	46	10
Total HOUSEHOLDS	227	152
New builds (non-residential construction) in accordance with the Energy Efficiency Regulation	123	73*
Renovation in accordance with the Energy Efficiency	21	17*

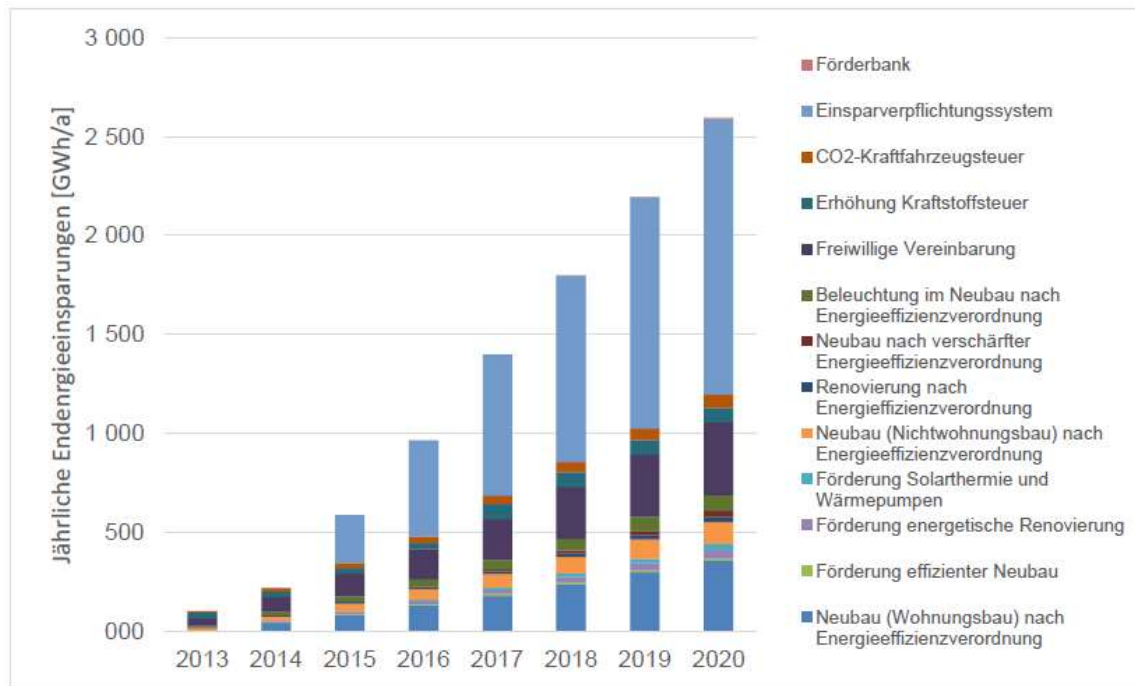
Regulation		
New builds in accordance with a stricter Energy Efficiency Regulation()	0	0
Lighting in new builds in accordance with the Energy Efficiency Regulation	52	52
Total TRADE, COMMERCE AND SERVICES	196	142
Voluntary agreement	229	229
Total INDUSTRY	229	229
Increase in fuel tax	94	87*
CO2 vehicle tax	54	52*
Total TRANSPORT	148	139
Energy savings obligation scheme	239	243
Development bank	0	0
Total HORIZONTAL	239	243
Result	1,039	905

* The difference in the case of these measures is exclusively due to the adjustment of basic data and also through the latest statistics and macroeconomic calculations.

To estimate the reductions in CO₂ emissions, the calculated final energy savings were multiplied by the CO₂ emission factors from the National Inventory Report (United Nations Framework Convention on Climate Change) for each energy source⁸. It has been assumed that only imported electricity will be displaced, so that there will be no reduction in CO₂ emissions in Luxembourg as a result of energy savings.

The following figure shows the development of final energy savings realised from 2013 to 2015 and the expected final energy savings from 2016 to 2020.

⁸ Since the National Inventory Report does not contain a CO₂ emission factor for heat, this was taken from the 'Amended Grand-Ducal Regulation of 30 November 2007 on the energy performance of residential buildings' (Reglement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation).



Annual energy savings [GWh/a]

- Development bank
- Energy savings obligation scheme
- CO₂ vehicle tax
- Increase in fuel tax
- Voluntary agreement
- Lighting in new builds in accordance with the Energy Efficiency Regulation
- New builds in accordance with a stricter Energy Efficiency Regulation
- Renovation in accordance with the Energy Efficiency Regulation
- New builds (non-residential construction) in accordance with the Energy Efficiency Regulation
- Promotion of solar thermal and heat pumps
- Promotion of energy renovation
- Promotion of energy-efficient new builds
- New builds (housing construction) in accordance with the Energy Efficiency Regulation

Figure 2: Actual final energy savings in the period 2013–2015 and the development of expected final energy savings in the period 2016-2020 as a result of the quantified energy efficiency measures

Note: Explanation of the calculation methodology

The calculation methodology is based on four modules, which correspond to four consumption sectors: households; trade, commerce and services (TCS); industry; and transport. It contains the historical development from 2001 to 2015 and forecasts for 2020.

Households

The calculation of energy consumption trends in Luxembourg is based on detailed housing statistics. Three types of housing (single-family, terraced, apartment blocks) and three age groups (before 1970, 1971-1995, after 1995) characterised by a different specific energy consumption (kWh/m² a) were identified. The latest available statistics and forecasts of STATEC were used to calculate the development of housing figures.

Based on housing figures and housing figure trends, the specific living space, the specific final energy consumption and the mix of energy sources of the energy consumption (baseline) were calculated for the above mentioned types of housing.

In order to calculate the reduction in energy consumption achieved through different measures, a new specific energy consumption will be determined for each of the three types of housing and the three age categories. Using the share of residential buildings in which the individual measures are implemented over time, the new, lower energy consumption is calculated. The difference with the baseline, therefore, indicates the savings effect of a measure.

Trade, commerce and services (TCS)

Baseline energy consumption is established on the basis of energy balances for the period 2001-2015 published by the statistical office, which are climate-adjusted for this purpose. The development of the number of employees in the TCS sector is used as the main driver for the forecast up to 2020, with consideration to the independent trends of heating and electricity.

The calculation of the expected energy savings is based on the baseline, and uses improvement rates and new build and renovation rates in the building stock.

Industry

Industrial production and added-value were used as main drivers for the forecast of industrial energy consumption trends and independent developments were taken into account. The industrial sector is divided into four branches: cement, steel, glass and other. Specific final energy parameters for each source of energy were taken into account for each branch.

The calculation of the savings effect of the energy efficiency improvement required in the voluntary agreement takes into account a deduction of independently achievable improvements.

Transportation

The calculation of the energy consumption baseline uses detailed data on the vehicles registered in Luxembourg. Four types of vehicles (cars, lorries, motorbikes, others) and two types of fuel (petrol and diesel) are distinguished. For each of these four vehicle categories, data are available concerning the total number of vehicles, fuel consumption (l/100 km) and the annual mileage (km/a). The trend of the figures is based on the latest econometric calculations of STATEC.

The energy balance of the transport sector is determined by the vehicles registered in Luxembourg, transit traffic and air traffic. As regards transit traffic, the latest calculations of STATEC were used, which are based on a linear rise of the oil price between the years 2015 and 2030. The average of the period 2004-2012 was used for air traffic.

The impact of the increase in fuel tax is taken into account in the baseline through price elasticities. The CO₂ motor vehicle tax is taken into account through an improvement rate of the specific fuel consumption of newly registered cars.

In addition to the aforementioned sectoral energy efficiency measures, the energy savings obligation scheme is also reflected in the calculation model. The savings generated as a result of the obligation correspond to the compulsory savings target, which is adjusted for overlaps with the sectoral measures to avoid double payments.

2.3 Primary energy consumption and savings

In accordance with the EED (Article 2 Point 2), primary energy consumption is defined as gross inland consumption, excluding non-energy uses. Since fossil fuels are without exception imported, these energy sources are to be taken into account for Luxembourg with a conversion factor of 1. In addition to domestic electricity generation, which is based mainly on cogeneration plants, Luxembourg imports the vast majority of the electricity it requires. This fact must be taken into account when comparing primary energy and final energy.

Table 4 shows the estimated primary energy consumption in 2020 by sector. A distinction is made between a baseline forecast and a forecast with measures. The expected development essentially reflects the presumed trend in final energy consumption.

Table 4: Primary energy consumption forecast (gross inland consumption, excluding non-energy uses) in 2020 by sector [GWh]

Sector	Baseline forecast	Forecast with measures
Households	7 767	6 831
Trade, commerce, services	5 614	4 839
Industry	9 133	8 203
Transportation	29 064	28 924
<i>of which transport excluding domestic road transport</i>	23 785	23 785
Agriculture	98	98
Result	51 676	48 895

Table 5 summarises the primary energy contribution of the individual measures to the scenario with measures. In total, almost 2 900 GWh will be saved in 2020 compared to the baseline.

Table 5: Overview of actual cumulated primary energy savings for the years 2013-2015 and the anticipated final energy savings as a result of the quantified energy efficiency measures in 2020 [GWh]

Measure	Primary energy savings achieved in the period 2013-2015	Primary energy savings anticipated in 2020
New builds (housing construction) in accordance with the Energy Efficiency Regulation	126	359
Promotion of energy-efficient new builds	6	10

Promotion of energy renovation	12	47
Support for solar thermal energy and heat pumps	10	29
Total HOUSEHOLDS	154	445
New builds (non-residential construction) in accordance with the Energy Efficiency Regulation	73	112
Renovation in accordance with the Energy Efficiency Regulation	17	26
New builds in accordance with a stricter Energy Efficiency Regulation()	0	30
Lighting in new builds in accordance with the Energy Efficiency Regulation	75	116
Total TRADE, COMMERCE AND SERVICES	165	284
Voluntary agreement	274	439
Total INDUSTRY	274	439
Increase in fuel tax	87	75
CO ₂ vehicle tax	52	65
Total TRANSPORT	139	140
Energy savings obligation scheme	256	1 469
Development bank	0	7
Total HORIZONTAL	256	1 475
Result	988	2 783

3 Policy measures implementing the Energy Efficiency Directive

This section brings together information on all the significant energy efficiency measures which have been taken or are planned for the implementation of the EED and which contribute to the national energy efficiency target for 2020.

3.1 Horizontal measures

3.1.1 Energy savings obligation scheme and alternative policy measures (Article 7)

In order to transpose Article 7 of the EED into national law, Luxembourg has decided to introduce a national system of energy saving obligations, which is briefly outlined in this section. Luxembourg intends to achieve the target in Article 7 Paragraph 1 using energy savings obligations. At present, there are no plans to use alternative measures to achieve the energy efficiency target in Article 7. Nonetheless, Luxembourg reserves the right, if the system of energy savings obligations should prove unsuccessful, to introduce alternative measures for achieving the target in full or in part.

The following description of the energy savings obligation scheme is based on the notifications from Luxembourg pursuant to Annex 5 Paragraph 4 of the EED and the NEEAP III and contains important explanations as regards the functioning of the mechanism which were not yet known in NEEAP III.

3.1.1.1 Obligated parties

All suppliers of electricity and natural gas serving residential, service sector and industrial customers located in Luxembourg shall be considered obligated parties under legal regulations. The obligation will apply to all suppliers operating within Luxembourg regardless of the size of their client base. Based on the latest official lists of businesses possessing a supply authorisation in Luxembourg, as maintained by the regulatory authority ('Institut Luxembourgeois de Régulation', www.ilr.lu), 27 suppliers of electricity and 15 suppliers of natural gas are potentially affected by the obligation (as of January 2017). In practice, 10 suppliers of electricity and 6 suppliers of natural gas are actually subject to an annual savings obligation in 2017.

Obligated parties are assigned the public service task ('mission de service public') of achieving the energy savings target imposed on Luxembourg under Article 7 of the Directive. To that end, the obligation scheme will be defined in Luxembourg law as a service of general economic interest ('service d'intérêt économique général').^{9 10} Such an arrangement will make it possible to finance the obligation scheme at least partly through public funds. However, at the moment no public funds have so far been spent on the energy savings obligation system.

3.1.1.2 Target sectors

The obligation applies only to electricity and gas suppliers. The obligated parties are, however, free to record energy savings achieved in other sectors, e.g. fuel oil. Energy savings in the residential, service and industrial sectors can also be taken into account, as well as savings in the transport sector, insofar

⁹ Law of 19 June 2015 amending – the amended Law of 1 August 2007 on the organisation of the electricity market; - the amended Law of 30 May 2005 on 1) the structure of the Luxembourg Institute of Regulation; 2) the amendment of the amended Law of 22 June 1963 on the salary scheme for civil servants.

¹⁰ Law of 19 June 2015 amending the amended Law of 1 August 2007 on the organisation of the natural gas market.

as these are provided for at the regulatory level.¹¹

Making energy savings may lead to the obligated parties incurring additional costs, part of which could be passed on to the final customers, thus leading to an increase in electricity and gas prices. In order to avoid any distortion of competition, a tax may be imposed on energy sources such as fuel oil, the suppliers of which are not included in the obligation scheme, if there is justifiable evidence for an actual rise in electricity and gas prices.

3.1.1.3 Level of the energy saving target

Based on Eurostat data¹², the energy savings target to be achieved by 31 December 2020 in accordance with Article 7 was calculated at 5 993 GWh. In accordance with Article 7 Paragraph 1, Luxembourg excludes the sales of energy used in transport and takes account of flexibility mechanisms pursuant to Article 7 Paragraphs 2 and 3, which result in a reduction of 25 % in the target. Luxembourg thus makes use of the following options:

- Exclusion of part of the energy consumption in industrial activities listed in Annex I to Directive 2003/87/EC (Article 7 Paragraph 2 Point b), and;
- progressive application of the energy efficiency obligation scheme (Article 7 Paragraph 2 Point a).

The calculation of the target value is shown in the table below.

Table 6: Calculation of Luxembourg's energy saving target in accordance with Article 7 [in GWh]¹³

GWh	2010	2011	2012	Average 2010-2012
Total final energy consumption [source: Eurostat Code B_101700]	50 323	49 974	48 579	-
Final energy consumption transport [source: Eurostat Code B_101900]	30 285	31 529	29 994	-
Final energy consumption excluding transport	20 038	18 445	18 585	19 023
Target before taking the reduction into account: $1.5 \% \times 28 \times 19\,023 = 7\,990$ GWh				
Target after taking the reduction into account: $(100 \% - 25 \%) \times 7\,990 = 5\,993$ GWh				

3.1.1.4 Duration of the obligation period and intermediate periods

¹¹ Grand-Ducal Regulation of 7 August 2015 on the energy efficiency obligation mechanism.

¹² Eurostat, *Energy balance sheets 2011-2012, 2014 edition*, Luxembourg, 2014 (Page 43)

¹³ The data published by Eurostat have already been converted into GWh in this table.

The energy savings obligation scheme was introduced for a period of six years – from 1 January 2015 to 31 December 2020. This does not, however, mean that the scheme cannot continue to operate after that time period by a simple adaptation of the relevant legal and regulatory provisions.

The obligated parties receive a savings target for each year, which is calculated on the basis of the market shares in the previous year. This enables regular monitoring the extent to which the target is met.

3.1.1.5 Eligible measure categories

The obligated parties may undertake measures in all sectors (including transport) and involving all types of energy. This flexibility allows the obligated parties to achieve energy savings with the best cost-benefit ratio.

During the year 2015, to support the obligated parties a catalogue of standard measures¹⁴ was prepared, which specifies the savings, which can be assigned to certain measures. This catalogue contains the following measures:

Table 7: List of standard measures (as of January 2017)

Category	Code	Measure title	Sector *
Buildings	BA-010	Thermal insulation of an exterior wall	H+T+I
	BA-020	Thermal insulation of a roof or of an upper floor contiguous with a non-heated area	H+T+I
	BA-030	Thermal insulation of a lower flooring contiguous with a non-heated area or with the ground.	H+T+I
	BA-040	Windows exchange	H+T+I
	BA-050	Controlled mechanical ventilation with heat recovery	H+T+I
	BA-060	Replacement of a heat production unit	H+T+I
	BA-070	Solar thermal installation, with or without central heating make-up	H
	BA-080	Thermal insulation of central heating or hot water piping networks	H+T+I
	BA-090	Heating circulation pump with an energy efficiency class A	H+T+I
Domestic appliances	AE-010	Replacement of a fridge or a freezer with an energy efficiency class A+ or better unit	H+T+I
	AE-020	Replacement of a dishwasher with an energy efficiency class A+ or better unit	H+T+I
	AE-030	Replacement of a washing machine with an energy efficiency A+ class or better unit	H+T+I
	AE-040	Replacement of a dryer with an energy efficiency class A or better unit	H+T+I
Office equipment	EB-010	Installation of a master-slave power strip	H+T+I
Lighting	EC-010	Non-directed lamp with an energy efficiency class A or better	H+T+I

¹⁴

Grand-Ducal Regulation of 7 August 2015 on the energy efficiency obligation mechanism, Annex II

	EC-020	Directed lamp with an energy efficiency class A or better	H+T+I
	EC-030	Motion sensor	T+I
	EC-040	Timer	T+I
Motors	MO-010	High efficiency electric motor	I+T
	PO-010	Speed variation on a circulating pump	I
Pumps	PO-020	Reduction of operating time of a circulation pump	I
	VE-010	High efficiency ventilator	I+T
Ventilation	VE-020	Reduction of operating time of a ventilation system	I+T
	AC-010	Reduction of compressed air pressure	I
Compressed Air Systems	AC-020	Reduction of inlet air temperature	I
	AC-030	Reduction of compressed air leaks	I
	AC-040	Heat recovery on a compressed air system	I
Industrial Boilers	CI-010	Economizer on an industrial boiler	I
	CI-020	Condensing economizer on an industrial boiler	I
	SR-010	Increase of the evaporating temperature	I+T
Cooling systems	SR-020	Reduction of the condensing temperature	I+T
	ME-010	Certified ISO 50001 energy management system	I+T
	TR-010	Replacement of a car with a more energy-efficient model	H+T+I
Transportation	TR-020	Replacement of a car with an electric or plug-in hybrid car	H+T+I

* I = Industry; H = Households; T = Tertiary sector

The calculation procedures of the individual standard measures, which are always specific to the initial situation, the corresponding formulas and calculation methods, are stipulated in the Grand-Ducal Regulation on the energy savings obligation scheme.

In principle, this catalogue can be adapted or expanded as required to take account of the most recent data on measures. The catalogue focuses mainly on technical measures the effects of which can be easily measured and documented. Without completely prohibiting them, measures aimed at changing behaviour will be taken into account only to a limited extent, as they are difficult to measure and their effect on behaviour may only be felt for a limited period.

The obligated parties will, however, remain free to implement other energy-saving measures not listed in the catalogue of standard measures, as long as they take into account the specified calculation methodology.

The obligated parties will be allowed considerable flexibility in terms of the nature of their actions with respect to their final customers. For instance, they may grant financial assistance for savings measures, offer information, advice and audits, or a combination thereof.

Obligated parties may also arrange for the savings to be achieved by third parties (installers, electricians, energy advisors etc.). In this case, they must ensure that the actions of the third party contribute to achieving the energy savings. The contact between the third party and the obligated

party must have taken place before the savings measure was implemented. The obligated parties are free to choose the implementing third party either through a tender process or through negotiations and bilateral contracts.

In view of the limited market for energy savings in Luxembourg, Luxembourg has no plans to introduce a trading system. Exchanges or bilateral transfers of energy savings certificates will not, however, be prohibited.

3.1.1.6 Calculation procedure

Annex V of the EED leaves Member States the freedom to select a method for calculating energy savings from those proposed under Point 1 of the Annex, namely (a) presumed savings, (b) metered savings, (c) estimated savings, and (d) surveyed savings.

To enable the obligated parties to determine the amount of savings produced by the measures as cost-effectively as possible, a standard catalogue of measures was prepared, as mentioned above. The catalogue contains presumed savings (Point 1 (a) of Annex V to the EED) and simple calculation procedures for the most common, standardised energy efficiency measures.

For measures not listed in the catalogue of standard measures, Luxembourg will establish a calculation method to evaluate the estimated energy savings (Point 1 (c) of Annex V to the EED). In this case, the obligated parties must document and justify how the savings were determined.

The conversion factors set out in Annex IV of the EED shall apply. Savings of electricity must be adjusted by applying the standard primary energy coefficient of 2.5.

Only energy savings achieved as a result of action by the obligated parties may be taken into account. Upon request, the obligated parties must demonstrate that the implementation of the energy efficiency measure resulted from or was prompted by their own action. In the declaration which the obligated parties are required to make to the Ministry of the Economy, obligated parties must mention the type of action undertaken with regard to the final customer, and must confirm that this took place before the implementation of the measure that led to the energy savings. In the event of an inspection, the obligated parties will be required to place all documents demonstrating their leading role at the disposition of the independent consultancy employed for that purpose.

3.1.1.7 Lifetime of measures

The lifetime of measures depends on the specific type of measure and is defined as a function of the actual lifetime, taking existing standards and/or empirical values into account. For standard measures, the catalogue establishes the lifetime to be taken into account. If the obligated parties propose measures which are not in the catalogue, they must indicate and justify the selection of the lifetime.

Even though the energy savings obligation scheme in Luxembourg relies on the 'first year savings' principle, the obligated parties may take into account energy savings produced in the obligation scheme from the year of implementation until the end of the lifetime of measures. Savings arising after 2020 cannot be recorded until a decision has been taken on the possible continuation of the energy savings obligation scheme. To simplify matters, the year of implementation is considered to be a whole year.

In summary,

- in the case of measures which on account of their lifetime will still be having an effect after 2020, only the effects between the year of implementation of the measure and 2020 may be

counted;

- in the case of measures whose lifetime ends after the year of implementation but before 2020, the effects will be divided evenly between the year of implementation and 2020.

3.1.1.8 Addressing climatic variations

In view of the small area occupied by Luxembourg, no specific distinctions were adopted in this regard.

3.1.1.9 Monitoring and verification

On 1 March of each year, the obligated parties must report on the energy savings achieved during the preceding year. This annual report must be compiled by each individual obligated party, and must contain information on the type of energy, the energy-saving measure, the type of action, the actions performed by third parties, as well as details of programme costs and the effect of the action(s). Supporting documentation regarding the savings declared must be retained by the obligated parties and produced in the event of an inspection.

Up to this date, data concerning the energy savings for the year 2015 have been collected.

Table 8: Development of targets and compliance (source: survey of the Ministry for the Economy).

Year	Annual target (for all obligated [MWh]	Reporting of obligated parties [MWh]	Savings assumed by the ministry [MWh]
2015	285 381	162 108	102 470

The obligated parties failed to meet their targets for the year 2015. A reason for this result in the first year after introduction may lie in the fact that the obligated parties need time to test their measures under market conditions and where necessary, adapt them. If they fail to meet their targets in a given year, obligated parties still have to meet their targets in the following years. This method of carrying forward savings against targets is also stipulated at regulatory level.

Initiated by the Ministry of the Economy, random annual inspections of statistically significant and representative samples of the energy-saving measures may be carried out. The first inspections concerning the year 2015 were initiated at the beginning of 2017. No findings of these inspections are available as of now.

3.1.2 Energy audits and management systems (Article 8)

In Luxembourg, all final customers have access to energy audits or energy advice. For households, enterprises and public bodies, there are various incentives for performing energy audits. The main instruments are explained below.

- **Households**

As described in the NEEAP III, the national advisory body myenergy raises the awareness of households concerning the benefits of energy audits. The national support programmes provide financial aid for energy advice in conjunction with the renovation of an existing residential building and for the implementation of the resulting recommendations. Since 2011, around 3 000 energy consultations have been subsidised. Details of this are described in the NEEAP III.

- **Companies:** Energy audits are supported at small and medium-sized enterprises, as well as large industrial corporations. Due to the significance of the service sector in Luxembourg's economy, energy efficiency in non-residential buildings plays an important part.
 - In accordance with Article 8 of the EED, the introduction of an **obligation for large enterprises (not SMEs) to carry out energy audits** was introduced in July 2016.¹⁵ An initial estimate indicates that between 100 to 150 enterprises in Luxembourg will be affected by the obligation based on the number of employees.¹⁶ Legislation incorporates the requirements of the EED:
 - Minimum criteria in accordance with Annex VI of the EED;
 - Alternative options for the implementation of environmental and energy management systems;
 - Licensing of the energy auditors;
 - Inspection of implementation;
 - Sanctions in cases of non-compliance.

A list of licensed energy auditors (24 auditors in March 2017) is available to the public at the government's website www.guichet.lu¹⁷.

- During the preparation of an energy consumption certificate for existing non-residential buildings – which is required, for instance, in the event of an extension, modification, alteration or change in owner or tenant – modernisation recommendations for improving the energy use of buildings and technical systems are necessary. Additional information may be found in section 5.2.5 of the Annex to the Regulation on the Energy Performance of Non-residential Buildings¹⁸. The aforementioned regulation also governs the conditions of authorisation for drawing up these energy audits.
- In accordance with the voluntary agreement with industry, which is described in more detail in section 3.4, the participating industrial companies undertake – in addition to improving their energy efficiency – to introduce an energy management system, by identifying and evaluating the potential for improvement (energy audit) and drawing up an action plan for implementing

¹⁵ Law of 5 July 2016 amending the amended Law of 5 August 1993 on the rational use of energy. (www.legilux.public.lu/eli/etat/leg/loi/2016/07/05/n2/jo)

¹⁶ www.statistiques.public.lu/fr/publications/series/repertoire-entreprises/2016/repertoire-2016/index.html

¹⁷ www.guichet.public.lu/entreprises/fr/urbanisme-environnement/energie/energie/obligation-audit-energetique/index.html

¹⁸ www.legilux.public.lu/leg/a/archives/2010/0173/index.html and www.energyefficient.lu

at least some of this potential. Almost all the large industrial companies present in Luxembourg (approximately 70) participate in the voluntary agreement.

- **Public bodies**

- The Climate Pact described in 3.3.2.1 obliges the participating municipalities to implement the European Energy Award® quality management system and to set up an energy management system for their municipal buildings, street lighting and vehicle fleet. In January 2017, 104 of the 105 Luxembourg municipalities were participating in the Climate Pact.
- Public non-residential buildings are subject to the same provisions in the area of energy efficiency requirements as those for enterprises, which are described above. In addition to the aforementioned cases, an energy consumption certificate must be drawn up for all buildings which are used by a public authority, which are frequently visited and which have an energy reference area of over 500 m². With effect from 9 July 2015, the threshold will be 250 m².

Furthermore, the introduced **energy savings obligation scheme** (see section 3.1.1) further reinforces the incentive to carry out energy audits and energy consultations in households and enterprises. To enable the obligated parties to achieve energy savings among end users, energy-saving measures must be identified, for example by means of energy audits.

3.1.3 Metering and billing (Article 9-11)

Ensuring that accurate and timely metering and billing information is provided to the final customers can significantly influence positive behavioural changes in relation to reducing energy wastage and developing a more rational use of energy sources. In this way, measures relating to the metering and billing of energy consumption may contribute to an improvement in energy efficiency and a reduction of spikes in consumption.

In the context of Directives 2009/72/EC and 2009/73/EC concerning common rules for the internal markets in electricity and natural gas, a study¹⁹ on the technical and economic feasibility of the introduction of smart metering for all end users of electricity and gas in Luxembourg proposed an implementation strategy, based on which the next steps were taken.

In accordance with Article 29 of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 35 of the amended Act of 1 August 2007 concerning the organisation of the gas market, with effect from 1 July 2016 all new final customers (electricity and gas), and final customers whose existing meters are being replaced (electricity and gas), will receive **smart meters** that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use. The existing meters, approximately 300 000 electricity meters and 80 000 gas meters will be replaced gradually, by geographical zone. The consumption information of all final customers will be transmitted to the distribution system operators via a common central system operated and managed by the interest group Luxmetering. This central system is designed in such a

¹⁹ Schwartz and Co, *Étude économique à long terme pour la mise en place de compteurs intelligents dans les réseaux électriques et gaziers au Luxembourg* [Long-term economic study for the introduction of smart meters on the Luxembourg electricity and gas networks] Luxembourg, February 2011 (www.gouvernement.lu/4608353/comptage-intelligent.pdf)

way that other media such as district heating and water can also be connected to it. 95 % of all final customers in the electricity sector must be equipped with smart meters by 31 December 2019, 90 % of all final customers in the gas sector by 31 December 2020. An initial analysis of technical feasibility found that the wide-spread introduction of smart meters in the near future is the most economically sensible option.

The smart meters are designed in such a way that they take into account the energy efficiency goals and the benefits for the final customers and the market participants. The functions and the technical and organisational specifications of the smart metering system will be determined by the regulatory authority following a consultation with all stakeholders.

The distribution system operators, or in the case of residential customers the electricity suppliers, shall in future ensure that a final customer, or an energy service company acting on behalf of the final customer, has the option of receiving metering data on their electricity input and off-take in an easily understandable format. This should make innovative offers tailored to the customers' profiles possible in the electricity, gas and service sectors.

Distribution system operators shall ensure that advice and information is given to customers at the time of installation of smart meters, in particular about their full potential with regard to meter reading management and the monitoring of energy consumption.

The introduction of smart meters is the first step towards achieving a so called 'smart' power grid, which should make use of information technologies to optimise the decentralised generation, distribution and consumption, as well as create a more fine-tuned link between supply and demand between power suppliers and consumers of electricity. In addition, this should also create favourable conditions for the further rise in the use in electric vehicles anticipated in the near future.

Until all final customers have smart meters, the energy utilities must ensure that **billing** takes place at least once a year on the basis of actual consumption. In order to enable final customers to regulate their own energy consumption, billing information should be made available at least quarterly, if requested by consumers or if consumers have opted to receive electronic billing, otherwise twice yearly.

The energy utilities provide their final customers, in advertising material aimed at them or on websites, and at least once a year on or as an appendix to their bills, with **information** on current actual prices and current consumption of energy, compared to energy consumption for the same period in the previous year, preferably in graphic form. They offer final customers the option of receiving electronic billing information and bills and ensure that they receive, on request, a clear and understandable explanation of how their bill was derived. In addition, in this way final customers obtain contact information for consumer organisations, energy agencies or similar bodies, including information on available energy efficiency improvement measures, comparative end-user profiles and objective technical specifications for energy-using equipment. In addition, the energy utilities will ensure that comparisons with an average normalised or benchmarked final customer in the same user category are made available to final customers in clear and understandable terms, in or together with their bills or advertising material.

Distribution system operator has already launched the following initiatives for the introduction of a smart metering system:

- All electricity and gas distribution system operators have joined together in the **Luxmetering** (www.luxmetering.lu) interest group in order to promote the development of the common infrastructure and then to operate the meter reading platform.

- Between 2011 and 2014, several pilot projects were carried out on smart metering systems to determine which meter and communication technology is best suited to the situation in Luxembourg.
- From 1 July 2016, all newly connected consumers are equipped with a 'smart meter', and the existing meters are being gradually replaced.

3.1.4 Consumer information programmes (Articles 12 and 17)

In Luxembourg in recent years great efforts have been made, structures have been created and initiatives established, to provide energy consumers with detailed information on their options for saving energy, for using renewable energy, and increase their use of sustainable materials in their renovation and construction projects. One of the main elements of these efforts is the public advisory and information body myenergy. Other information and advisory initiatives are making valuable contributions, as increasingly are the market participants themselves.

3.1.4.1 myenergy

myenergy is the national advisory body in the energy sector, whose duties involve raising awareness, informing and supporting households, enterprises, municipalities and professionals with regard to energy savings, the use of renewable energy and the development of sustainable residential construction. The extensive website www.myenergy.lu is an important tool for informing the aforementioned target groups.

myenergy offers free, neutral basic advice to private individuals. This service can be provided both over the phone (hotline 8002 11 90), during personal consultations at a regional myenergy information point or in the form of on-site consultation. myenergy operates an almost closed, extensive network of 48 regional or local advice centres (divided into 21 information points; infopoint.myenergy.lu/) in partnership with 100 municipalities (as of January 2017). As part of these partnerships, myenergy organises, among other things, action weeks including on-site consultations, information events with presentations.

At the basic consultation, the customer is informed in a targeted manner about the additional services and products offered in the market. The advantages and disadvantages of the potential measures are discussed, the energy efficiency, sustainability and costs of a project are optimised, and information is provided on the use of renewable and sustainable energy, on how to save energy in everyday life, as well as on the state support programmes and the energy performance certificate.

In addition to the provision of basic advice, myenergy's further main activities include providing information and awareness-raising, which it implements in the form of attending national trade fairs, creating information brochures and Internet platforms, a regular presence in the national media and by developing its own events.

myenergy also offers the online calculation model 'myenergy home' for the purposes of awareness-raising. With the help of this tool interested users can perform a simplified assessment of the energy efficiency of their residential buildings. This tool is currently mainly used for demonstrational purposes at the different national trade fairs. In addition, myenergy also commissioned an application called

'myAAA' (www.myenergy.lu/fr/myaa), which is intended to explain to the user in a playful manner how to correctly treat and maintain an AAA house and also the most important aspects of planning.

myenergy offers enterprises basic advisory services free of charge, over the phone. As part of the voluntary agreement to improve energy efficiency in the industrial sector (see section 3.4 for further information), myenergy supports the participating enterprises in their monitoring and assists them in their first steps in the implementation of measures, e.g. by means of seminars on specific topics. myenergy also supports the Ministry for the Economy in the implementation and further development of the energy savings obligation. myenergy is also implementing a pilot project concerning corporate networks. The aim of this project is to promote energy efficiency and sustainable development through a structured and moderated exchange of information and experience between the participating companies.

On behalf of the Ministry of Sustainable Development and Infrastructure, myenergy manages the Climate Pact and as such, it is the first point of contact for municipalities in all matters of energy efficiency. The Climate Pact website may be found under the following address: www.pacteclimat.lu/. In addition to the assistance it provides in connection with the Climate Pact, myenergy also provides information to the municipalities on the national Environmental Protection Fund. The Climate Pact and Environmental Protection Fund are explained in more detail in sections 3.3.2.1 and 3.1.8.1. myenergy also develops actual implementation tools e.g. at the level of energy efficient communal planning or the introduction of construction inspections.

On behalf of the Ministry of Sustainable Development and Infrastructure, and the Ministry for Families, Integration and the Greater Region, in cooperation with the 'Offices sociaux', myenergy offers basic, customised consultation services aimed specifically at low-income households since 15 September 2016. In this context, social welfare offices identify the affected households, which are then invited to make use of and benefit from the basic advisory services provided by myenergy. The consultant at myenergy analyses the situation on site based on a standardised checklist, gives advice on improvement measures and use behaviour, and hands over to the households certain useful tools for saving energy (e.g. socket strip with switch, thermometer for the refrigerator). The energy consultant also identifies household appliances, which should be replaced. The Ministry for Sustainable Development and in certain cases social services take over a part of the costs for the replacement of old appliances based on the completed checklist.

myenergy also supports the ministries responsible for structure in different areas in its role as a facilitator. Among others this includes:

- support during the preparation and implementation of the further development of the national building renovation strategy;
- coordination of the Luxbuild2020 project;
- support in the implementation and finalisation of the Third Industrial Revolution Letzebuerg“ study (for further information see section 3.1.7.1) and further assistance in the implementation of the core recommendations of this study within the framework of the platforms 'Energy future Letzebuerg' (Energiezukunft Letzebuerg) and CNCD (Conseil National pour la Construction Durable);
- the coordination of an interministerial working group for reforming the promotion programme for residential buildings (introduction of sustainability aspects);

- participation at different discussion meetings with the representatives of ministries and/or the construction sector as part of promoting renewable energies, such as e.g. in the area of promoting geothermal projects.

3.1.4.2 Other information and advisory initiatives

The most important initiatives were already listed in the NEEAP III. For details see the section with the same title. These are:

- the online portal www.oekotopten.lu;
- an initial ecological consultation by the Ecocentre Pafendall (Ökozentrum Pafendall);
- a basic, free-of-charge consultation on sustainable construction by the Ministry for Residential Construction (Wohnungsbauministerium); and
- the Luxembourg administrative portal www.guichet.lu. In addition, the 'Residential' (Wohnen) area of the portal provides information on the formalities (e.g. the energy performance certificate) associated with renting, buying, building or renovating residential property and explores various financial support options (<http://www.guichet.public.lu/citoyens/de/logement/index.html>)

The 'Guichet unique', launched on 1 January 2017, of the Ministry for Residential Construction and the Ministry for Sustainable Development and Infrastructure is a new information and advisory network within the framework of the legislation on the Climate Bank (www.guichet.public.lu/citoyens/fr/organismes/ministere-logement/service-aides-logement/index.html).

This central administrative body receives interested individuals on site, and manages all submitted applications for financial support in the area of housing, also including financial support for energy renovations or new ecological construction. It is compulsory for energy renovations to obtain an approval from the 'Guichet unique' before the work starts based on the energy renovation concept prepared by a licensed energy expert.

Municipalities are also becoming increasingly active in raising the awareness of and providing information to members of the public. This development is mainly being driven by the incentive of the Climate Pact and the cooperation with myenergy in the local and regional information points.

3.1.4.3 Involvement of market participants

Based on the qualification and certification schemes described in more detail in section 3.1.5, the various market participants, such as craftsmen, architects, engineers and energy consultants, are involved in the provision of appropriate information and advice to energy consumers. For their part, customers have the opportunity to receive market guidance in the selection of energy service providers by means of a number of certifications (from advice, by way of planning, through to implementation). The myenergy advisors inform customers about the existing certification schemes.

The energy savings obligation scheme described in section 3.1.1 obliges all electricity and gas suppliers to achieve energy savings among their end users. This means that energy suppliers also have to strive to ensure that customers have access to the necessary information.

On 1 January 2017, the Climate Bank (see section 3.1.7.1) was launched, which is pre-financed through investments in energy efficiency and renewable energies in cooperation with existing credit

institutions. The financial institutions are also more closely involved this way.

3.1.5 Qualification and certification schemes (Article 16)

In the development of European and national energy and climate change policies, the requirements on the efficient use of energy are constantly increasing. Parallel to this, there are rising demands on the skills of professionals, and these professionals are facing new challenges. To enable professionals to acquire the necessary skills and to make these skills visible in the market, numerous qualification and certification initiatives have arisen in recent years. By means of information and advisory activities, myenergy, among others, makes energy consumers aware of the existing schemes. The individual certification schemes and training programmes are explained in more detail below – broken down into planners and consultants (project planning/support), craftsmen (project execution) and other initiatives.

We shall continue to examine whether the existing instruments and initiatives are sufficient to achieve the required level of technical skill, objectivity and reliability. In this context, the LuxBuild2020 initiative should be highlighted; this will be examined in more detail below.

3.1.5.1 Planners and advisors

In accordance with the two regulations on the energy performance of buildings²⁰, energy performance certificates may only be issued for residential or non-residential buildings by persons who are registered as architects or consulting engineers or have received a permit from the Ministry of the Economy. Permits are granted upon submission of proof of certain basic qualifications.

In addition, the **issuers of energy performance certificates** are encouraged to participate in expert training courses on the energy efficiency of buildings. These trainings have been provided on behalf of the Ministry of the Economy since the publication of the aforementioned regulations. After participating at the expert training courses, individuals are entitled to register on a list of experts for residential and/or non-residential buildings. At present (as of February 2017), there are around 440 individuals on the list of experts for residential buildings, around 170 individuals on the list for existing non-residential buildings and around 115 individuals on the list for new non-residential buildings. Further information, including the aforementioned lists of experts, may be found at www.guichet.public.lu/entreprises/fr/urbanisme-environnement/energie/energie/agrement-expert-cpe/index.html.

Since mid-2013, myenergy has been offering the **myenergy certified voluntary** certification for energy advisors (see www.mvenergv.lu/de/experten/mvenergy-certified). This provides consumers with transparent and reliable information on the quality of energy advisors and issuers of energy performance certificates. It defines the professional knowledge and skills that an energy advisor must demonstrate in order to be approved by the certification scheme and to be entitled to conduct PRIME House energy consultations eligible for support. Furthermore, the expert also contractually undertakes, among other things, to have his/her services checked and to regularly attend training courses. The list of certified energy advisors, the approval criteria and the subsequent quality assurance procedures are published on the myenergy website and are accessible to everyone. On 1 January 2017, 29 energy advisors were certified.

²⁰ Grand-Ducal Regulation of 30 November 2007 on the energy performance of residential buildings, www.legilux.public.lu/leg/a/archives/2007/0221/index.html
Amended Grand-Ducal Regulation of 31 August 2010 on the energy performance of office buildings, www.legilux.public.lu/leg/a/archives/2010/0173/index.html

In relation to qualification and certification systems, it is also important to mention the **Luxembourg Sustainability Certificate of Residential Buildings**, or **LENOZ**, introduced on 1 January 2017. This is a voluntary certification for new buildings based on ecological, economic and social criteria. The certificate is issued under a subsidy, and if a certain number of criteria are met, new residential constructions may be eligible for financial support of up to EUR 24 000. The experts licensed to issue energy performance certificates are also entitled to issue LENOZ certificates. The Ministry for Residential Construction offers corresponding training to experts.

A whole range of further training courses and advanced courses are offered in the market. Private companies for example organise the training '**Certified Passive House Designer**'. Since 2011, a 10-day training of the Passive House Institute Darmstadt prepares participants for the final exam to become a certified passive house designer (see www.passivhausplaner.eu). Altogether 103 certified passive house designers are registered in Luxembourg (as of February 2017).

Since 2003, the Professional Association of Architects and Consulting Engineers (OAI), in collaboration with the CRP Henri Tudor, has been organising an advanced training course series in **construction and energy**. This series deals with topics relating to sustainable, energy-efficient construction and is aimed primarily at architects and engineers. Since 2011, the advanced training programme has offered a wider range of topics. One third of the events continue to deal with the area of sustainable construction. Further information can be found at www.oai.lu/fr/162/oai/accueil/formations-continues/oai/.

In October 2016, e.g. the OAI in collaboration with private companies conducted a training on the calculation of thermal bridging. The event was targeted at engineers, architects and energy advisors working in the field of energy efficiency of building. Additional further training series are planned for the period 2016–2017 for advising architects and engineers, among others also on the topic of **sustainable construction and energy**.

Further training received a significant boost in 2015 through the establishment of the foundation **House of Training**, which is the result of the merger of the further training organisation of the Chambre de Commerce (Chamber of Commerce) and those of the Association des Banques et Banquiers Luxembourg. This organisation offers more than 600 different courses, in altogether 18 different training areas, among them also construction, with the sub-area **Energy and sustainable construction**. Detailed information about the offer of courses and the schedule of trainings in 2017 can be found here: www.houseoftraining.lu/training/categories

3.1.5.2 Skilled workers in the craft trades

Between 2001 and 2011, the **Luxembourg Chamber of Crafts** organised a further training programme on the topics of energy renovation, passive house (envelope and technical systems), ventilation systems, solar energy systems, heat pumps, internal insulation, hydraulic balancing and support programmes. By participating in this programme, companies could receive the **Energie fir d'Zukunft** certification. The programme was aimed primarily at the managers of companies in the relevant crafts and has been offered on an annual basis since 2001, with the exception of 2005–2007.

Since 2012, the training programme has been restructured and the certification has been further developed into **Energie fir d'Zukunft +** (see <http://www.cdm.lu/entreprise/labels/le-label-energie-fir-zukunft>). The core of this programme is the **passive house craftsman certification** (see www.passivhaus-handwerk.de). It includes a cross-craft section and a craft-specific section and is aimed at all the crafts involved in creating the building envelope and the technical systems. Upon

passing the final examination, participants receive both the **Energie fir d'Zukunft +** certification of the Luxembourg Chamber of Crafts and the international passive house craftsman certification of the Passive House Institute at Darmstadt. Both certifications are valid for 5 years and may be extended if sufficient experience in the construction of passive houses can be demonstrated. In total, 688 certified passive house craftsmen are registered in Luxembourg (as of March 2017). By way of comparison: in Belgium at the same time there were 69 certified passive house craftsmen, with further 126 in Germany, and 48 in France and 19 in the Netherlands.

As the construction of highly efficient nearly zero-energy buildings demands up-to-date abilities and expert knowledge, and requires even greater precision on the construction site, companies and their employees have to acquire new competences in performing their work. For this reason, the Chamber of Crafts and the IFSB organise courses on **passive house construction sites** for shell constructors, joiners, window fitters, plasterers, electricians and building services engineers. To complement the certified passive house craftsman course, which is aimed at owners and managers of crafts companies, this one-day craft-specific course is designed for fitters and craftsmen who carry out the manual work on site. Intensive practical exercises are carried out on an example house and using demonstration objects.

Finally, the Chamber of Crafts organises 1 to 3-day training courses on the installation and mounting of solar panels, biomass boilers and heat pumps, some of which have been a mandatory requirement since 2014 for becoming a master craftsman in the respective craft.

In addition to the courses provided by the Chamber of Crafts, since 2010 the Construction Sector Further Training Institute **IFSB (Institut de Formation Sectoriel du Bâtiment)** (www.ifsb.lu) has been offering an intensive training programme on **sustainable construction**. The programme is aimed at planners and craftsmen. Topics such as sustainable construction and renovation, insulation, windows, joinery, energy balancing, thermography, air tightness tests, solar energy systems, heat pumps and wood heaters are dealt with in practical training sessions.

One of the IFSB's important duties is to bring unskilled workers up to the level of an apprenticeship exam by means of in-service multistage training. In this training programme, approximately 5 % of the training hours are devoted to energy efficiency issues (thermal bridges, air tightness, insulation etc.).

3.1.5.2 Other initiatives in the area of qualification and certification

Some initiatives in this area were already listed in the NEEAP III. For details see the section with the same title. These services are:

- the **Learning Factory** (www.learningfactory.lu);
- the **Luxembourg EcoInnovation Cluster** (www.ecoinnovationcluster.lu); und
- **education** at secondary school and college level.

The University of Luxembourg is also offering masters courses, which are closely focussing on the topic of energy efficiency: Masters in sustainable development and Masters in engineering sciences - energy efficiency and economic efficiency. More information about the study courses can be found at: www.en.uni.lu/studies/masters.

From 2014 to 2017 the consortium 'LuxBuild2020', which consists of the Luxembourg Chamber of

Crafts, the IFSB, the Craftmen's Guild and myenergy, successfully implemented the national roadmap to the qualification of craftsmen in the area of energy efficiency and renewable energies. The work of the consortium was supported by the European Commission under the European initiative 'Build up skills, energy training for builders'. The Ministry for the Economy actively supported the project, as several initiatives were linked to this and developed further long-term until 2020.

The Luxembourg roadmap stands out due to its comprehensive approach, under which both specific further trainings and accompanying measures were realised.

In the area of communication, campaigns were realised, which informed crafts companies about the challenges in the area of energy efficient new construction, in order to raise the interest of craftsmen for further training. myenergy is in charge of communication and the coordination of the whole initiative.

Under the leadership of the Chamber of Crafts an innovative further training concept was developed and implemented. So far 650 individuals could be trained or certified as passive house craftsmen. Further 400 craftsmen participated at the practical training on passive house construction. Another element of the innovative concept is an offer of coaching. Crafts companies can either train an employee to become an expert in the field of energy efficient construction and to impart cross-craft knowledge, or rely on an external expert. A new training tool, the so called AAA box was developed for the purposes of coaching.

Structural improvements were achieved through the establishment of two competence centres. The Craftmen's Guild is charge of drawing up competence grids for all crafts involved in installations and internal construction. The LuxBuild initiative also placed particular emphasis on competences in the field of energy efficiency and renewable energies in addition to the cross-craft and organisational competences. The competence grids are structured in accordance with the European Certification Framework (CEC) and represent an important element within the competence centres 'Internal construction' and 'Technical installations'. These competence centres started their work in 2016.

Under the leadership of the IFSB, a series of services have been launched, which make it easier for craftsmen to access further training. This includes support for drawing up training plans, as well as in applying for public financial aid for participating in further training measures. Small and medium-sized craft companies particularly benefit from this offer. The website www.luxbuild.lu gathers all information important for craftsmen in relation to available trainings, the legislative framework and accompanying services.

3.1.6 Energy Services (EED Article 18)

In recent years, the Luxembourg market for energy services has developed differently in each market segment. While the supply of and demand for energy advice have both risen sharply, initial experiences are currently being made with energy savings contracts. When describing this market

development, a distinction is made between the following types of services²¹:

- Energy savings contracts (the EED uses the term ‘energy performance contracting’);
- Energy supply contracting (contracts for the supply of heating/cooling or emergency power);
- Energy management and energy accounting (see description in section 3.1.2)
- Energy advice or energy audits (see description in section 3.1.2.) Additional information relating to supporting measures may be found in sections 3.1.4 and 3.1.5).

Overall, the potential for development of the energy services market is considered to be high. The **energy savings obligation scheme** described in section 3.1.1 should help to tap this potential. Under this scheme, all electricity and gas suppliers are obliged to generate energy savings at end user level.

This obligation will encourage energy suppliers to integrate energy services within their business model, by offering energy services themselves or using the services of third parties.

Lists of the available energy service providers have already been published for some types of services. A list is published on the website www.guichet.public.lu of the experts authorised to issue energy performance certificates for residential and non-residential buildings who have taken part in training organised by the Ministry of the Economy. Energy advice in the context of subsidised home renovations²² may only be provided by experts licensed by the Ministry for Sustainable Development and Infrastructure since 1 January 2017. The list of energy advisors certified by myenergy for residential construction may be found at www.myenergy.lu/fr/experts/comment-devenir-conseiller-myenergy-certified (see also section 3.1.5).

As the market for energy savings contracts is being set up at present, it is too early to publish a consolidated list of providers of such contracts. It is estimated that nearly a dozen enterprises based in Luxembourg possess the necessary qualifications and prerequisites to offer energy savings contracts. On account of Luxembourg’s close economic ties with neighbouring countries, specialised foreign enterprises may also provide such contracts.

3.1.6.1 Energy savings contracts

On behalf of the Ministry of the Economy and in cooperation with myenergy, a **model contract** for the drafting of energy savings contracts in buildings has been produced. The model contract is aimed primarily at public buildings and may be downloaded from <http://promotiondusecteur.myenergy.lu/>.

In order to increase the incentive for municipalities to use energy savings contracts, in addition to the Climate Pact **financial aid** was introduced via the reform of the Environmental Protection Fund. Both the project management costs as well as any subsidy of construction costs will, under certain conditions, be eligible for public aid.

The possible use of energy savings contracts has been reviewed by several public actors since the last NEEAP report and evaluated for specific application options. In response to new instruments, such as the energy savings obligation scheme and energy audits (see 3.1.2) in addition to energy

²¹ Inspection and maintenance of heating and air conditioning systems or other technical systems, as well as air tightness tests and thermography, are examples of other existing energy service offerings that are not considered in more detail in this overview.

²² In accordance with the ‘Grand-Ducal Regulation of 23 July 2016 amending 1. the amended Grand-Ducal Regulation of 30 November 2007 on the energy performance of residential buildings; 2. the amended Grand-Ducal Regulation of 31 August 2010 on the energy performance of office buildings; and 3. the Grand-Ducal Regulation of 12 December 2012 establishing an aid scheme to encourage the rational use of energy and promote renewable energy in the housing sector <http://legilux.public.lu/eli/etat/leg/rgd/2016/12/23/n40/jo>

savings contracts, additional energy policy incentive instruments now exist, which have a stimulating effect on the market and are favourable for new dynamics.

3.1.6.2 Energy supply contracting

In Luxembourg, the market for energy supply contracting began to develop in the 1990s. Based on a large number of projects and the presence of multiple experienced suppliers, this market may be described as mature. During the last 20 years, cogeneration plants and district heating networks – linked to energy supply contracting – have been installed in many municipalities, larger buildings and industrial enterprises. The anticipated future developments are described in section 3.6.2.

3.1.7 Introduction of the 'climate bank' (Klimabank) to facilitate investments in energy efficiency and renewable energy

The so called Climate bank entered into effect in January 2017, which is aimed at private individuals and legal entities. Within the framework of the Climate Bank, applicants are offered financial support in the form of a loan with reduced interests, or for the support of low-income households, an interest-free loan. The supported measures include renovation projects, replacement of technical installations, and in the case of interest-free loans, the initial energy advice in relation to residential buildings.

The Climate Bank is complementary to the promotion programme PRIME House and relies on its support criteria. The applicants can benefit from both financial aids this way. In contrast to ex-post investment aid of PRIME House, the investments are financed by loans at the Climate Bank. In the case of interest-free loans the investment aid of PRIME House may be used for repayment.

The aim of the introduction of the Climate Bank is to contribute to the rise in the number of energy efficient and sustainable residential building renovations through the pre-financing of energy renovation projects. The two types of loans provided for are described in more detail below.

Interest-free climate loan

This loan is aimed at households, which meet the socio-economic conditions of the regulation for individual housing promotion in accordance with the amended version of the Act of 25 February 1979 about housing promotion.

Modalities:

- Directly covering the costs for energy consulting, which is required in advance for the use of the loan, by the Ministry for Residential Construction;
- Covering all interests of the loan;
- the beneficiary only has to repay the amount of the agreed loan, which may not exceed EUR 50 000 over a maximum term of 15 years;
- the loan is fully secured by the state in order to provide easier access to a bank loan, and to reduce the costs related to the collaterals required by financial institutions;
- Providing a one-off capital grant amounting to 10 % of the borrowed capital to reduce the total amount to be repaid (maximum EUR 5 000).

Climate loan with reduced interests

Every natural person and legal entity, which is the owner of a residential building in Luxembourg no

more than 10 years old can make use of a climate loan with reduced interests.

Modalities:

- The loan is limited to an amount of EUR 100 000 per residential building over a term of 15 years;
- 1.5 % subsidy on the interests of the bank (maximum EUR 10 000)

The calculation of final energy savings is based on the amount of subsidy and the initially presumed ratio of financial support.

The ratio of financial support presumed to be the same as with the programme 'Energy efficient construction/renovation' of the KfW (Source: The sectoral distribution is 100 % for residential buildings, and the regulation only stipulates the support of housing projects.

The legislative basis of the « Climate Bank » are « la loi du 23 décembre 2016 relative á un régime d'aides á des prêts climatiques »

www.legilux.public.lu/eli/etat/leg/loi/2016/12/23/n23/jo,

and « le règlement grand-ducal du 23 décembre 2016 fixant les mesures d'exécution de la loi du 23 décembre 2016 relative á un régime d'aides á des prêts climatiques »

www.legilux.public.lu/eli/etat/leg/rgd/2016/12/23/n43/jo.

Further information on the « Climate Bank » is available at the following address:

www.myenergy.lu/fr/particuliers/lois-et-reglements/soutien-financier#prets-climatiques

3.1.8 Other measures of a horizontal nature (Articles 19 and 20)

3.1.8.1 Financial instruments

In Luxembourg, households, enterprises and municipalities are all encouraged by promotion programmes to invest in energy efficiency. This should help to overcome the financial constraints of energy efficiency projects.

Households

Households are supported mainly in the form of investment aid²³ for energy renovation, the construction of a passive or nearly zero-energy building and the use of renewable energy. The promotion programme has been extended and adapted several times since 2001. Based on the latest regulations on nearly zero-energy buildings (which generally correspond to the construction standard AAA), which has been in effect for residential buildings since 1 January 2017, not only energy efficiency, but also increasingly sustainability is at the focus of promotion programmes in the area of new construction.

Further information can be found at www.mvenergy.lu/de/privatpersonen/gesetze-und-

²³ In accordance with the 'Grand-Ducal Regulation of 23 July 2016 amending 1. the amended Grand-Ducal Regulation of 30 November 2007 on the energy performance of residential buildings; 2. the amended Grand-Ducal Regulation of 31 August 2010 on the energy performance of office buildings; and 3. the Grand-Ducal Regulation of 12 December 2012 establishing an aid scheme to encourage the rational use of energy and promote renewable energy in the housing sector legilux.public.lu/eli/etat/leg/rgd/2016/07/23/n8/jo

[vorschriften/finanzierungshilfe](#) and in the section 3.2.

To further boost investment in energy-efficient housing, the so called Climate Bank was launched on 1 January 2017.

Enterprises

Investment by enterprises in energy efficiency and renewable energy will also be supported by means of investment aid through two promotion programmes²⁴. Further information may be found at www.guichet.public.lu/entreprises/de/urbanisme-environnement/aides-environnement/index.html and entreprises.myenergy.lu/informations-et-outils/solutions-de-financement/.

Local authorities

The promotion programme of the Environmental Protection Fund²⁵ supports municipalities in measures for increasing energy efficiency and the use of renewable energy. It was adapted to the current challenges in 2014. In conjunction with the Climate Pact, this should encourage an increased dynamism in the municipalities. At planning level, municipal/regional energy concepts are promoted (in coordination with the Climate Pact process), as well as the energy optimisation of spatial planning concepts. At building level, the Environmental Protection Fund supports energy renovation measures, energy-efficient new buildings and the preparation and implementation of energy savings contracts. In addition to the use of renewable energy, the energy improvement of street lighting is also promoted. The details of the promotion programme are available on the following website: particuliers.myenergy.lu/fr/subvention/communes.

Remuneration for renewable electricity generation

Irrespective of the owner's articles of association, the electricity generated from renewable energy is paid for at statutorily regulated tariffs. The current tariffs came into effect in 2014²⁶. An adjustment was introduced in 2016 on the side of feed-in tariffs.²⁷

Climate and Energy Fund

The Climate and Energy Fund set up by the amended Act of 2004²⁸ helps to finance the flexibility mechanisms of the climate agreement²⁹, national measures to reduce greenhouse gas emissions and support measures for renewable energy. It is funded primarily by the so-called 'climate contribution' in the fuel tax and part of the motor vehicle tax.

²⁴ 'Amended Law of 18 February 2010 on an aid scheme for the protection of the environment and the rational use of natural resources' www.legilux.public.lu/leg/a/archives/2010/0044/2010A0712A.html and 'Amended Law of 30 June 2004 establishing a general framework for aid schemes for medium-sized enterprises', www.legilux.public.lu/leg/a/archives/2004/0142/2004A20141.html

²⁵ Amended Law of 31 May 1999 establishing a fund for the protection of the environment - legilux.public.lu/eli/etat/leg/loi/1999/05/31/n1/jo

²⁶ Amended Grand-Ducal Regulation of 1 August 2014 on the generation of electricity from renewable energy sources - legilux.public.lu/eli/etat/leg/rgd/2014/08/01/n1/jo

²⁷ Amended Grand-Ducal Regulation of 23 July 2016 amending the Grand-Ducal Regulation of 1 August 2014 on the generation of electricity from renewable energy sources - legilux.public.lu/eli/etat/leg/rgd/2016/07/23/n4/jo

²⁸ Amended Law of 23 December 2004 1) establishing a greenhouse gas emissions trading system; 2) creating a fund to finance the Kyoto mechanisms; 3) amending Article 13bis of the amended Law of 10 June on classified establishments, www.legilux.public.lu/leg/a/archives/2012/0282/2012A4420A.html

²⁹ Purchase of greenhouse gas emission permits

The current government programme emphasises the financing of national measures. The possibility of using the Climate and Energy Fund in the context of the planned energy savings obligation scheme or of the implementation of Article 7 of the EED is currently being reviewed.

Study on the 'Third Industrial Revolution'

The government of Luxembourg together with the Chamber of Commerce and IMS Luxembourg (Inspiring More Sustainability) in close cooperation with the American economic scientist Jeremy Rifkin and his team of experts introduced the strategic study *'The Third Industrial Revolution Strategy'* in September 2015. This process, which was aimed at making the current economic model more sustainable and smarter for future generations was concluded with a precise report on the findings, which was presented in November 2016. The government decided that the synthesis of this strategic study should represent a general orientation for the future development of the country, and decided to implement a series of strategic measures and specific projects relying on existing or new platforms. It was decided that in addition to other discussion platforms in relation to energy, the platform 'Energy future Letzebuerg' (Energiezukunft Letzebuerg) should be created. This platform will deal with all strategic aspects of the medium and long-term energy revolution, as well as the implementation of the 'energy internet', i.e. a digital and smart power network in Luxembourg. The desired goal of this platform is not only the shift to a sustainable energy system, but also the implementation of further energy saving measures by relying on innovative technologies. The platform will also more closely analyse and process the results of the strategic study from other areas, such as 'Building', 'Mobility' and 'Smart economy'. The platform was divided into two parallel work processes. The first one should develop and conclude a recommendation for a national energy strategy, while the second should cover the implementation of the measures identified by the strategic study, in particular in the area 'smart' energy infrastructure and the implementation of the national energy internet.

Detailed information on this topic is available at www.troisiemerevolutionindustrielle.lu/2016/03/02/jeremy-rifkin-third-industrial-revolution/.

3.1.8.2 Other barriers and solutions

In spite of the affordable financial instruments described above, high property prices – driven primarily by general economic trends – represent a barrier to the energy renovation of buildings. In addition, the division of incentives between owners and tenants or between owners can, as in other European countries, occasionally be a hindrance to renovations. During the further development of the national building renovation strategy these and other hurdles were identified together with the possible matching solutions. The details of the measures will be summarised in the report on the further development of the building renovation strategy and published by the middle of 2017.

Apart from the aforementioned barriers, for the removal of which various options are currently being reviewed, no other significant barriers could be identified.

3.2 Energy efficiency measures in buildings

With regard to the achievement of the national energy efficiency target for 2020, the measures for improving the energy efficiency of buildings will make a significant contribution (see section 2).

The energy efficiency measures in buildings cover both the residential and non-residential building sectors. In this connection, ambitious minimum standards are being set for both sectors by regulatory law. For residential buildings, a promotion programme is also encouraging the implementation of the

highest standards of new construction and renovation. The measures are described in more detail below.

Housing construction in accordance with the Energy Efficiency Regulation																			
Type of measure	Regulatory – energy efficiency standards for buildings																		
Target application	Energy consumption for heating and hot water in new residential buildings																		
Mechanism of action	<p>Tightening energy efficiency requirements on new non-residential buildings</p> <p>Timetable of energy efficiency requirements</p> <table border="1"> <thead> <tr> <th>Date of building application</th> <th>before 01/07/2012</th> <th>from 01/07/2012</th> <th>from 01/01/2015</th> <th>from 01/01/2017</th> </tr> </thead> <tbody> <tr> <td>Thermal insulation class</td> <td>D</td> <td>C</td> <td>B</td> <td>nZEB</td> </tr> <tr> <td>Energy efficiency class</td> <td>D</td> <td>B</td> <td>A</td> <td>nZEB</td> </tr> </tbody> </table> <p>The energy efficiency standard of the nearly zero-energy building (nZEB) generally corresponds to an AA building.</p> <p>Effect of the measure approximately 1 year after the respective closing date.</p>				Date of building application	before 01/07/2012	from 01/07/2012	from 01/01/2015	from 01/01/2017	Thermal insulation class	D	C	B	nZEB	Energy efficiency class	D	B	A	nZEB
Date of building application	before 01/07/2012	from 01/07/2012	from 01/01/2015	from 01/01/2017															
Thermal insulation class	D	C	B	nZEB															
Energy efficiency class	D	B	A	nZEB															
Implementation status and timeframe	<p>In force</p> <p>See timetable in Mechanism of action</p>																		
Important measure parameters	Average rate of new construction: approx. 3.5 %/a in ratio of the annual housing stock. This corresponds to approximately 8 600 housing units/a in 2020 and is determined by an annual population increase of around 13 000 units at present and an estimated annual demolition rate of 0.2 %.																		
Anticipated energy savings in 2020	Final energy savings: 355 GWh																		
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 125 GWh, as opposed to the 115 GWh anticipated in the NEEAP III. The difference is due only to the adjustment of building numbers and their growth rate.																		
Financing	The implementation of the energy efficiency requirements is financed through the market for non-residential construction.																		
Legislative basis	Grand-Ducal Regulation of 30 November 2007 on the energy performance of residential buildings.																		
Further information	www.legilux.public.lu/leg/a/archives/2012/0096/index.html www.quichet.public.lu																		

Promotion of energy efficient housing construction																			
Type of measure	Financial – Grants																		
Target application	Energy consumption for heating and hot water in new residential buildings																		
Mechanism of action	<p>The promotion of low-energy and passive houses should accelerate the introduction of corresponding standards before their mandatory application.</p> <p>Timetable for support</p> <table border="1"> <thead> <tr> <th>Year of building application</th> <th>2013</th> <th>2014</th> <th>2015</th> <th>2016</th> </tr> </thead> <tbody> <tr> <td>Low-energy houses</td> <td>X</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Passive houses</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> </tr> </tbody> </table>				Year of building application	2013	2014	2015	2016	Low-energy houses	X	-	-	-	Passive houses	X	X	X	X
Year of building application	2013	2014	2015	2016															
Low-energy houses	X	-	-	-															
Passive houses	X	X	X	X															

	<p>Low-energy houses correspond to the energy efficiency standard B/B. Passive houses correspond to the energy efficiency standard A/A.</p> <p>Effect of the measure manifests for several years after the respective closing date.</p>
Implementation status and timeframe	From 1 January 2017 energy efficient new residential buildings are no longer supported. See timetable under Mechanism of action The last promotion programme ran from 1 January 2013 to 31 December 2016.
Important measure parameters	The calculation of the expected energy savings is based on the number of houses supported, which is statistically known for the period from 2013 to 2015. Even though the measure is implemented until 31 December 2016, putting the energy systems of these houses in operation and their recording in statistics can be expected to take place in the next several years. As statistical figures after 2015 are not complete, the number of houses in the calculation of savings was set as zero after that date.
Anticipated energy savings in 2020	Final energy savings: 9 GWh
Between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 6 GWh, as opposed to the 48 GWh anticipated in the NEEAP III. The difference is caused by the fact that the actual effect of the measure manifests for several years after the closing date. This development can be best observed statistically in the support for nearly zero-energy buildings. In the NEEAP III, a delay of the measure's effect by a year was assumed. The latest statistical data however show a distribution of affected buildings as late as into the year 2017, when assessed on the basis of the year when the application for support was submitted (i.e. definitely after the building was completed). A similar delay period can also be expected in relation to AAA buildings. The final energy savings achieved in the period 2013 to 2015 is based on the latest statistical figures of the supported cases. As the latest statistical figures about supported cases are not complete from 2016 onwards, no new supported cases are assumed to occur for the purposes of the calculation of final energy savings from 2016 onwards due to estimation difficulties, although such cases can be expected.
Financing	To finance this proportion of the support programme, a state budget of between approx. EUR 5 million and EUR 7 million has been allocated over the period.
Legislative basis	Amended Grand-Ducal Regulation of 12 December 2012 establishing an aid scheme to encourage the rational use of energy and promote renewable energy in the housing sector
Further information	www.legilux.public.lu/leg/a/archives/2012/0264/index.html particuliers.mvenergy.lu/de/finanzielle_unterstuetzung

Promotion of the energy renovation of residential buildings

Type of measure	Financial – Grants
Target application	Heating demand in existing residential buildings
Mechanism of action	<p>The support provides a financial incentive for the energy renovation of existing residential buildings in accordance with the Energy Efficiency Regulation. Subsidies are granted for improving the thermal insulation of the building envelope and for the use of a mechanical ventilation system. Prior to the renovation, the provision of energy advice is mandatory, which is also subsidised. The better the standard achieved, the higher the subsidy. For extensive energy renovations, which result in a thermal insulation class C, B or A, the grants were doubled as compared to the previous promotion programme. An additional increase of the amount of support compared to the previous promotion programme becomes available if ecological construction materials are used.</p> <p>The effect of the measure may manifest for several years after the respective closing date.</p>
Implementation status and timeframe	In force The previous promotion programme ran from 1 January 2013 to 31 December 2016. The new and current promotion programme runs from 1 January 2017 to 31 December 2020.
Important measure	The calculation of final energy savings is based on the figures of the individual supported

parameters	measures, which are published by the environmental administration. The surface area of insulated building components are also recorded in statistics on support applications. The presumed insulation standard after renovation corresponds to the required minimum insulation standard for eligibility. As regards the trends of the figures of supported measures from 2016 onwards, an annual increase of 20 % up to 2020 is assumed for the purpose budget estimations.
Anticipated energy savings in 2020	Final energy savings: 47 GWh
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 12 GWh, as opposed to the 18 GWh anticipated in the NEEAP III. The difference is due to the more precise calculation method, and also the statistically known figures of the individual supported measures for the years 2013-2015.
Financing	To finance this proportion of the support programme, a state budget of between approx. EUR 5 million and EUR 9 million has been allocated over the period.
Legislative basis	Grand-Ducal Regulation of 23 December 2016 on the implementing measures of the Law of 23 December 2016 establishing an aid scheme to promote sustainability, the rational use of energy and renewable energy in the housing sector
Further information	http://legilux.public.lu/eli/etat/leg/rqd/2016/12/23/n40/fo https://www.mvenergv.lu/de/privatpersonen/gesetze-und-vorschriften/finanzierungshilfe

Promotion of solar systems and heat pumps in residential buildings

Type of measure	Financial – Grants
Target application	Final energy consumption for heating and hot water in new and existing residential buildings
Mechanism of action	Thanks to the promotion of the use of solar thermal systems and heat pumps, the support should lead to the improved energy efficiency of heating systems in existing and new residential buildings. The new promotion programme, which entered into force on 1 January 2017, stipulates additional grants in the case of the combined use of a solar thermal system and a heat pump, or a biomass boiler.
Implementation status and timeframe	In force The earlier promotion programme ran from 1 January 2013 to 31 December 2016. The current promotion programme runs from 1 January 2017 to 31 December 2020.
Important measure parameters	The number of supported cases were published by the environmental administration. The total number of supported systems was 246 in 2013, 450 in 2014 and 585 in 2015. 644 applications were submitted in 2016, but this number may rise further. For the purpose of the trends of the number of supported cases, an annual increase of 10 % is assumed up to 2020, which takes into account the budget estimation of the responsible administration.
Anticipated energy savings in 2020	Final energy savings: 28 GWh
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 10 GWh, as opposed to the 46 GWh anticipated in the NEEAP III. The reason for the difference is exclusively the adjustment of supported cases by statistically known figures.
Financing	To finance the portion of technical installations, a state budget of between approx. EUR 9 million and EUR 14 million per year was allocated over the period.
Legislative basis	Grand-Ducal Regulation of 23 December 2016 on the implementing measures of the Law of 23 December 2016 establishing an aid scheme to promote sustainability, the rational use of energy and renewable energy in the housing sector
Further information	http://legilux.public.lu/eli/etat/leg/rqd/2016/12/23/n40/fo https://www.mvenergv.lu/de/privatpersonen/gesetze-und-vorschriften/finanzierungshilfe

Non-residential construction in accordance with the Energy Efficiency Regulation

Type of measure	Regulatory – energy efficiency standards for buildings
Target application	Energy consumption for heating and hot water in new residential buildings
Mechanism of action	Tightening of energy efficiency requirements on new non-residential buildings. Since 1 January 2011 (date of building application) non-residential buildings have to meet efficiency class D. Compared to buildings before the introduction of this regulation savings of approximately 30 % are anticipated. Effect of the measure approximately 2 years after the respective closing date.
Implementation status and timeframe	In force since 1 January 2011
Important measure parameters	Average rate of new construction: 1.5 %/a
Anticipated energy savings in 2020	Final energy savings: 112 GWh
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 73 GWh, as opposed to the 123 GWh anticipated in the NEEAP III. The difference is due only to the adjustment of basis data.
Financing	The implementation of the energy efficiency requirements is financed by the market for non-residential construction.
Legislative basis	Amended Grand-Ducal Regulation of 31 August 2010 on the energy performance of office buildings
Further information	www.legilux.public.lu/leg/a/archives/2010/0173/index.html

Renovation of non-residential buildings in accordance with the Energy Efficiency Regulation

Type of measure	Regulatory – energy efficiency standards for buildings
Target application	Final energy consumption for heating and hot water in existing non-residential buildings
Mechanism of action	Introduction of energy efficiency requirements during the conversion or renovation of non-residential buildings. Since 1 January 2011, non-residential buildings have to meet minimum requirements in the case of conversions or renovation (U-values, thermal insulation of distribution pipes, control systems etc.) in relation to conversion or renovation. Compared to the existing building stock, savings of around 20 % are expected. Effect of the measure approximately 2 years after the respective closing date.
Implementation status and timeframe	In force since 1 January 2011
Important measure parameters	Average renovation rate: 0.5 %/a
Anticipated energy savings in 2020	Final energy savings: 26 GWh
Financing	The implementation of the energy efficiency requirements is financed by the market for non-residential construction.
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 17 GWh, as opposed to the 21 GWh anticipated in the NEEAP III. The difference is exclusively due to the adjustment of basis data.
Legislative basis	Amended Grand-Ducal Regulation of 31 August 2010 on the energy performance of office buildings
Further information	www.legilux.public.lu/leg/a/archives/2010/0173/index.html

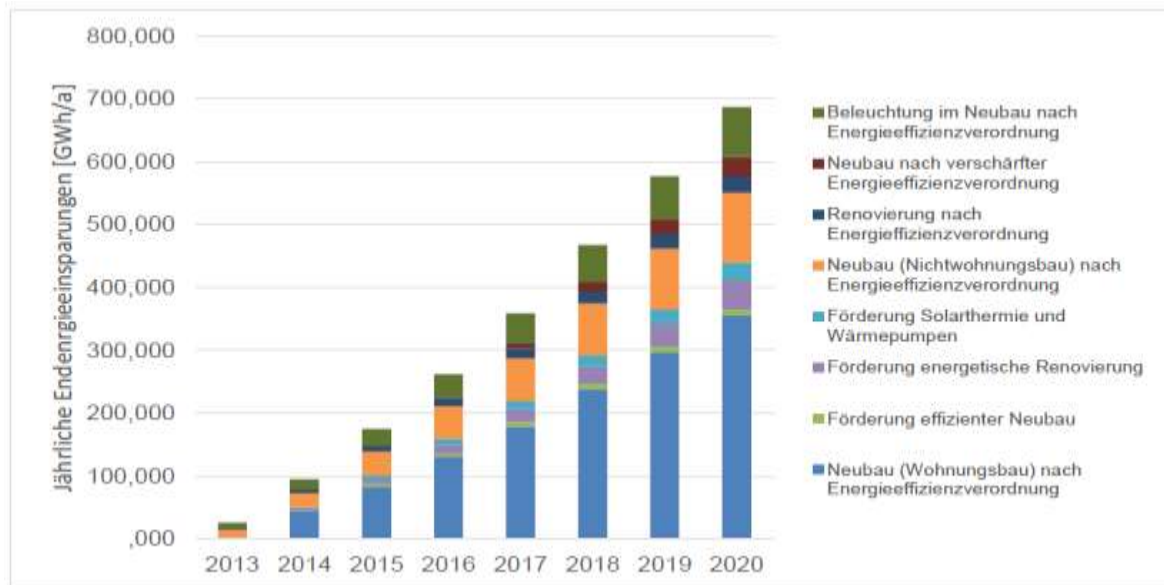
Non-residential construction in accordance with the stricter Energy Efficiency Regulation

Type of measure	Regulatory – energy efficiency standards for buildings
Target application	Energy consumption for heating and hot water in new residential buildings
Mechanism of action	Further tightening of energy efficiency requirements on new non-residential buildings. From 1

	July 2015 (date of building application) non-residential buildings have to meet efficiency class C. Compared to the previous standard, this tighter standard corresponds to savings of 15 %. Effect of the measure approximately 2 years after the respective closing date.
Implementation status and timeframe	In force since 1 July 2015
Important measure parameters	Average rate of new construction: 1.5 %/a
Anticipated energy savings in 2020	Final energy savings: 30 GWh
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 0 GWh, as opposed to the 0 GWh anticipated in the NEEAP III.
Financing	The implementation of the energy efficiency requirements is financed by the market for non-residential construction.
Legislative basis	Grand-Ducal Regulation of 26 May 2014 amending the amended Grand-Ducal Regulation of 31 August 2010 on the energy performance of office buildings
Further information	www.legilux.public.lu/eli/etat/leg/loi/2014/05/26/n2/fo

Lighting in non-residential construction in accordance with the Energy Efficiency Regulation	
Type of measure	Regulatory – energy efficiency standards for buildings
Target application	Electricity consumption for lighting in new non-residential buildings
Mechanism of action	Introduction of an energy efficiency requirement on lighting in new non-residential buildings (additional requirements on ventilation, cooling etc.). Since 1 January 2011 (date of building application), non-residential buildings have to meet efficiency class D. Compared to buildings before the introduction of this regulation, savings of around 40 % in electricity for lighting are expected. Effect of the measure approximately 2 years after the respective closing date.
Implementation status and timeframe	In force since 1 January 2011
Important measure parameters	Average rate of new construction: 1.5 %/a
Anticipated energy savings in 2020	Final energy savings: 80 GWh
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 52 GWh, equivalent to the 52 GWh anticipated in the NEEAP III.
Financing	The implementation of the energy efficiency requirements is financed by the market for non-residential construction.
Legislative basis	Amended Grand-Ducal Regulation of 31 August 2010 on the Energy Performance of Non-residential
Further information	www.legilux.public.lu/leg/a/archives/2010/0173/index.html

The figure below shows the expected final energy savings as a result of energy efficiency measures in buildings. It is clear that the continuous tightening of energy efficiency standards in new buildings achieves the proportionately greatest effect. The listed support instruments will generate additional energy savings beyond 2020, as the measures will be in force at least up to 2020.



Annual energy savings [GWh/a]

- Lighting in new builds in accordance with the Energy Efficiency Regulation
- New builds in accordance with a stricter Energy Efficiency Regulation
- Renovation in accordance with the Energy Efficiency Regulation
- New builds (non-residential construction) in accordance with the Energy Efficiency Regulation
- Promotion of solar thermal and heat pumps
- Promotion of energy renovation
- Promotion of energy-efficient new builds
- New builds (housing construction) in accordance with the Energy Efficiency Regulation

Figure 3: Actual final energy savings in the period 2013–2015 and the expected development of final energy savings in the period 2016–2020 as a result of quantified energy efficiency measures in buildings

The building measures described, particularly in the area of building renovation, require accompanying measures to reinforce their effect. The measures taken in this regard are explained in more detail in section 3.1 (Horizontal measures), in section 3.3 (Energy efficiency measures in public buildings) and in the following sections 3.2.1 (Building renovation strategy) and 3.2.2 (National plan for increasing the number of nearly zero-energy buildings).

The following instruments and measures may be highlighted:

- Energy savings obligation scheme (section 3.1.1);
- myenergy information point advisory network (see section 3.1.4.1);
- LuxBuild Project (see section 3.1.5.3)
- Introduction of the 'climate bank' (Klimabank) to facilitate investments in energy efficiency and renewable energy;
- Building renovation strategy (section 3.2.1)
- Climate Pact with the municipalities (see section 3.3.2)

3.2.1 Building renovation strategy (Article 4)

In view of the significant potential for energy savings in the building stock, and its importance within Luxembourg's energy policy, the implementation of a national initiative for energy renovation was announced in the national building renovation strategy published in December 2014. A new document was prepared within the framework of the initiative for energy renovation, which deals with the further development of the building renovation strategy. It is based on the national building renovation strategy from the year 2014, complements and develops it further. This document should be published until mid-2017.

In May 2015, the Ministry of the Economy in collaboration with myenergy and an external expert, and also in consultation with the affected sectors started the further development process of the building renovation strategy. An introductory workshop marked the launch on 19 May 2015, which enabled the first exchange between the invited actors.

In the following, five topic-oriented workshops were organised on the basis of the information gathered and the contents of the building renovation strategy between October 2015 and February 2016. Altogether 180 individuals participated at this workshop series. The following workshops were held:

- Workshop 1: 'Architectural requirements and solutions' (27 October 2015)
- Workshop 2: 'Legal hurdles and solutions' (18 November 2015)
- Workshop 3: 'Motivating owners' (16 December 2015)
- Workshop 4: 'Financial hurdles' (13 January 2016)
- Workshop 5: 'Opportunities for the construction sector' (3 February 2016)
- At a complementary workshop in May 2016 hurdles for building renovation and first solution approaches were discussed with representatives of municipalities.

The aim of this series of workshops was a systematic analysis of current hurdles for energy renovations and the preparation of possible solution approaches in cooperation with the design and construction sector. The contents of the workshops were based on the national building renovation strategy, the working document presented at the introductory workshop, and the position papers submitted to this document. In addition, two surveys were carried out by TNS ILRES at the end of 2015 and beginning 2016 (at owner and expert level). The findings of the workshop were summarised and will be included in a complete form in the annex to the developed version of the building renovation strategy.

The strategic elements and the main measures from the individual topic-oriented workshops were analysed and drafted as guidelines:

1. Priority for highly efficient renovations;
2. Financeability of energy renovation measures;
3. Reconciling the goals of energy policies and monument protection;
4. Taking into account the aspects of sustainable construction and the recycling economy.

Plans exist for the implementation of the building renovation strategy to be accompanied in the future at the CNCD („Conseil National pour la Construction Durable") by a working group specifically established for the purpose.

3.2.2 National plan for increasing the number of nearly zero-energy buildings

The revised version of Directive 2010/31/EU on the energy performance of buildings introduced the concept of nearly zero-energy buildings. The Directive specifies that all new buildings must meet this standard by 31 December 2020. Furthermore, Member States must ensure that after 31 December 2018 the buildings occupied and owned by public authorities are nearly zero-energy buildings.

In addition to adapted regulations, the market and the sector also have to be prepared for the practical implementation of the new energy-saving building standard. For this purpose, national implementation and action plans for increasing the number of nearly zero-energy buildings are required. This is specified in Article 9 of the Directive.

The national plan for increasing the number of nearly zero-energy buildings³⁰ is described in detail in section 3.2.2.1 of the NEEAP III, and is available at:

www.gouvernement.lu/4579609/nationaler-plan.pdf.

In the meantime, the Grand-Ducal Regulation of 23 July 2016 has now stipulated that with effect from 1 January 2017 all new residential buildings have to meet the nearly zero-energy standard. This regulation is available at: data.legilux.public.lu/file/eli-etat-leg-memorial-2016-146-fr-pdf.pdf.

The nearly zero-energy standard for non-residential buildings enters into effect on 1 January 2019 in accordance with the Grand Ducal Regulation of 26 May 2014. This regulation is available at: data.legilux.public.lu/file/eli-etat-leg-memorial-2014-99-fr-pdf.pdf.

The staggered implementation up to 2017 of the following measures and actions is also envisaged in order to increase the number of nearly zero-energy buildings.

- Research & Development
 - Priority given to these issues at the national level;
 - Aid for research activities;
 - Aid for the development of simple tools (e.g. tools and simulators were developed and managed for the simplified calculation or estimation of energy balances: *LuxEe-B-Tool*, *myenergy home*, *EnerCalc*, ...).
- Promotion programme
 - Adjustment of requirements and levels of support (see introduction of LENOZ and Climate Bank).
- Quality assurance and energy passport
 - Further linking of the energy performance certificate with support instruments;
 - Quality assurance by means of automatic plausibility tests;
 - Establishing a central database for energy performance certificates;

³⁰ Source: Government of the Grand Duchy of Luxembourg, *Nationaler Plan Luxemburgs zur Erhöhung der Zahl der Niedrigstenergiegebäude* [Luxembourg's national plan for increasing the number of nearly zero energy buildings], Luxembourg, July 2013

- Quality control by means of a database and spot checks.
- Training, education and advanced training programmes
 - Further development of the existing offerings on the nZEB proposal
 - Implementation of the conclusions of the LuxBuild project (in the context of the European BUILDUP project) and creation of a link to the nZEB proposal.
- Implementation in national legislation
 - Tightening requirements for non-residential buildings;
 - Definition of the requirement levels for nZEBs in relation to residential buildings and Modification or introduction of various methodological bases, such as e.g..
 - Stipulating global requirements levels based on the reference building method;
 - Integration of PV systems and power storage equipment;
 - Reconciling demand and consumption;
 - requirements on thermal insulation in the summer in accordance with the method used for non-residential buildings.

3.2.3 List of existing and proposed instruments adopted or planned to promote the objectives of Directive 2010/31/EU on the energy performance of buildings (EPBD)

In accordance with Article 10 Paragraph 2 of Directive 2010/31/EU on the energy performance of buildings (EPBD), Member States must draw up a list of existing and proposed instruments and measures which are not required by this Directive, but which promote its objectives.

In this context, Luxembourg has at its disposal a wide range of instruments, which will be explained in more detail at the appropriate places in this National Energy Efficiency Action Plan. Some of the most important measures within the individual instruments are mentioned specifically in the following list. For the other measures, please refer to the appropriate sections.

- Tightening the energy efficiency standard for residential and non-residential buildings. Please see:
 - The measures in section 3.2;
 - National plan for increasing the number of nearly zero-energy buildings (section 3.2.2). From 1 January 2017, all new residential buildings have to meet the nearly zero-energy standard.
- Building renovation strategy (section 3.2.1)
- Energy savings obligation scheme (section 3.1.1)
- Energy audits and management systems (section 3.1.2)
- Metering and billing (section 3.1.3)
- Consumer information programmes (section 3.1.4)

- myenergy information point advisory network;
- Qualification and certification schemes (section 3.1.5);
 - LuxBuild Project;
 - House of Training;
 - Centre de compétences;
- Energy services (section 3.1.6)
- Other horizontal measures (section 3.1.8)
 - Promotion programmes for the energy renovation of buildings and energy-efficient new builds. These programmes are aimed at households (see also measures in section 3.2), enterprises and municipalities (LENOZ+Climate Bank);
- Central government buildings (section 3.3.1)
- Buildings of other public bodies (section 3.3.2)
 - Climate Pact with the municipalities;
- Purchasing by public bodies (section 3.3.3).

3.2.4 Calculation of cost-optimal levels of minimum energy performance requirements for new and existing residential and non-residential buildings

In accordance with Regulation No 244/2012 supplementing Directive 2010/31/EU on the energy performance of buildings, all European Member States have to review the energy requirements for new and existing residential and non-residential buildings. The aforesaid regulation describes the framework conditions for a methodical approach to the analysis of the cost-effectiveness of minimum requirements for buildings, their components and technical systems. For a number of selected reference buildings, the optimal minimum requirements and targets for increasing energy efficiency are to be determined using the method described in the regulation, from the perspective of cost-effectiveness and of primary energy, or it must be demonstrated that the requirements on building and technical systems laid down in a Member State are based on these cost-optimal levels.

The complete report is available at: www.gouvernement.lu/4579561/berechnung-gebaude.pdf

Based on the trends identified in this report, it may be stated that the introduction of further energy efficiency standards will be determined primarily by the development of energy prices and the additional costs of the energy-efficient technologies. Furthermore, the assessment and importance of the long-term security of supply and the dependence on energy imports are of the utmost significance.

The assessment based on most scenarios of the development of inflation, economic cycles, economic growth, base rate levels and market expectations allowed for the following conclusions as regards new residential buildings:

- by achieving thermal insulation class C, the range of optimal cost levels in accounting terms (whereas also higher thermal insulation standards may be considered optimal for cost levels);
- if energy prices rise, the optimal cost level usually shifts towards more efficient standards;

- public promotion programmes result in a shift in optimal cost levels towards more efficient standards;
- in relation to technical equipment, the optimal cost level corresponds to class B for primary energy consumption.

The estimates of the dependence from energy imports and the associated monetary effects, and also the conclusions about the optimal level of costs in accounting terms were ultimately crucial in determining speed following introduction and the design of the latest defined efficiency standards.

3.3 Energy efficiency measures in public buildings

3.3.1 Central government buildings (Article 5)

Article 5 of the EED requires that, with effect from 1 January 2014, 3 % of the total floor area of heated and/or cooled buildings owned and occupied by the central government is renovated each year to meet at least the minimum energy performance requirements. The 3 % rate is to be calculated based on the total floor area of buildings with a useful floor area over 500 m², which do not meet the minimum energy performance requirements. That threshold will be lowered to 250 m² as of 9 July 2015.

To calculate this renovation obligation, Luxembourg created an inventory of the affected public buildings. This was based on the definition of 'central government' in the EED and only took into account the buildings of the administrative departments whose competence extends over the whole territory of Luxembourg. Overall, the inventory records a figure of approximately 142 700 m² of total useful floor area, which is used for determining the annual target.

In the years 2014 to 2016 already 13 846 m² total useful floor area was renovated in terms of energy, which means that the required rate for the years 2014 to 2017 was slightly exceeded, as the level needed in accounting terms was at 12 429 m².

In the year 2017 the completion of further 16 043 m² is foreseen, further 6 544 m² are planned, which means that altogether 36 433 m² floor area will be renovated in terms of energy by 2020. The total renovated floor area required in accounting terms up to the year 2020 of approx. 25 900 m² is therefore exceeded by about 10 500 m².

The government programme³¹ confirms that the state will strive to play an exemplary role by launching an ambitious renovation programme for government buildings. The efforts over recent years will continue to be intensified, and even buildings that are not covered by the above definition of central government are being renovated (e.g. schools).

3.3.2 Buildings of other public bodies (Article 5)

Article 5 Paragraph 7 of the EED requires that public bodies, which are not part of central government should be encouraged to demonstrate their exemplary role in the energy efficiency of buildings. The

³¹ Government programme 2013–2018, *Luxembourg, 2013*

corresponding measures in relation to municipalities and social housing bodies governed by public law are explained below.

3.3.2.1 Local authorities

The **Climate Pact**, which is based on corresponding legislation, entered into force in January 2013. This central instrument for directing municipal energy and climate change policy is based partly on the European Energy Award® (eea) – a quality management system for municipalities in the area of energy and climate change policy – and partly on an energy management system.

The Climate Pact is described in detail in section 3.3.2.1 of the NEEAP III.

The main instrument is a catalogue of around 79 measures in 6 different areas: Development and spatial planning, municipal buildings and facilities, utility supply and waste disposal, mobility, internal organisation, communication and cooperation.



In December 2016, 104 of the 105 Luxembourg municipalities were participating in the Climate Pact.



19 signed the Climate Pact and are not yet certified (*commune engagée*).

At the same time, 85 municipalities were certified:



- 9 municipalities reached certification level 1 (40 % of the maximum score achieved);



- 72 municipalities reached certification level 2 (50 % achieved);

- 4 municipalities reached certification level 3 (75 % achieved).

Adjustments were carried out in the catalogue of measures of the Climate Pact for 2017 to take closer account of the aspects of air quality. Based on the national programme for improving air quality the focus is on reducing nitrogen oxides (NOx) and particulate matter.

In addition to the Climate Pact, the **Environmental Protection Fund** provides financial support to the municipalities for investments in energy efficiency and renewable energy.

The Environmental Protection Fund was described in the NEAAP III in section 3.3.2.1. The success of the fund is mirrored by figures. In the year 2016 EUR 5.6 million were invested, as opposed to EUR 4.2 million in 2014 and EUR 5.0 million in 2015. In comparison, this amount in the year 2013, i.e. the year when the Climate Pact was introduced (the regulation entered into force on 1 January 2013) was still at EUR 1.3 million.

3.3.2.2 Social housing bodies governed by public law

Since 2008, the **Société Nationale des Habitations à Bon Marché** (SNHBM) has been working on improving its portfolio of rental housing. The already introduced measures either involve a comprehensive energy and spatial overhaul of the existing properties or a new construction in accordance with the nearly zero-energy building standard in Luxembourg.

The **Fonds du Logement** (Housing Fund) is also fulfilling its exemplary role by implementing new construction projects to a nearly zero-energy building standard and by gradually renovating and improving its stock of rental housing in terms of energy usage. Efforts are also being made to optimise the density standard, and other functions, e.g. day care centres, nursing homes, shops and offices, are being integrated within residential buildings.

Both the Fonds du Logement and the municipalities are subject to the provisions of the aforementioned regulation.

3.3.3 Purchasing by public bodies (EED Article 6)

Article 6 of the EED requires central government to purchase products, services and buildings with high energy-efficiency performance, and to encourage all public bodies to do likewise. For the implementation of this article, Luxembourg is adapting its legislation on public procurement accordingly.

3.3.3.1 Central government

In order to take account of the requirements of Article 6, on 5 July 2016 an amendment is introduced

in the national regulation on the awarding of public works contracts, public supply contracts and public service contracts ('Grand-Ducal Regulation of 3 August 2009 concerning the implementation of the amended Act of 25 June 2009 on public procurement and concerning the modification of the threshold specified in Article 106(10) of the amended municipal Act of 13 December 1988'). A new Article 169bis was entered into the Grand-Ducal Regulation of 3 August 2009, which adopts the text and meaning of Article 6 of the EED.

Moreover, the government programme³² specifies that, in the context of the implementation of Directive 2014/24/EU, Luxembourg will be adjusting the national rules on public procurement, which will encourage a greater use of environmentally friendly materials and innovative processes. The government will, as far as possible, adapt its invitations to tender to reflect sustainability criteria.

With regard to the introduction of the standard for nearly zero-energy buildings³³, the energy efficiency requirements on all new non-residential buildings will be tightened. With effect from 1 July 2015, non-residential buildings will have to meet efficiency class C. Furthermore, Directive 2010/31/EU specifies that by 31 December 2018 the buildings occupied and also owned by public authorities should be nearly zero-energy buildings. To reinforce the state's exemplary role, the government programme stipulates that in the future only the construction of public buildings meeting the passive house standard will be approved.

In accordance with the government programme, the state will be supplied exclusively with electricity from renewable energy sources. This goal had been largely achieved by 2014.

3.3.3.2 Local authorities

At municipal level, the **Climate Pact** raises awareness and provides assistance, and municipalities are supported financially in the energy-efficient procurement of products, services and buildings through the **Environmental Protection Fund**. Section 3.3.3.2 of the NEEAP III contains a detailed description of this.

3.3.3.3 Other initiatives in the area of energy-efficient procurement

The web portal www.oekotopten.lu and the initiative 'Akaf [plus]' of 'Emweltberodung Letzebuerg' and other partners were described in the same section of the NEEAP III.

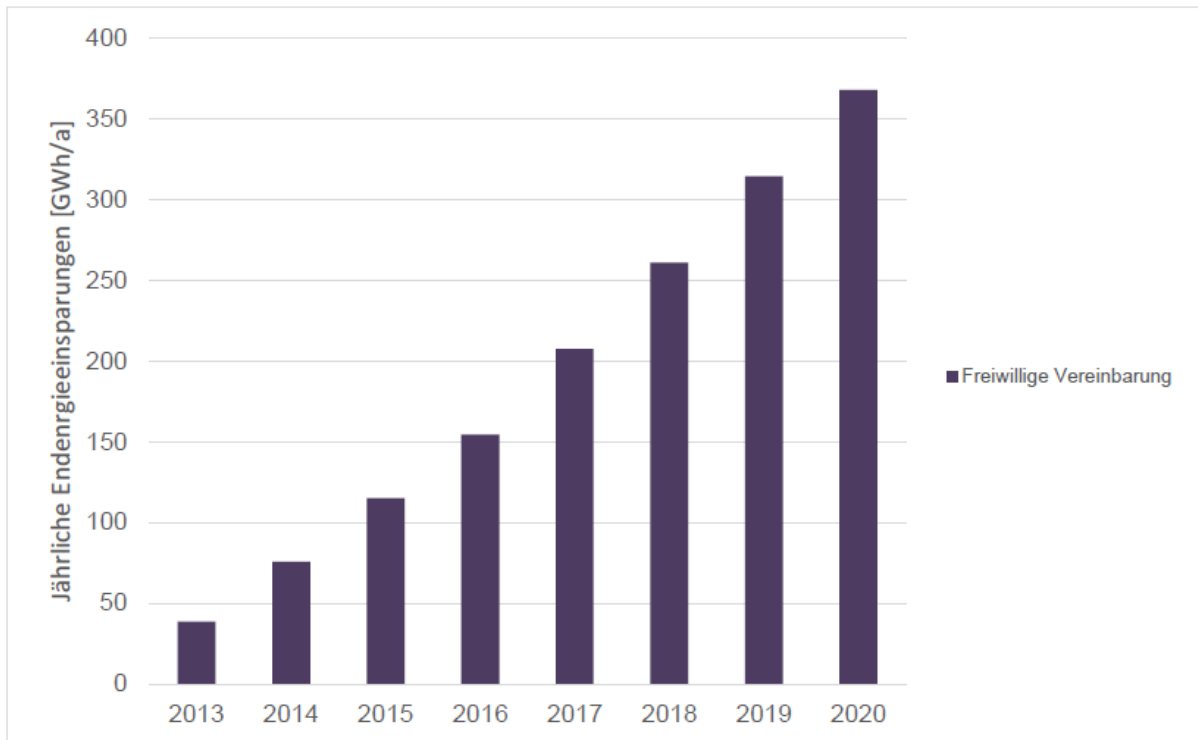
3.4 Energy efficiency measures in industry

The central energy efficiency measure in industry is the voluntary agreement between the Luxembourg Government and Fedil – the Luxembourg Business Federation – on improving energy efficiency in the industrial sector. The first agreement came into force in 1996. Since then, it has been extended and adjusted several times. The current agreement – which will expire in 2020 – is described in more detail below. In this respect, myenergy supports the participating enterprises in monitoring and assists them in their first steps of the implementation of measures, e.g. by means of seminars on a particular topic, or experience-exchange events.

³² Government programme 2013–2018, *Luxembourg*, 2013

³³ Directive 2010/31/EU on the energy performance of buildings requires all new buildings to meet the nearly zero-energy standard by 31 December 2020. In Luxembourg, the Grand-Ducal Regulation of 26 May 2014 stipulated that with effect from 1 January 2019 all new buildings (residential and non-residential) have to meet the nearly zero-energy standard.

Voluntary agreement with industry	
Type of measure	Cooperative – voluntary agreement
Target application	Energy consumption in the industrial sector (incl. ETS). Almost all the large industrial companies based in Luxembourg (approx. 70) participate.
Mechanism of action	<p>The aim of the former voluntary agreement was to improve energy efficiency by 7 % between 2011 and 2016. The new agreement once again sets a 7 % target for the period 2016-2020. The average value for 2014 and 2015 is used as a reference. The development of energy efficiency is measured using a characteristic value of general efficiency, which corresponds to the arithmetic mean of the company-specific efficiency characteristics. If the company-specific improvement is below the 7 % target, the relevant participating enterprises must pay a proportion of the tax on the purchasing of electricity and gas, from which they are otherwise exempt.</p> <p>In addition to improving their energy efficiency, the participating industrial companies undertake to introduce an energy management system, by identifying the potential for improvement and drawing up an action plan for implementing at least some of this potential.</p> <p>Since 2017 new requirements apply in accordance with the current agreement. All participating companies (non-SMEs and SMEs) accordingly have the following obligations:</p> <ul style="list-style-type: none"> perform energy audits in accordance with international norms (EN 16247, ISO 50001, ISO 14001); specify energy savings in accordance with the methods of the obligation mechanism (3.1.1.6); submit a final report on implementation upon the expiry of the agreement; offer and conduct further training on energy efficiency for their employees; participate in a process where experiences are exchanged; regularly contact the obligated parties (3.1.1.1) to receive advice on energy efficiency measures and their implementation options. <p>Enterprises that fail to meet their obligations – including annual reporting requirements – may be excluded from the agreement.</p>
Implementation status and timeframe	From 2011 to 2016; from 2017 to 2020.
Important measure parameters	<p><u>Explanation of the target 2011-2016:</u></p> <p>$(7\% / 6 \text{ years}) - 0.5\%/\text{a}$ (improvement of energy efficiency through independent progress) = $1.2 - 0.5 = 0.7\%/\text{a}$.</p> <p><u>Explanation of the target 2017-2020:</u></p> <p>$((7 - 1.2\%^{(1)}) / 4 \text{ years}) - 0.5\%/\text{a}$ (improvement of energy efficiency through independent progress) = $1.5 - 0.5 = 1\%/\text{a}$.</p> <p>⁽¹⁾1.2 % = deduction of the year 2016, which is already included in the previous agreement.</p> <p>In the calculation, it is assumed that the initial effect of the measure occurred in 2013, since the development of energy consumption up to 2012 is reflected in the energy balance for Luxembourg.</p>
Anticipated energy savings in 2020	Final energy savings: 154 GWh in 2016; 368 GWh in 2020.
Savings achieved between 2013 and 2015	The cumulated final energy savings calculated in accordance with the model for the period 2013-2015 was 229 GWh, equivalent to the 229 GWh anticipated in the NEEAP III.
Financing	The participating enterprises are required to finance the energy efficiency improvements themselves. In return, they are exempted from a proportion of the tax on electricity and gas.
Legislative basis	Voluntary agreement between the Luxembourg Government, My Energy GIE and Fedil – the Luxembourg Business Federation – on improving energy efficiency in Luxembourg industry
Further information	www.gouvernement.lu/3595080/2013-rapport-activite-economie.pdf (p 90)



Annual energy savings [GWh/a]

- Voluntary agreement

Figure 4: Actual final energy savings in the period 2013–2015 and the anticipated development of expected final energy savings in the period 2016-2020 as a result of the voluntary agreement with the industry.

Table 9: Results of the voluntary agreement (2011-2016) with industry (Source: annual data collection among the participating companies)

	Reference (2009-2010)	2011	2012	2013	2014	2015
General energy efficiency target	100 %	98.8 %	97.7 %	96.5 %	95.3 %	94.2 %
General characteristic efficiency value	100 %	95.1 %	95.5 %	93.1 %	91.9 %	89.4 %

The participating companies have to take part in a survey every year. These records among others the data required for the calculation of the characteristic efficiency value and the implemented energy efficiency measures, or the volume of savings. The development of the general energy efficiency target as compared to the expectations of the agreement has so far been satisfactory. From 2017, the final energy savings as a result of the introduction of the methods of the obligation scheme (3.1.1.6) will also be monitored.

At the same time, there are other adopted or planned energy efficiency measures aimed at industrial companies. To date, these have not been quantified, but are described in more detail in section 3.1 (Horizontal measures).

From 2017, the participating industrial companies have the obligation to report energy savings in accordance with the methodology described in section 3.1.1.6.

The following instruments and measures may be highlighted:

- Energy savings obligation scheme (section 3.1.1), which is expected to give a further boost to energy efficiency, especially in the industrial sector;
- Energy audits and management systems (section 3.1.2)
- Financial aid (section 3.1.8.1)
- Consideration of the establishment of a public financial institution to facilitate investment in energy efficiency and renewable energy (see section 3.1.8.1).

3.5 Energy efficiency measures in the transport sector

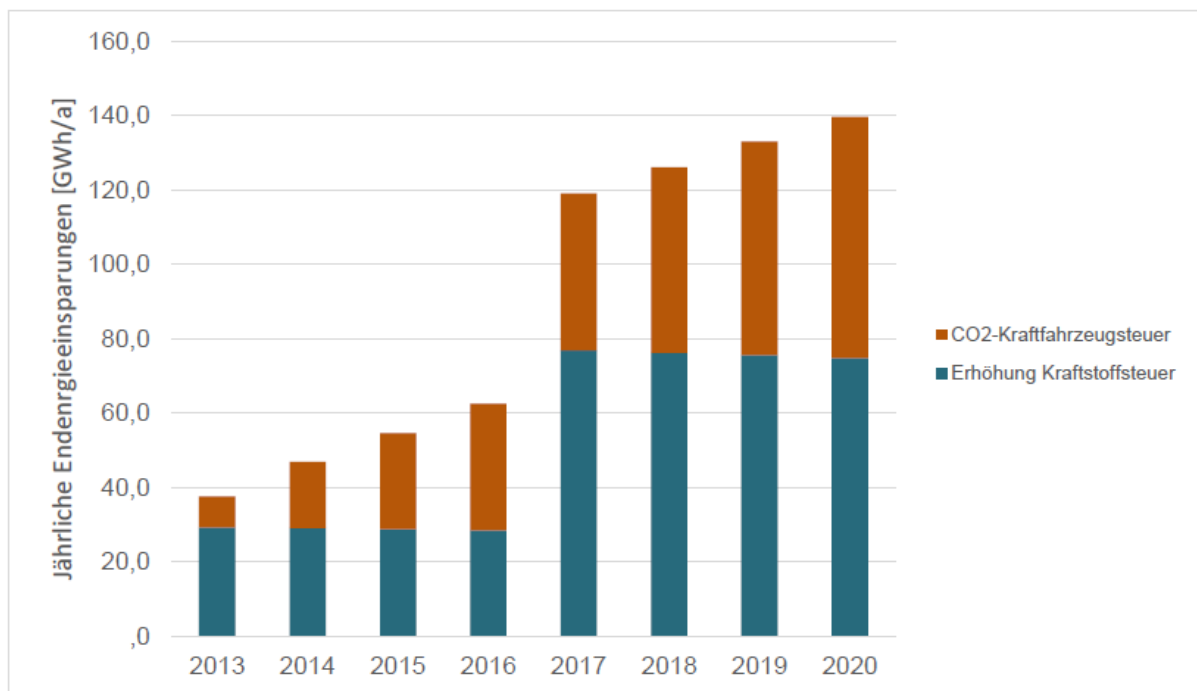
To increase energy efficiency in the transport sector, Luxembourg is, firstly, implementing measures in motorised private transport and, secondly, expanding public transport and soft mobility. Two fiscal measures that will increase the cost of motorised transport, and which are described in more detail below, should make the vehicle population more economical and encourage a shift to more sustainable forms of transport.

Increase in fuel tax	
Type of measure	Fiscal – fuel tax
Target application	Final energy consumption in passenger and freight traffic (petrol and diesel)
Mechanism of action	Taxes on fuel (petrol and diesel) are raised on a regular basis. The last tax increase on diesel took place in 2012–2013 (+ct EUR 1.5/l). In the short term this will encourage driving behaviour that aims to achieve lower fuel consumption, and in the longer term will influence motorists to purchase more economical vehicles.
Implementation status and timeframe	See Mechanism of action
Important measure parameters	Price elasticity (diesel): estimated at +0.6 % (short-term) and 1.6 % (long-term) on domestic consumption. Only the last tax increase on diesel is taken into account. All previous increases are already reflected in the baseline.
Anticipated energy savings in 2020	Final energy savings: 75 GWh
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 87 GWh, as opposed to the 94 GWh anticipated in the NEEAP III.
Financing	The tax increase is borne by the consumer.
Legislative basis	Amended Law of 17 December 2010 on excise duties and similar taxes on energy products, electricity, manufactured tobacco products, alcohol and alcoholic beverages.
Further information	www.do.etat.lu/acc/Taux droits accise/Documents/Tableau Accises 2005-2014.pdf

CO₂ motor vehicle tax	
Type of measure	Fiscal – vehicle tax
Target application	Final energy consumption in passenger and freight traffic (petrol and diesel) Domestic vehicle fleet.
Mechanism of action	Since 1 January 2007, vehicle tax has been dependent on the vehicle's CO ₂ emissions. On average, this change in approach led to an increase in tax. In the longer term, this will influence purchasing decisions in favour of more economical vehicles.
Implementation status and timeframe	In force since 1 January 2007
Important measure parameters	Rate of improvement in the specific fuel consumption of new vehicles: 2 %/a
Anticipated energy savings in 2020	Final energy savings: 65 GWh
Savings achieved between 2013 and 2015	The cumulated final energy savings achieved in accordance with the model between 2013 and 2015 was 52 GWh, as opposed to the 54 GWh anticipated in the NEEAP III.
Financing	The tax increase is borne by the vehicle owner.
Legislative basis	Law of 22 December 2006 promoting job retention and defining special measures in social security and environmental policy.
Further information	www.do.etat.lu/vehaut/Taxes/index.htm

The anticipated final energy savings achieved by the two fiscal measures are shown in Figure 5.

The gradual development of the estimated savings as a result of increasing the fuel tax is based on the assumed price elasticities.



Annual energy savings [GWh/a]

- CO₂ motor vehicle tax
- Increase in fuel tax

Figure 5: Actual final energy savings in the period 2013–2015 and the anticipated development of final energy savings in the period 2016-2020 as a result of two fiscal measures in the transport sector.

In addition to these tax rules, Luxembourg began some time ago to intensify its efforts in the transport sector. Although the energy savings that may be expected from these efforts have thus far not been quantified, they nevertheless provide a significant contribution to improving energy efficiency. The strategies and measures for expanding public transport and soft mobility, as well as for the development of electromobility are explained in more detail below. It is also worth mentioning that the driving test now includes training modules for environmentally-conscious driving.

Approximately three quarters of the energy consumption in road transport is caused by transit traffic. On the one hand, this results from Luxembourg's central location in the Western European economic area and its good road links to neighbouring countries, and on the other hand from its lower fuel prices compared to those countries. The increase in Luxembourg fuel taxes will inevitably influence these price differences. Fuel sales peaked in 2005. Since then, they have been fluctuating at around 30 TWh/a.

3.5.1 Sustainable mobility

One of the fundamental features of Luxembourg's transport policy is the integrated, comprehensive strategy for sustainable mobility ('stratégie MoDu'³⁴ (mobilité durable)), which aims to reduce the negative impacts of traffic by promoting public transport and soft mobility.

The policy goals in MoDu for Horizon 2020 are as follows:

- A modal share of 25 % of traffic volume for soft mobility and
- for the remaining volume of motorised traffic a modal share of 25 % for public transport.

In addition to a better interaction between urban development and sustainable mobility, the strategy mainly focuses on the goal of creating attractive public passenger transport services, which encourages users to make a large number of their motorised journeys by public transport. An essential element of the MoDu strategy is also the promotion of mobility, e.g. creating attractive mobility chains by combining different means of transport. The convenient link between the individual means of transport should above all be ensured at the so called transfer points (pôles d'échange). In addition, the national telematics project „mLive" up to the end of 2017 ensures that timetable information of all means of public passenger transport is available in real time.

Within the country and also for cross-border traffic the railroad network provides the backbone of public passenger transport. Intercity buses (RGTR) are intended to reach regions not connected to the railway network. Park & Ride facilities should make it easier for motorists to transfer to means of public transport. In addition attractive cycle paths should encourage cycling. Specific measures for the implementation of this national and cross-border mobility strategy include: the continuous development of capacities in the railroad network, the construction and modernisation of train stations, a complete overhaul of the RGTR network (2018), construction of P+R facilities (number of parking places 2016:

³⁴ Further information at:
www.mt.public.lu/planification_mobilite/1strategie_modu/index.html

13 600, >2020: 28 700, the construction of secured Bike & Ride facilities³⁵ and the construction of national cycle paths (length of the cycle network in 2016: 613 km, 2018: 838 km). Multimodal platforms are created for freight transport (rail-road and ship-rail-road).

In the conurbation of the city of Luxembourg, where the majority of jobs in the country can be found, the existing passenger traffic should be moved from a monocentral to a network-based system, which can accommodate the intensive polycentric development of the city and the increasing demand for mobility of the development hubs in its suburban belt. The backbone of the new local public transport network in the capital will be the tram in the future, which is already running in December 2017 at Kirchberg between the stops 'Pafendall - Rout Bréck' and 'Luxexpo', and is expected to run on the whole route between the Cloche d'Or and the airport by 2021³⁶. In addition to the first stage of development of the tram, the two peripheral railway stations Howald and Pfaffenthal-Kirchberg will also start operation in December 2017, as well as a cablecar, which is to transport travellers from the latter to the Kirchberg Plateau.

Other measures for influencing the modal choice are the continuous expansion of rail transport (including 2-track and 4-track railway lines, the construction of intermodal hubs, the modernisation of Luxembourg Central Station and the expansion of multimodal platforms in freight transport (rail-road and ship-rail-road)), the designation of additional bus lanes, the improvement of services such as real-time information at bus stops and online timetable information, a nationwide parking space management system in urban areas and the creation of cross-border transport strategies ('schéma de mobilité transfrontalière') in the Greater Region. In accordance with the concept of mobility chains, park & ride facilities were set up at strategic points. In addition to the facilities that have already been created in recent years further expansion and new construction measures are planned (doubling capacity by 2020).

The energy efficiency of public transport will be improved by, among other things, the fact that the whole rail network of Luxembourg is electrified and the electricity used in rail-bound passenger transport of the CFL is 100 % renewable. In addition, Luxembourg has a modern and clean bus fleet as a result of the regular renewal of the vehicles (Euro 6 and hybrid buses). Since the beginning of 2017, also so called plug-in hybrid buses are used at RGTR and in the bus fleet of the city of Luxembourg (AVL). These buses are recharged at quick charging stations, between the individual trips with 100 % renewable electricity and can therefore run in fully electric mode on part of their route. The town of Differdingen will put four completely electric buses into operation in May 2017.

The avoidance of motorised transport is encouraged by the promotion of soft mobility: supported at regional level within the framework of the mobility concepts developed in the convention areas and at national level in accordance with the sectoral transport plan and the updating of the Act of 6 July 1999 concerning the National Cycle Network. Some towns offer bike-sharing facilities.

As part of the tax reform from 1 January 2017, a series of measures bundled under the slogan 'Travel smart, save taxes' (Klever fahren Steuern sparen) will be introduced to promote sustainable mobility. A tax allowance for the owners of emission-free cars is also foreseen. The amount of the tax allowance for a purely electric car is EUR 5 000, and EUR 300 for the purchase of a bicycle or pedelec. In order to make electric cars more attractive, 800 charging stations will be set up until 2020 across the country in all municipalities. Further information is available at www.chargy.lu/ and at www.clever-fueren.lu.

³⁵ www.m-box.lu

³⁶ www.developpement-durable-infrastructures.public.lu/fr/actualites/articles/2016/10/26-ligne-tram/index.html

The flat-rate financial advantage for company cars subject to their harmful effect on the environment in relation to the greenhouse effect and air pollution has also be re-assessed. Bicycles and pedelecs put at the disposal of employees by the employer for non-job-related purposes are also exempt from tax.

The focus is now more on incentives than penalties. These measures, which serve both health and environmental protection complement the efforts for supporting means of public transport and soft mobility.

The policy of promoting public transport is beginning to bear fruit. The share of public transport in cross-border trips has risen from 9 % in 2007 to 14 % in 2010. At national level, there has been a 23 % increase in rail passengers between 2009 and 2014. With regard to bus transport, there has been an increase in passenger numbers of 37 % for regional bus services and 17 % for urban bus services between 2006 and 2010.

3.5.2 Electromobility

The Luxembourg government sees electromobility, in both private and public transport, as a key element for a more sustainable and more energy-efficient transport sector.

In a study³⁷ on the coordinated introduction of electromobility in Luxembourg, a strategy for the establishment of a standard, public charging infrastructure was prepared. In accordance with Article 27 of the amended Act of 1 August 2007 concerning the organisation of the electricity market, distribution system operators are obliged to build a national charging infrastructure, based on a common central unit, which ensures the communication of data by means of a single common system in which the user is free to choose their electricity supplier.

The distribution system operators will be responsible for setting up, operating and maintaining this public infrastructure. The Grand-Ducal Regulation of 3 December 2015 defines the number and technical specifications of the charging stations and of the central unit, as well as the organisation of the common infrastructure. The aim of these provisions is to establish a nationwide network of approximately 800 public charging stations with two charging points for electric vehicles by 2020. The platform 'Chargy' developed for this purpose is still in a testing phase. The start of the operation of the shared central system, which will perform the data management of the charging stations is planned for the first half of 2017. Then the official start of operation and the delivery of the first 'badges' will follow. The first 800 public charging stations were already set up by network operators at the end of 2016.

The government is currently reviewing potential strategies for establishing and financing a fast charging infrastructure on motorways and other important locations in the country.

Other initiatives have been implemented for the introduction of electromobility in Luxembourg in recent years, including:

- The 'elektromobilitéit.lu' platform (<http://www.elektromobiliteit.lu/>) was set up in 2010 with the aim of promoting electromobility in Luxembourg. It is composed of, among others, electricity suppliers, electricity grid operators, a research centre, car manufacturers, private enterprises and interest groups;

³⁷ Schwartz and Co, *Etude technico-économique pour la mise en oeuvre nationale de l'électro-mobilité au Luxembourg* [Technical and economic study on the nationwide implementation of electromobility in Luxembourg], Luxembourg, December 2011 (www.gouvernement.lu/4607913/etude-electromobilite.pdf)

- Until the end of the year 2014, the purchase of an electric car had been supported by state aid in the form of a subsidy of EUR 5 000. A precondition for this is the signing of a supply contract for green electricity;
- Tax reform from 1 January 2017: For purchases of new electric cars for private purposes are eligible for a EUR 5 000 tax deduction;
- By 2016, around 150 charging stations accessible for the public had been set up by private companies and municipalities;
- Several pilot projects for 'car sharing' with electric cars have been implemented at a regional level or are currently being implemented. Examples: Carloh, Nordstadt;
- Cross-border projects and studies into the potential of electromobility and the creation of intermodal platforms along the main traffic axes in the border regions.

3.6 Promotion of efficient heating and cooling (Article 14)

3.6.1 In-depth assessment

Article 14 of the EED specifies that Member States should carry out a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling. Implementation in Luxembourg will be based on the methodology and results developed in the course of the national study conducted in 2016 into the potential use of high-efficiency cogeneration plants and efficient district heating and cooling³⁸.

3.6.2 Further measures to promote efficiency in heating and cooling

As also described in the NEAAP III (section 3.6.2), the efficiency of district heating and cooling (referred to as district heating in the following) can be supported through several measures:

- high-efficiency cogeneration
- efficient district heating
- efficient, decentralised heating supply systems
- use of waste heat and renewable energy sources for heating

In the context of Directive 2012/27/EC on the promotion of efficiency in cogeneration in the internal energy market, Luxembourg conducted the above mentioned national study into the potential use of high-efficiency cogeneration plant and efficient district heating and cooling. This calculated the potential for the use of high-efficiency cogeneration plants and efficient district supply in three main areas of application.

The areas are as follows:

- decentralised cogeneration plants in buildings,
- cogeneration plants in industry, and

³⁸ Fraunhofer Institute for Systems and Innovation Research on behalf of the Ministry for the Economy of Luxembourg, *Assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling*, Luxembourg, August 2016

- central cogeneration plants with district heat supply.

The most significant findings and recommendations for action of the study are summarised subject to local heat demand and geographical thermal density.

The aim of this study on the potential is to defined the current situation relying on existing analyses on the potential of cogeneration and district heating, and also to define possible future development and economic potential based on a cost/benefit calculation.

It can be established in general that a significant proportion of the available cogeneration potential in buildings is already made use of in the form of local heating concepts. According to the analyses of the study however, there is one more potential for the future to further improve the current situation.

Heat networks may play a central role in the decarbonisation of energy systems. Particularly in urban and densely populated areas with multi-storey residential buildings the potentials for the use of decentralised renewable energies for heat supply such as heat pumps, solar systems and biomass boilers are significantly limited. At the same time, ambitious measures for reducing energy consumption can only be implemented to a limited extent due to different restrictions to insulation such as monument protection or regulations on spacing. Heat networks offer an economical heat supply both in an immediate and wider sense, which can be covered with mostly or exclusively renewable energies. The use of the potential of waste heat from industries also becomes possible. Heat networks also provide the central infrastructure for cogeneration in areas with high thermal density, unfavourable conditions for renovation or for the use of decentralised renewable energies.

Creating cogeneration plants in areas with a lower thermal density is nor recommended. Small decentralised networks could however be sensible under certain conditions.

In the industries, exploiting cogeneration potentials further is currently not economical, as the decommissioning of existing industrial cogeneration plants also shows. In the medium term, extending industrial cogeneration is also only expected to be economical to a limited extent.

Industrial fossil-fuel plants have become significantly less economical in the recent period. Analyses have however shown that at sites with a continuous heat demand and as a result high rate of utilisation of the capacities the costs of generation are close to retail electricity prices and under the purchasing costs of electricity for companies. These potentials may be exploited.

The use of cogeneration has been promoted in Luxembourg since the 1990s, with the objective of creating an efficient supply of energy and a supply of electricity that was less dependent on electricity imports. By the end of 2015, Luxembourg had around 126 cogeneration plants in various performance classes. Total electrical output was 104 MW, and in total these plants generated approx. 260 GWh of electricity in 2015.

The potentials of cogeneration have already been described in detail in the NEAAP III. In relation to the use of renewable energies, the new reimbursements for electricity generation from renewable energies have to be mentioned. The current tariffs entered into force³⁹ in 2016 upon the introduction of a market premium (for larger plants) instead of feed-in tariffs, which are payable above the market price. New plants with a power output of over 500 kW or 3 MW, or three units for power generation in the wind energy sector are affected.

³⁹ Grand-Ducal Regulation of 23 July 2016 on the generation of electricity from renewable energy sources, www.legilux.public.lu/eli/etat/leg/rgd/2016/07/23/n4/jo, amending the Grand-Ducal Regulation of 1 August 2014 on the generation of electricity from renewable energy sources, www.legilux.public.lu/eli/etat/leg/rgd/2014/08/01/n1/jo

As an additional incentive for using heat from biomass and biogas plants, a heat premium is granted under certain conditions. The Climate Pact with the municipalities also promotes efficient heating with, for example, municipal district heating networks and the use of renewable energy sources influencing the assessment of the municipality.

The Kiowatt⁴⁰ plant commissioned in 2014 represents a good example of heating and cooling (detailed information is available in the NEEAP III).

A further important project in this area is the planned biomass-fuelled and heat-driven cogeneration plant at an industrial company in wood processing⁴¹. The power output is said to be 20 MW, while heat 65 MW. The targeted production of 119 GWh electricity and 387 GWh of heat per year are to be generated with a total efficiency of over 91 %.

3.7 Energy transformation, transmission, distribution, and demand response (Article 15)

The provisions in the Directive concerning energy efficiency in the areas of energy transformation, transmission, distribution and demand response were transposed into national law in Luxembourg in 2015 by two acts of law of 19 June 2015, which amend the two acts of 1 August 2007 concerning the organisation of the electricity and that of the gas market and the amended Act of 1 August 2007 concerning the organisation of the gas market.

3.7.1 Energy efficiency criteria in network tariffs and regulation

Pursuant to Article 54 Paragraph 1 Point (d) of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 51 Paragraph 1 Point (d) of the amended Act of 1 August 2007 concerning the organisation of the gas market, the regulatory authority is obliged to take measures to enable the cost-optimal achievement of the desired development of efficient systems, in accordance with the general energy policy and energy efficiency objectives, in both transmission and distribution networks. Article 20, new paragraph 5, of the documents currently in the legislative procedure specifies that the methods for calculating network tariffs must contain incentives for network operators so that they may provide services to network users permitting them to implement energy efficiency measures in the context of the continuing development of smart grids. In this respect, the network operators must take into account the cost-benefit ratio of the individual measures.

3.7.2 Facilitation and promotion of demand response

The methods defined by the regulatory authority methods for calculating network tariffs in accordance with Article 20, new paragraph 1, of the amended Act of 1 August 2007 concerning the organisation of the electricity market, should produce network tariffs that enable final customers to participate in

⁴⁰ www.kiowatt.lu/de

⁴¹ www.kronospan.lu/de

improving the overall efficiency of the system, including demand response. Network tariffs also have to accurately reflect electricity and cost savings in networks achieved from the demand side and demand response measures and distributed generation, including savings from lowering the cost of delivery or of network investment and a more optimal operation of the network.

The documents currently in the legislative procedure specify that in future network operators, in accordance with Article 27, new paragraph 7 of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 33 Paragraph 3 of the amended Act of 1 August 2007 concerning the organisation of the gas market, shall be obliged, in the fulfilment of their obligations in terms of demand response and control energy, to treat suppliers of demand response services in a non-discriminatory manner, on the basis of their technical capabilities and subject to the technical constraints inherent in the operation of their networks.

Article 54 Paragraph 2, new subsections u) and v), of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 51 Paragraph 5, new subsections t) and u) of the amended Act of 1 August 2007 concerning the organisation of the gas market, the regulatory authority must encourage the participation of demand-side resources, such as demand response, in the wholesale and retail markets to the same extent as supply-side resources.

Furthermore, the regulatory authority must in future, subject to the network operators' technical constraints inherent in the operation of their networks, support access and participation of demand response in balancing, reserve and other system services markets. In this context, the regulatory authority must define the technical modalities for participation in these markets. These modalities are to be developed on the basis of the technical requirements of these markets and the capabilities of demand response and must include the participation of aggregators.

3.7.3 Energy efficiency in network design and regulation

Article 27, new paragraph 14 of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 33 Paragraph 1, new subsection f) of the amended Act of 1 August 2007 concerning the organisation of the gas market, transport and distribution system operators must identify concrete measures and investments in network infrastructure, with the objective of implementing the cost-effective introduction of energy efficiency improvements in the network infrastructure within a timeframe to be defined.