LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie

Third National Energy Efficiency Action Plan for Luxembourg

under 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, December 2014

Contents

1 Introduction

This report fulfils the reporting requirements pursuant to the Energy Efficiency Directive 2012/27/EU[1] (EED). In accordance with Article 24(2), Member States are required, with effect from 2014 and subsequently every three years, to submit National Energy Efficiency Action Plans (NEEAPs).[2] At the same time, this report is also intended to fulfil the reporting requirement pursuant to the Energy Services Directive 2006/32/EC (ESD), which still applies in 2014.

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 1 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 under Article 24(2): The National Energy Efficiency Action Plans shall 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(1). The National Energy Efficiency Action Plans shall be 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

In accordance with Article 3 of the EED, the Member States must set an indicative national energy efficiency target for 2020, based on either primary[3] or final energy consumption[4] or on primary or final energy savings, or on energy intensity. They also express these targets as the absolute value of the primary energy consumption and final energy consumption in 2020.

In the context of Luxembourg's first annual monitoring report in 2013[5], Luxembourg set itself, in accordance with Article 3(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 is[6]:

52 111 GWh or 4 481.6 ktoe (primary energy)

Luxembourg reserves the right to modify these targets based on more accurate calculations of the effects of measures.

2.2 Final energy consumption and savings

The following figure shows:

- the statistical development of final energy use in Luxembourg from 2001 to 2012 [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 taken and currently planned energy efficiency measures 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(1) of the EED (49 292 GWh final energy)

[3] In accordance with Article 2(2) of the EED, 'primary energy consumption' means gross inland consumption, excluding non-energy uses. In this document, we use the term primary energy consumption, as in the EED, to indicate gross inland consumption excluding non-energy uses.

[4] In accordance with Article 2(3) of the EED, 'final energy consumption' means all energy supplied to industry, transport, households, services and agriculture. It excludes deliveries to the energy transformation sector and the energy industries themselves.

[5] *Luxembourg's first annual monitoring report 2013*, Luxembourg, 2013, http://www.eco.public.lu/documentation/rapports/Erster_j__hrlicher_Monitoringbericht_Luxemburgs_2013.pdf

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

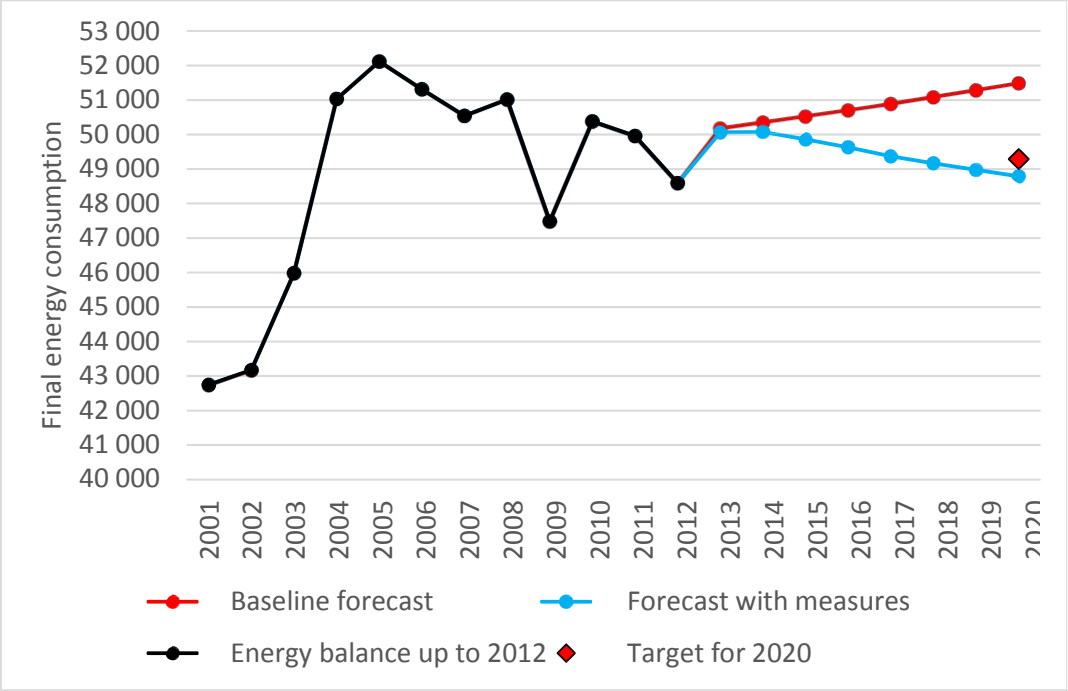


Figure 1: Development of final energy consumption in Luxembourg 2001–2020 (2001–2012: historical data [source: Statec] and 2013–2020: national forecast)

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. 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 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 2005–2012, 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. The fall in energy consumption over this period was also supported by a decrease in consumption by private households. This decrease suggests that the energy efficiency measures taken over a period of 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 has grown by nearly 20 % since 2005.

[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.

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 51 486 GWh.

It is therefore necessary for Luxembourg to implement new energy efficiency measures in order to achieve its target. The effects of future measures, as well as of the necessary new 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 48 789 GWh [source: Statec]. The energy efficiency target of 49 292 GWh (final energy) would therefore be achieved in 2020.

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

Sector	Baseline forecast	Forecast with measures
Households	6 661	5 654
Trade, commerce and services	7 395	6 542
Industry	7 048	6 363
Transport	30 297	30 145
of which transport excluding domestic road transport	*24 321*	*24 321*
Agriculture	85	85
Result	**51 486**	**48 789**

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 2 698 GWh are planned. Among the significant measures, the principal measure is the energy savings obligation scheme.

The expected resulting energy savings will be spread across all sectors, with a significant proportion in buildings. In addition to the energy savings obligation scheme, around a quarter of the savings is expected in residential buildings (households) and non-residential buildings (trade, commerce, services), which means that it is anticipated that the energy efficiency measures in buildings will account for more than half of the final energy savings achieved in 2020. With the exception of the energy savings obligation scheme and the intensification of the Energy Efficiency Regulation for non-residential buildings, all the other measures are already in force.

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 CO_2 emission reductions in Luxembourg in 2020 as a result of the quantified energy efficiency measures

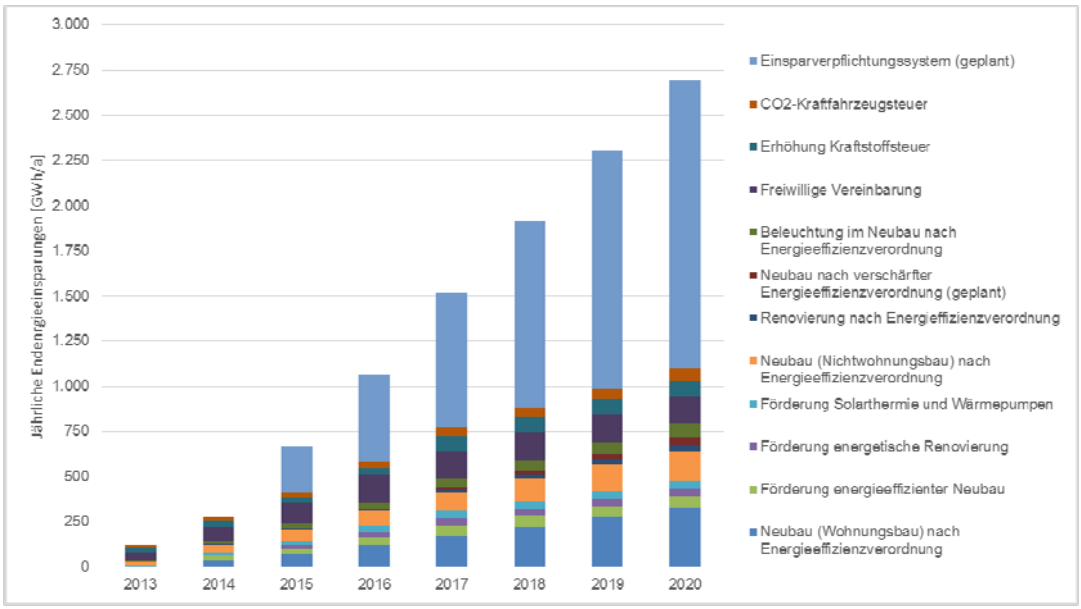
Measure	Final energy savings in 2020 [GWh]	CO_2 emissions reductions in 2020 [kt CO_2]
New builds (housing construction) in accordance with the Energy Efficiency Regulation	331	69
Promotion of energy-efficient new builds	58	12
Promotion of energy renovation	45	10
Support for solar thermal energy and heat pumps	40	10
Total HOUSEHOLDS	**474**	**101**
New builds (non-residential construction) in accordance with the Energy Efficiency Regulation	168	28
Renovation in accordance with the Energy Efficiency Regulation	29	5
New builds in accordance with a stricter Energy Efficiency Regulation (planned)	44	7
Lighting in new builds in accordance with the Energy Efficiency Regulation	78	0
Total TRADE, COMMERCE AND SERVICES	**319**	**40**
Voluntary agreement	152	20
Total INDUSTRY	**152**	**20**
Increase in fuel tax	86	23

CO_2 vehicle tax	66	17
Total TRANSPORT	**152**	**40**
Energy savings obligation scheme	1 599	333
Total HORIZONTAL	**1 599**	**333**
Result	**2 698**	**534**

To estimate the reductions in CO_2 emissions, the calculated final energy savings were multiplied by the CO_2 emission factors from the National Inventory Report (United Nations Framework Convention on Climate Change) for each energy source[8]. It has been assumed that only imported electricity will be displaced, so that no there will be no reduction in CO_2 emissions in Luxembourg as a result of energy savings.

[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'.

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



German	**English**
Jährliche Endeenergieeinsparungen [GWh/a]	Annual final energy savings [GWh/a]
Einsparverpflichtungssystem (geplant)	Energy savings obligation scheme (planned)
CO2-Kraftfahrzeugsteuer	CO2 vehicle tax
Erhöhung Kraftstoffsteuer	Increase in fuel tax
Freiwillige Vereinbarung	Voluntary agreement
Beleuchtung im Neubau nach Energieeffizienzverordnung	Lighting in new builds in accordance with the Energy Efficiency Regulation
Neubau nach verschärfter Energieeffizienzverordnung (geplant)	New builds in accordance with a stricter Energy Efficiency Regulation (planned)
Renovierung nach Energieeffizienzverordnung	Renovation in accordance with the Energy Efficiency Regulation
Neubau (Nichtwohnungsbau) nach Energieeffizienzverordnung	New builds (non-residential construction) in accordance with the Energy Efficiency Regulation
Förderung Solarthermie und Wärmepumpen	Support for solar thermal energy and heat pumps
Förderung energetische Renovierung	Promotion of energy renovation
Förderung energieeffiziener Neubau	Promotion of energy-efficient new builds
Neubau (Wohnungsbau) nach Energieeffizienzverordnung	New builds (housing construction) in accordance with the Energy Efficiency Regulation

Figure 2: Anticipated development of final energy savings in the period 2013–2020 as a result of the quantified energy efficiency measures

Discussion: Explanation of the calculation methodology

The calculation model consists of 4 different modules, corresponding to the following 4 consumption sectors: Households; Trade, commerce and services (TCS); Industry and Transport. It includes the historical development from 2001 to 2012 and forecasts up to 2020.

Households

The calculation of the development of energy consumption is based on the detailed Luxembourg housing statistics. Three residential building types (single-family houses, terraced houses and apartment blocks) and three building age groups (before 1970, 1971–1995, after 1995) were formed, which are characterised by different specific final energy consumptions (kWh/m^2 a). The development of dwelling numbers was based on the official forecasts of the 'Department of Spatial Planning and Development' (DATer) (Regional Planning).

The specific dwelling floor area, the specific final energy consumption and the energy source mix of the energy consumption (baseline) are calculated for the aforementioned building groups, using data and data trends compared to the number of dwellings.

To calculate the reduction in final energy consumption as a result of various measures, a new specific final energy consumption is then determined for the three building types and the three building age classes. Based on the proportion of dwellings in which the individual measures are implemented over time, the new lower energy consumption is then calculated. The difference from the baseline thus shows the savings effect of a measure.

Trade, commerce and services (TCS)

The energy consumption baseline is determined on the basis of the energy balances for 2001–2012 published by the Statistical Office, which were climate-adjusted for this purpose. The development of the number of persons employed in the tertiary sector is applied as a driver for the forecast for 2020, taking into account the autonomous trends observed in the case of heat (falling) and electricity (rising).

The energy savings over the baseline expected as a result of the individual measures are calculated using improvement rates and new construction and renovation rates of the building stock.

Industry

To calculate the development of energy consumption in industry, industrial production or value creation were applied as drivers and autonomous trends were taken into account. Industry was divided into 4 subsectors: Cement, steel, glass and other. For each subsector, specific energy source-related final energy characteristics were taken into account.

The savings effect is calculated via the energy efficiency improvement required in the voluntary

agreement, minus an assumed autonomous improvement.

Transport

The calculation of the energy consumption baseline is based on detailed statistical data on vehicles registered in Luxembourg. A distinction is made between four different types of vehicles (passenger cars, lorries, motorcycles, other) and two types of fuel (petrol and diesel). For each of these vehicle categories, data is available on the vehicle population, fuel consumption (l/100 km) and annual mileage (km/a). In the absence of official forecasts, the development observed since 2001 has been extrapolated to 2020.

In addition to the road traffic caused by vehicles registered in Luxembourg, the energy balance of the transport sector is influenced by transit traffic and air transport. Based on the trend in recent years, the energy consumption of transit traffic was – as a first approximation – assumed to be constant from 2012 onwards. In the case of air transport, the average value for 2001–2012 was applied.

The impact of the increase in fuel tax is calculated by applying price elasticities to the baseline. The CO_2 vehicle tax is depicted using the rate of improvement in the specific fuel consumption of newly registered cars.

In addition to the aforementioned sectoral energy efficiency measures, the planned energy savings obligation scheme is also included in the calculation model. The savings generated by the obligation correspond to the mandatory savings target, which is adjusted to avoid double counting relating to overlaps with the sectoral measures.

2.3 Primary energy consumption and savings

In accordance with the EED (Article 2(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 (including the Twinerg CCGT), Luxembourg imports the vast majority of the electricity it requires. This fact must be taken into account when comparing primary energy and final energy.

In **Error! Reference source not found.** summarises the primary energy contribution of the individual measures to the scenario with measures. In total, in 2020 almost 2 900 GWh will be saved compared to the baseline.

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.

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2.4 Report on the achievement of the target in Directive 2006/32/EC

In the second National Energy Efficiency Action Plan for Luxembourg[9] (NEEAP 2011), which was prepared in the context of Directive 2006/32/EC on energy end-use efficiency and energy services[10], the final energy savings targets were calculated for 2010 and 2016 in accordance with the aforementioned Directive (see page 21). The savings target for 2010 is 590 GWh/a and for 2016 is 1 769 GWh/a.

Table 5 shows the effects achieved by 2010 and expected by 2016 for the various measures. The calculations were performed using the same methodology as in NEEAP 2011 and are also explained in more detail there. The calculation parameters were adjusted as required. Additional descriptions of measures are annexed to NEEAP 2011. Measures with an effective period lasting beyond 2012 have been updated and are described in detail in this National Energy Efficiency Action Plan 2014.

The effects of measures for 2010 reported in NEEAP 2011 have been confirmed. In total, final energy savings of 1 497 GWh/a were achieved by 2010 in compliance with Directive 2006/32/EC. This means that with a figure of 7.6 %, the savings target of 3 % has been significantly exceeded.

From a current perspective, the savings target for 2016 should also be achieved. Compared to NEEAP 2011, the calculated final energy savings for 2016 in order to comply with Directive 2006/32/EC have increased slightly. This increase is mainly due to the planned energy savings obligation scheme, the effect of which will more than offset the correction of the effects of individual measures compared to NEEAP 2011. It is anticipated that the savings target of 9 % will be significantly exceeded in 2016 with a figure of more than 14 %.

[9] *Second National Energy Efficiency Action Plan for Luxembourg under the EU Directive on energy end-use efficiency and energy services (2006/32/EC),* Luxembourg, 2011, http://www.eco.public.lu/documentation/rapports/Zweiter_nationaler_Energieeffizienzaktionsplan_Luxemburg_im_Rahmen_der_EU-Richtlinie_ber_Endenergieeffizienz_und_Energiedienstleistungen 2006–32-EG_.pdf

[10] Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC

	Sector	Measure (reference in NEEAP 2011)	Effective period	2010		2016	
				Final energy savings [GW h/a]	Contribution to savings target	Final energy savings [GW h/a]	Contribution to savings target
savings target				**590**	**3%**	**1 769**	**9%**
Early action	HH	New builds and building renovation in accordance with W D1996 (A1)	1996–2007	385	1.96%	385	1.96%
	HH	Promotion of efficient new builds and renovation of heating (A2)	2001–2007	90	0.46%	90	0.46%
	TCS	New builds and building renovation in accordance with W D1996 (A3)	1996–2007	171	0.87%	171	0.87%
	IND	Voluntary agreement (A6)	1996–2007	254	1.29%	254	1.29%
	CHP/REG	Promotion of decentralised renewable energies (A4)	2001–2007	47	0.24%	47	0.24%
	CHP/REG	Promotion of decentralised CHP (A5)	1996–2012	206	1.05%	213	1.08%
Measures taken and planned in NEEAP 2011	HH	New builds in accordance with W D2008 (B1)	2008–2012	44	0.22%	90	0.46%
	HH	Building renovation in accordance with W D2008 (B1)	2008–2012	19	0.10%	36	0.19%
	HH	Promotion of building renovation (B2)	2008–2012	9	0.04%	11	0.06%
	HH	Promotion of energy-efficient new builds (B3)	2008–2012	5	0.03%	11	0.06%
	HH	Promotion of renovation of heating (B11)	2008–2012	11	0.06%	21	0.11%
	HH	New builds in accordance with W D2012 (C4)	2013–2016	0	0.00%	121	0.62%
	HH	Promotion of building renovation (C1)	2013–2016	0	0.00%	27	0.14%
	HH	Promotion of energy-efficient new builds (C3)	2013–2016	0	0.00%	40	0.20%
	HH	Promotion of A++ refrigerators (B12)	2008–2011	3	0.01%	3	0.02%
	TCS	New builds and building renovation in accordance with W D2008 (B4)	2008–2012	47	0.24%	102	0.52%
	TCS	New builds and building renovation in accordance with W D2010 (B14)	2013–2016	0	0.00%	133	0.68%
	IND	Voluntary agreement (B15)	2008–2010	46	0.24%	46	0.24%
	IND	Voluntary agreement (B16)	2011–2016	0	0.00%	152	0.77%
	TRA	Kyoto Cent (B7)	2007–2016	35	0.18%	93	0.47%
	TRA	CO2 vehicle tax (B8)	2007–2016	28	0.14%	81	0.41%
	TRA	Promotion of low-CO2 cars (B9)	2007–2012	53	0.27%	90	0.46%
	CHP/REG	Promotion of decentralised renewable energies (B5)	2008–2012	44	0.22%	67	0.34%
	CHP/REG	Support for solar thermal energy and heat pumps (C8)	2013–2016	0	0.00%	40	0.20%
New measures	HOR	Energy savings obligation scheme (n/a)	2015–2016	0	0.00%	489	2.49%
Savings by sector	HH	Households	-	566	2.88%	836	4.25%
	TCS	Trade, commerce and services	-	218	1.11%	406	2.07%
	IND	Industry	-	300	1.53%	452	2.30%
	TRA	Transport	-	116	0.59%	264	1.34%
	CHP/REG	Cogeneration / Renewable energy	-	297	1.51%	367	1.87%
	HOR	Horizontal measures	-	0	0.00%	489	2.49%
Savings by type of measure	-	Total, Early actions	-	1 153	5.86%	1 160	5.90%
	-	Total, Measures taken/planned in NEEAP 2011	-	344	1.75%	1 165	5.93%
	-	Total, New measures	-	0	0.00%	489	2.49%
Total savings				**1 497**	**7.61%**	**2 814**	**14.32%**
Achievement of target				**254%**		**159%**	

Table 3: Final energy savings achieved by 2010 and anticipated by 2016 to comply with Directive 2006/32/EC

3 Policy measures implementing the Energy Efficiency Directive

This chapter 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(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 largely based on the notification from Luxembourg pursuant to Annex 5(4) of the EED.

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 declared obligated parties by law. 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 agency (‘Institut Luxembourgeois de Régulation’), 25 suppliers of electricity and 11 suppliers of natural gas are affected by the obligation (as of August 2014).

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’), which the obligated parties will be mandated to provide. Such an arrangement will make it possible to finance the obligation scheme at least partly through public funds.

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 as these are provided for at the regulatory level.

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.

3.1.1.3 Level of the energy saving target

Based on Eurostat data, the energy savings target to be achieved by 31 December 2020 in accordance with Article 7 was calculated[11] at 5 993 GWh. In accordance with Article 7(1), Luxembourg excludes the sales of energy used in transport and takes account of flexibility mechanisms pursuant to Article 7(2) and (3), which leads to a reduction of 25 % in the target. Luxembourg thus make 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(2b)), and
- progressive application of the energy efficiency obligation scheme (Article 7(2)(a)).

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

Table 4: Calculation of Luxembourg's energy saving target in accordance with Article 7 [in GWh][12]

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 % x 28 x 19 023 = 7 990 GWh				
Target after taking the reduction into account: (100 % - 25 %) x 7 990 = 5 993 GWh				

[11] Eurostat, *Energy balance sheets 2011–2012, 2014 edition*, Luxembourg, 2014 (page 43) (see Annex)
[12] The data published by Eurostat have already been converted into GWh in this table.

3.1.1.4 Duration of the obligation period and intermediate periods

The energy savings obligation scheme is to run for 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 simply adaptation of the relevant legal and regulatory provisions.

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.

A catalogue of standard measures is currently in preparation, which will specify the energy savings that can be assigned to specific measures. Initially, the catalogue will contain a limited number of measures. In principle, it will be adapted or expanded each year to take account of the most recent data on measures. The catalogue will focus mainly on technical measures of which the effects 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 may have a time-limited effect.

The obligated parties will, however, remain free to implement other energy-saving measures not listed in the catalogue of standard measures, taking account of the specified calculation methodology. This will give free rein to the obligated parties' creativity in the development of measures.

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 method

Annex V of the Directive leaves Member States the freedom to choose the method for calculating energy savings from among those proposed under point 1 of the Annex, namely (a) deemed savings (catalogue of standard measures in preparation), (b) metered savings, (c) scaled 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 is, as mentioned above, currently being prepared. The catalogue will contain deemed savings (point 1(a) of Annex V to the EED) and simple calculation methods 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, in accordance with the methodology that is to be published by the Ministry of the Economy in a regulation.

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 recorded. Upon request, the obligated parties must demonstrate that the execution of the energy efficiency measure resulted from or was prompted by action by them. In the declaration which they 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 Lifetimes 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 experiential 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.

In the context of the energy savings obligation scheme, the obligated parties may count the energy savings produced by measures from the year of their implementation until the end of their lifetime. 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 are 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 sector, 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). Standard notification forms will be published as required on the website of the Ministry of the Economy. Supporting documentation regarding the savings declared must be retained by the obligated parties and produced in the event of an inspection.

On the initiative of the Ministry of the Economy, a random annual inspection of a statistically significant and representative sample of the energy-saving measures may be carried out by an independent consultancy.

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 part of its activities as described in section 3.1.4.1, the national advisory body myenergy raises the awareness of households concerning the benefits of energy audits and informs interested parties about the process of selecting an energy advisor (among other things, by means of the *'myenergy certified'* certification scheme for energy advisors (see section 3.1.5.1)) and the issue of subsidies.
  - The support programme mentioned in section 3.1.7.1 provides financial aid for energy advice in conjunction with the renovation of an existing residential building and for the implementation of the resulting recommendations. Renovation measures are subsidised only if energy advice has previously been provided, and the content of the energy advice is mandatory. The energy advice will only be funded if at least one recommended measure is implemented. Only persons who are entitled to issue energy performance certificates may conduct an energy advice. Since 2009, over 2 000 energy consultations have been subsidised.
- **Enterprises**: Energy audits are supported in both industrial and service companies. On account of the importance of the service sector in the Luxembourg economy, the energy efficiency of non-residential buildings plays an important role.

- 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. This must involve an assessment of the current efficiency of buildings and technical systems, as well as the identification of weaknesses and corresponding modernisation recommendations. Additional information may be found in section 5.2.5 of the Annex to the Regulation on the Energy Performance of Non-residential Buildings[13]. 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[14]) and drawing up an action plan for implementing at least some of this potential. Almost all the large industrial companies based in Luxembourg (approximately 60) participate in the voluntary agreement.
- The support programmes for enterprises mentioned in section 3.1.7.1 offer companies financial assistance for the implementation of energy audits. The implementation of energy efficiency measures is subsidised by the same programmes.

- **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 July 2014, 88 of the 106 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 m^2. With effect from 9 July 2015, the threshold will be 250 m^2.

Furthermore, the planned **energy savings obligation scheme** (see section 3.1.1) will further reinforce the incentive to carry out energy audits and energy advice 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.

[13] http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html and http://www.energyefficient.lu

[14] Participating enterprises whose annual energy consumption exceeds 130 GWh in one location must draw up an energy audit in accordance with the criteria defined in the following regulation: 'Amended Grand-Ducal Regulation of 11 August 1996 on the performance of energy audits in residential and tertiary sector buildings and in enterprises' (http://www.legilux.public.lu/leg/a/archives/1996/0067/index.html).

In accordance with Article 8 of the EED, the introduction of an **obligation on large enterprises (not SMEs) to carry out energy audits** is currently being planned. An initial estimate indicates that between 100 to 150 enterprises in Luxembourg will be affected by the obligation.

3.1.3 Metering and billing (Articles 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.

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 study[15] 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 2015 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 consumption information of all final customers will be transmitted to the distribution system operators via a common central system. This central system must be designed in such a way that other media such as district heating and water may also be connected to it. 95 % of all final customers in the electricity sector must be equipped with smart meters by 31 December 2018, 95 % of all final customers in the gas sector by 31 December 2020.

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 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

[15] Schwartz and Co, *Long-term economic study into the introduction of smart metering in Luxembourg's electricity and gas networks*, Luxembourg, February 2011 (http://www.eco.public.lu/documentation/etudes/2012/Etude_ComptageIntelligent.pdf)

installation of smart meters, in particular about their full potential with regard to meter reading management and the monitoring of energy consumption.

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 have 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 press ahead with 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.

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 and for using renewable energy. 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 and sustainable 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) or in the context of a personal advice session in a regional myenergy information point. myenergy operates an extensive network of regional or local advice centres (http://infopoint.myenergy.lu/) in partnership with 77 municipalities (as of July 2014; almost three quarters of all the municipalities in Luxembourg). As part of these partnerships, myenergy organises, among other things, action weeks including on-site consultations, information events with presentations and awareness-raising activities in primary schools (myenergy4kids).

In the basic advice, the customer is informed in a target-oriented manner about the additional services and products offered by 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 (further information on support programmes in section 3.1.7.1) and the energy performance certificate.

In addition to the provision of basic advice, myenergy's other main activities include information and awareness-raising, which it puts into practice by attending national trade shows, creating information brochures and Internet platforms, a regular presence in the national media and by developing its own events. In 2011, with the support of several partners, myenergy launched the myenergy days – www.myenergydays.lu – a national exhibition aimed at households, SMEs and experts; it now attracts around 90 exhibitors every year – craft enterprises, manufacturers, architects, engineers and energy advisors – around the topic of energy renovation. The first edition of the exhibition was immediately a great success, with around 2 500 visitors. In 2014, myenergy days attracted more than 3 000 visitors. The event also offers a full programme of lectures, product presentations and demonstrations. The 5th edition of myenergy days will take place in 2015. In addition to renovation, the exhibition will also focus on the theme of new builds.

Since 2011, myenergy has been addressing the subject of passive houses by means of an annual event, the 'passive house weeks', during which theme nights, exhibitions and visits to passive houses for individuals and experts are organised.

The free, online calculation model myenergy home – www.myenergyhome.lu – can be used to carry out a simplified evaluation of the energy efficiency of residential buildings.

myenergy offers enterprises free basic advice 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 with monitoring and assists them in their first steps in the implementation of measures, e.g. by means of seminars on a particular theme.

On behalf of the Ministry of Sustainable Development and Infrastructure, myenergy manages the Climate Pact and is thus the municipalities' first point of contact on the subject of energy efficiency. The Climate Pact website may be found here: http://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 state Environmental Protection Fund. The Climate Pact and Environmental Protection Fund are explained in more detail in sections 3.3.2.1 and 3.1.7.1.

A further reinforcement of the activities of myenergy and an expansion to target groups that are not yet fully covered are being planned and supported by the government[16].

3.1.4.2 Other information and advisory initiatives

The web portal www.oekotopten.lu was launched in 2007 on the initiative of the Mouvement Ecologique and the Pafendall Eco-Centre, with the support of the Ministry of Sustainable Development and Infrastructure and Intelligent Energy Europe. The portal introduces consumers to the most efficient and environmentally friendly products in various fields (e.g. household appliances, office equipment, mobility, entertainment, lighting, construction) and has been constantly expanded in recent years. It is also designed to be an incentive for providers to offer the most energy-efficient and environmentally friendly products. Oekotopten is a partner of the European Euro-Topten Max project and is a member of the international network Topten International Group.

In cooperation with the Ministry of Housing, the Pafendall Eco-Centre also provides initial environmental construction advice by phone or by appointment (http://mouvement.oeko.lu/oekozenter_Bauberatung.158-3.html). The Ministry of Housing itself also offers free basic advice on sustainable construction by phone or by appointment. (http://www.ml.public.lu/fr/aides-logement/logement_durable/conseils_en_batiment/index.html).

The Luxembourg government portal www.guichet.lu contains, among other things, information on the state support programmes for investments in energy efficiency and renewable energy. In addition, the 'Residential' area of the portal provides information on the formalities (e.g. the energy performance certificate) associated with renting, buying, building or renovating residential property (http://www.guichet.public.lu/citoyens/de/logement/index.html).

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 that are described in more detail in section 3.1.5, the

[16] *Government programme 2013–2018*, Luxembourg, 2013

various market participants, such as tradesmen, architects, engineers and energy advisors, 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 must also strive to ensure that customers have access to the necessary information.

The government programme is considering the creation of a public financial institution (see section 3.1.7.1) which, in cooperation with existing credit institutions, would help to finance investments in energy efficiency and renewable energy. This would also lead to a greater involvement of the financial institutions.

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 faced by 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), tradesmen (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 buildings[17], 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 on the demonstration 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. This training has been provided on behalf of the

[17] Amended Grand-Ducal Regulation of 30 November 2007 on the Energy Performance of Residential Buildings, http://www.legilux.public.lu/leg/a/archives/2007/0221/index.html

Amended Grand-Ducal Regulation of 31 August 2010 on the Energy Performance of Non-residential Buildings, http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html

Ministry of the Economy since the publication of the aforementioned regulations. Participation in the expert training courses leads to registration on a list of experts for residential and/or non-residential buildings. At present (as of July 2014), there are around 480 people on the list of experts for residential buildings, around 190 people on the list for existing non-residential buildings and around 110 people on the list for new non-residential buildings. Further information, including the aforementioned lists of experts, may be found at www.energyefficient.lu.

Since mid-2013, myenergy has been offering the **myenergy certified** voluntary certification for energy advisors (see http://certified.myenergy.lu/). 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. 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. In July 2014, 25 energy advisors were certified.

A whole range of further training courses and advanced courses are offered in the market. The Energy Agency organises the following training courses, among others: The complete list may be found at http://eacademy.lu/.

- **Energy advisor for residential buildings**: The 11-day course deals in detail with energy renovation, energy-efficient new builds and technical systems (from mechanical ventilation systems to heating with renewable energy). At the end of the course, the knowledge that has been acquired is tested in an examination.
- **Certified passive house planner**: Since 2011, a 10-day training course has been preparing participants to take the Passive House Institute Darmstadt's examination to become a certified passive house planner (see www.passivhausplaner.eu). In total, 84 certified passive house planners are registered in Luxembourg (as of July 2014). By way of comparison: in Belgium at the same time there were 39 certified passive house planners, 13 in the Netherlands and 267 in France.
- **Advanced courses on thermal bridge calculations, internal insulation**.
- **Training in energy management (ISO 50001)**: The course is aimed at energy advisors and consulting engineers, corporate energy and environmental officers, quality managers and internal auditors, and those responsible for production and maintenance. The basics of energy management and the requirements of ISO 50001 are communicated.

Since 2003, the Professional Association of Architects and Consulting Engineers (OAI), in collaboration with the CRP Henri Tudor, has been organising a series of advanced training courses 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 http://www.oai.lu/fr/162/oai/accueil/formations- continues/oai/ and http://webserver.tudor.lu/cms/OAI2014/content.nsf/id/Accueil.

In 2014, the OAI carried out a training course on the 'Hygiene of ventilation systems in practice' in cooperation with the Luxembourg Chamber of Crafts. The event was aimed specifically at tradespersons and planners. Both target groups view this cooperation in an extremely positive light, with the result that courses are being planned on other energy efficiency issues in cooperation between planners and tradespersons.

3.1.5.2 Tradespersons

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 trades 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 tradesperson certification** (see www.passivhaus-handwerk.de), in collaboration with the Energy Agency. It includes a cross-trade section and a trade-specific section and is aimed at all the trades involved in the building envelope and the technical systems. On passing the final examination, participants receive both the Energie fir d'Zukunft + certification of the Luxembourg Chamber of Crafts and the international passive house tradesperson certification of the Passive House Institute, 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, 290 certified passive house tradespersons are registered in Luxembourg (as of July 2014). By way of comparison: in Belgium at the same time there were 24 certified passive house tradespersons, 69 in Germany, and none at all in France and the Netherlands.

In collaboration with the Energy Agency and the IFSB, the Chamber of Crafts also organises **passive house building site courses** for shell constructors, joiners, window fitters, plasterers, electricians and building services engineers. To complement the certified passive house tradesperson course, which is aimed at owners and managers of trades companies, this one-day trade-specific course is designed for fitters and tradespersons who carry out the manual work on site. Intensive practical exercises are carried out on an example house, using demonstration projects.

Finally, the Chamber of Crafts organises 1–3-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 in the respective trade:

In addition to the courses provided by the Chamber of Crafts, since 2010 the Construction Sector 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 tradespersons. 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.).

3.1.5.3 Other initiatives in the area of qualification and certification

In 2013, a government-backed private sector initiative (Luxembourg Chamber of Commerce, FEDIL, ArcelorMittal, Schneider Electric, Enovos, Creos, Sudstroum and the town of Esch) set up the **Learning Factory** (www.learningfactory.lu). Based on the concept of 'learning by doing', the Learning Factory offers advanced training courses in the areas of energy efficiency and process optimisation through the 'Lean Six Sigma' methodology. The model factory makes it possible to imitate the various processes used in modern industrial manufacturing – at the level of production, storage and administration – and thus combine theory and practice in an optimum manner. The training programme is aimed at large industrial companies as well as at SMEs or service companies in Luxembourg and the Greater Region.

The **Luxembourg EcoInnovation Cluster** (www.ecoinnovationcluster.lu) is a network that supports the various actors in the field of eco-technology, with the aim of creating and developing new, sustainable business opportunities - among other things by means of joint R&D and innovation projects. The main objective of the network is to promote and expand the energy, environment and sustainable development sectors in Luxembourg. At present, the network focuses on the following three themes: Recycling, mobility, sustainable cities and smart technologies.

Alongside vocational training, specific skills in the areas of renewable energy and energy efficiency are also **beginning to be taught** at secondary school and college level. The Atert-Lycée Rédange secondary school offers a study programme for future technicians in energy systems and building services. An application-oriented engineering degree course 'Energy and the Environment' at the University of Luxembourg covers all the basics of energy and environmental technology in the fields of construction and electrical and mechanical engineering, focussing on technical building services and the building envelope.

In 2012, the Luxembourg Chamber of Crafts, the Construction Sector Training Institute IFSB and myenergy formed a consortium and, with the financial support of Intelligent Energy Europe, launched the **LuxBuild2020 initiative for training tradespersons with a view to 202**0 (http://luxbuild2020.myenergy.lu/) as part of the European BUILD UP Skills initiative. Many representatives of the construction sector accepted the consortium's invitation and together in a joint platform have developed a national roadmap for the qualification of tradespersons, which will be implemented in a three-year programme from mid-2014 to mid-2017. The Ministry of the Economy is actively supporting the project, since it brings together the many different initiatives and with a long-term perspective can be extended up to 2020.

In July 2014, the consortium gained another member in the form of the Guild of Tradespersons and is now working on the implementation of this roadmap. This includes the following priorities:

- Structural improvement of the qualification of tradespersons: The Chamber of Crafts and the Guild of Tradespersons have decided to put in place the necessary infrastructure to be able to provide independent training or further training of workers in all trades. To ensure the qualification of all persons working in construction, in addition to the IFSB, whose jurisdiction is limited to building companies, two other centres of excellence are to be established: a centre of excellence for development and a centre of excellence for technical systems. The concept and implementation planning for the centres should be available by the end of 2015.

- Development of the programmatic and educational content of training programmes: As is already the case with the passive house building site courses, the Chamber of Crafts is going to expand the courses it offers to include the implementation level (foreman, construction worker). Customised teaching materials and teaching methods are being developed that are based more on a visual and practical communication of the training content. In view of the large quantitative requirement for training, a coaching system is at the preparation stage. This will involve experienced staff in a trades company being trained to become internal quality managers. They will receive detailed training on critical issues such as air tightness, thermal bridges etc., and will be able to pass on the knowledge they have gained within the company or 'assure the quality' of multiple building sites.

3.1.6 Energy services (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, the initial experiences with energy savings contracts are being collected. When describing this market development, a distinction is made between the following types of services[18]:

- 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, 3.1.5 and 3.1.7.)

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 service. At http://www.energyefficient.lu there is a listing 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 renovations[19] may only be provided by these experts. The list of energy advisors certified by myenergy for residential construction may be found at http://certified.myenergy.lu/fileadmin/user_upload/certified/Liste_conseillers_myenergy_certified.pdf (see also section 3.1.5). The aforementioned lists are updated at regular intervals.

As the market for energy savings contracts is only just being set up at present, it is too early to publish a consolidated list of providers of such contracts. A list is being prepared and will be made public as soon as possible. It is estimated that have nearly a dozen enterprises based in Luxembourg possess the necessary qualifications and prerequisites to offer energy savings contracts. On account of Luxembourg's the close economic ties with neighbouring countries, specialised foreign enterprises may also provide

[18] 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.

[19] In accordance with the 'Grand-Ducal Regulation of 12 December 2012 establishing a support programme for promoting the rational use of energy and the development of renewable energy in the housing sector'

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/.

After intensive discussions with various public authorities, the first **pilot projects** were carried out in mid-2014. The aforementioned model contract is being tested in government buildings in relation to a savings contract with investment measures. In an additional pilot project, the energy consumption of a newer government property is to be reduced exclusively by means of non-investment measures. In cooperation with the Public Buildings Administration, myenergy is supporting the pilot projects in order to use the experience gained to further develop the energy services market.

To date, the municipalities in particular have been reluctant to use energy savings contracts. This may be explained, among other things, by the often small structures of many Luxembourg municipalities, as in general the economic benefits of savings contracts can only be achieved above a certain energy cost threshold.

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. Further explanations of this support programme are provided in section 3.1.7.

There is insufficient data on the use of energy savings contracts in the private sector. It may, however, be assumed that these services are currently still being underutilised there.

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

3.1.7.1 Financial instruments

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

Households

Households are supported mainly by investment aid[20] for energy renovation, the construction of a passive or low-energy house and the use of renewable energy. The support programme has been extended and adjusted several times since 2001. The current provisions apply from 1 January 2013 to 31 December 2016. Further information may be found at http://particuliers.myenergy.lu/de/finanzielle_unterstuetzung. The energy savings expected from this support programme are described in section 3.2.

The current government programme[21] provides for the introduction of an accelerated tax write-off of investments in energy renovations. At present, the competent authorities are examining the details of implementation.

In addition, there are plans to extend the aforementioned support programme after 2016. Among other things, the introduction of an interest-free loan for low-income households for the financing of an energy renovation is being considered.

To further boost investment in energy-efficient dwellings (and enterprises), the government programme is also considering the creation of a public financial institution, a so-called 'climate bank'. Additional information is provided below.

Enterprises

Investment by enterprises in energy efficiency and renewable energy will also be supported by means of investment aid via two support programmes[22]. Further information may be found at

[20] Grand-Ducal Regulation of 12 December 2012 establishing a support programme for promoting the rational use of energy and the development of renewable energy in the housing sector http://www.legilux.public.lu/leg/a/archives/2012/0264/index.html

[21] *Government programme 2013–2018*, Luxembourg, 2013

[22] Act of 18 February 2010 relating to a support programme for the protection of the environment and the rational use of natural resources, http://www.legilux.public.lu/leg/a/archives/2010/0044/2010A0712A.html and Act of 30 June 2004 on the creation of a general framework of support programmes for the small and medium-sized

http://www.guichet.public.lu/entreprises/de/urbanisme-environnement/aides-environnement/index.htmland http://entreprises.myenergy.lu/informations-et- outils/solutions-de-financement/.

Local authorities

The support programme of the Environmental Protection Fund[23] supports the municipalities in measures for increasing energy efficiency and the use of renewable energy. In 2014 it was adapted to the current challenges. 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 support programme are available on the following page: http://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 2014[24].

Consideration of the creation of a public financial institution to facilitate investment in energy efficiency and renewable energy

To further boost investment in renewable energy and energy efficiency, the government programme[25] is also considering the creation of a public financial institution. This should, among other things, solve the problem of capital-related financing constraints. In contrast to ex-post investment aid, the investments would be financed by loans. The main areas of activity are to include projects in the field of building renovation for private individuals and enterprises. It is intended, in cooperation with existing credit institutions, to offer loans at preferential rates. The initial considerations and discussions have already begun.

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enterprise sector, http://www.legilux.public.lu/leg/a/archives/2004/0142/2004A20141.html

[23] Amended Act of 31 May 1999 on the establishment of an Environmental Protection Fund, http://www.legilux.public.lu/leg/a/archives/1999/0069/index.html#1999A14642

[24] Grand-Ducal Regulation of 1 August 2014 relating to the generation of electricity from renewable energy sources, http://www.legilux.public.lu/leg/a/archives/2014/0154/index.html

[25] *Government programme 2013–2018*, Luxembourg, 2013

Climate and Energy Fund

The Climate and Energy Fund set up by the amended Act of 2004[26] helps to finance the flexibility mechanisms of the climate agreement[27], 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.

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.

3.1.7.2 Other barriers and solutions

In spite of the preferential 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 act as a brake on renovations. One solution proposed in the current government programme is to introduce an accelerated tax write-off of investments in energy renovations. Other measures to reduce these barriers might include an obligation, linked to the efficiency standard of the building, to create a reserve for energy renovations or the greater involvement of residential property managers in the dissemination of information on energy efficiency measures.

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

[26] Amended Act of 23 December 2004 1) establishing a greenhouse gas emissions trading system; 2) creating a fund for financing the Kyoto mechanisms; 3) …,
http://www.legilux.public.lu/leg/a/archives/2012/0282/2012A4420A.html
[27] Purchase of greenhouse gas emission permits

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 Chapter 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 support programme is also promoting the implementation of the highest standards of new construction and renovation. The measures are described in more detail below.

<table>
<tr><th colspan="2">Housing construction in accordance with the Energy Efficiency Regulation</th></tr>
<tr><td>Type of measure</td><td>Regulatory – energy efficiency standards for buildings</td></tr>
<tr><td>Target application</td><td>Energy consumption for heating and hot water in new residential buildings</td></tr>
<tr><td>Mechanism of action</td><td>Intensification of energy efficiency requirements on new residential buildings

Timetable of energy efficiency requirements
<table>
<tr><td>Date of building application</td><td>before 1.7.2012</td><td>from 1.7.2012</td><td>from 1.1.2015</td><td>from 1.1.2017</td></tr>
<tr><td>Thermal insulation class</td><td>D</td><td>C</td><td>B</td><td>A</td></tr>
<tr><td>Energy performance class</td><td>D</td><td>B</td><td>A</td><td>A</td></tr>
</table>
The energy efficiency standard A/A corresponds to a passive house.

Effect of the measure approximately 1 year after the respective closing date.</td></tr>
<tr><td>Implementation status and timeframe</td><td>In force
See timetable in Mechanism of action</td></tr>
<tr><td>Important measure parameters</td><td>Average rate of new construction: approx. 3 %/a in relation to the annual housing stock. This corresponds to approximately 7 900 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 0.85 %.</td></tr>
<tr><td>Anticipated energy savings in 2020</td><td>Final energy savings: 331 GWh</td></tr>
<tr><td>Financing</td><td>The implementation of the energy efficiency requirements is financed by the housing construction market.</td></tr>
<tr><td>Legislative basis</td><td>Amended Grand-Ducal Regulation of 30 November 2007 on the energy performance of residential buildings (as amended by the Grand-Ducal Regulation of 5 May 2012)</td></tr>
<tr><td>Further information</td><td>http://www.legilux.public.lu/leg/a/archives/2012/0096/index.html
http://www.energyefficient.lu</td></tr>
</table>

<table>
<tr><th colspan="2">Promotion of energy-efficient housing construction</th></tr>
<tr><td>Type of measure</td><td>Financial – Grants</td></tr>
<tr><td>Target application</td><td>Energy consumption for heating and hot water in new residential buildings</td></tr>
<tr><td>Mechanism of action</td><td>The promotion of low-energy and passive houses should accelerate the introduction of corresponding standards before their mandatory application.

Timetable for support
<table>
<tr><td>Year of building application</td><td>2013</td><td>2014</td><td>2015</td><td>2016</td></tr>
<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>
</table>
Low-energy houses correspond to the energy efficiency standard B/B/B.
Passive houses correspond to the energy efficiency standard A/A/A.

Effect of the measure approximately 1 year after the respective closing date.</td></tr>
<tr><td>Implementation status and timeframe</td><td>In force
See timetable in Mechanism of action. The current support programme runs from 1 January 2013 to 31 December 2016.</td></tr>
<tr><td>Important measure parameters</td><td>Support rate for low-energy houses: 30 % market share in 2013
Support rate for passive houses: 5 % market share in 2013, 10 % in 2014, 20 % in 2015 and 30 % in 2016
(Market share/support rate: Proportion of subsidised dwellings in the total number of newly constructed dwellings in a year)</td></tr>
<tr><td>Anticipated energy savings in 2020</td><td>Final energy savings: 58 GWh</td></tr>
<tr><td>Financing</td><td>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.</td></tr>
<tr><td>Legislative basis</td><td>Grand-Ducal Regulation of 12 December 2012 establishing a support programme for promoting the rational use of energy and the development of renewable energy in the housing sector</td></tr>
<tr><td>Further information</td><td>http://www.legilux.public.lu/leg/a/archives/2012/0264/index.html
http://particuliers.myenergy.lu/de/finanzielle_unterstuetzung</td></tr>
</table>

Promotion of the energy renovation of residential buildings	
Type of measure	Financial – Grants
Target application	Heating demand in existing residential buildings
Mechanism of action	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. Effect of the measure approximately 1 year after the respective closing date.
Implementation status and timeframe	In force The current support programme runs from 1 January 2013 to 31 December 2016.
Important measure parameters	Support rate: 0.2 % in 2013, 0.4 % in 2014, 0.6 % in 2015 and 0.8 % in 2016 in relation to the total number of dwellings built by 1995 (on average, this corresponds over the period to approximately 750 dwelling units per year)
Anticipated energy savings in 2020	Final energy savings: 45 GWh
Financing	To finance this proportion of the support programme, a state budget of between approx. EUR 3 million and EUR 12 million has been allocated over
Legislative basis	Grand-Ducal Regulation of 12 December 2012 establishing a support programme for promoting the rational use of energy and the development of renewable energy in the housing sector
Further information	http://www.legilux.public.lu/leg/a/archives/2012/0264/index.html http://particuliers.myenergy.lu/de/finanzielle_unterstuetzung

Support for solar thermal energy 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.
Implementation status and timeframe	In force The current support programme runs from 1 January 2013 to 31 December 2016.
Important measure parameters	Subsidies for solar thermal energy: between 1 000 and 2 500 systems per year Subsidies for heat pumps: between 220 and 500 systems per year
Anticipated energy savings in 2020	Final energy savings: 40 GWh

Financing	To finance this proportion of the support programme, a state budget of between approx. EUR 4 million and EUR 8 million has been allocated over the period.
Legislative basis	Grand-Ducal Regulation of 12 December 2012 establishing a support programme for promoting the rational use of energy and the development
	of renewable energy in the housing sector
Further information	http://www.legilux.public.lu/leg/a/archives/2012/0264/index.html http://particuliers.myenergy.lu/de/finanzielle_unterstuetzung

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 non-residential buildings
Mechanism of action	Intensification of the energy efficiency requirements on new non-residential buildings. Since 1 January 2011 (date of building application), non-residential buildings have been obliged to meet efficiency class D. Compared to buildings before the introduction of this regulation, savings of around 30 % 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: 2.0 %/a
Anticipated energy savings in 2020	Final energy savings: 168 GWh
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 concerning the energy performance of non-residential buildings
Further information	http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html http://www.energyefficient.lu

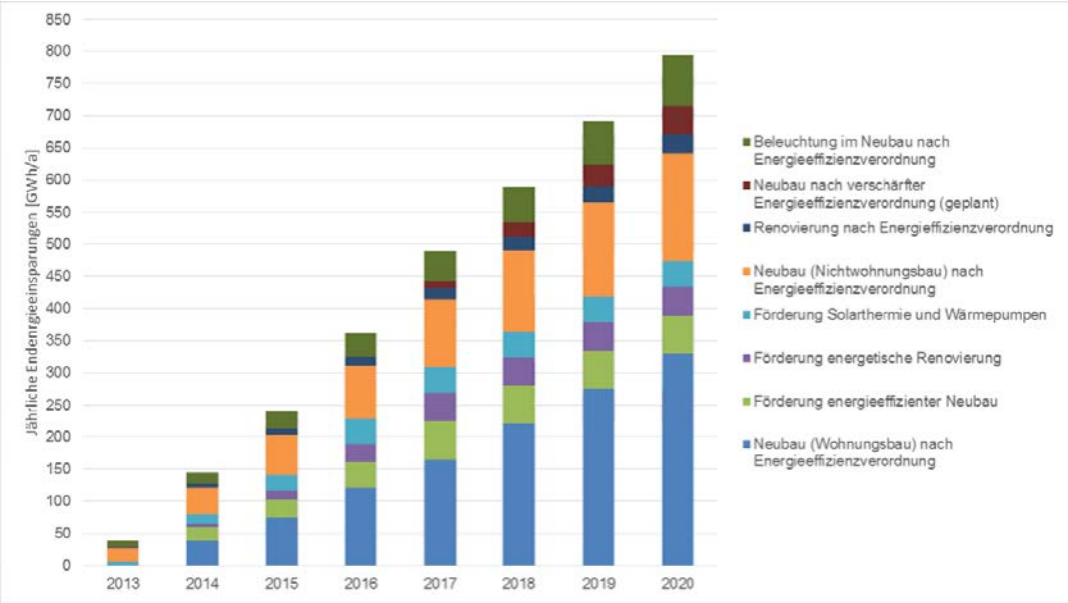
Renovation of non-residential buildings in accordance with the Energy Efficiency Regulation	
Type of measure	Regulatory – energy efficiency standards for buildings
Target application	Final energy consumption for heating and hot water in existing non-residential buildings
Mechanism of action	Introduction of energy efficiency requirements during the conversion or renovation of non-residential buildings. Since 1 January 2011, non-residential buildings have been obliged to meet minimum requirements (U-values, thermal insulation of distribution pipes, control systems etc.). 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: 29 GWh
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 concerning the energy performance of non-residential buildings
Further information	http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html http://www.energyefficient.lu

Non-residential construction in accordance with a stricter Energy Efficiency Regulation (planned)	
Type of measure	Regulatory – energy efficiency standards for buildings
Target application	Energy consumption for heating and hot water in new non-residential buildings
Mechanism of action	Further intensification of energy efficiency requirements on new non-residential buildings. It is expected that with effect from 1 July 2015 (date of building application) non-residential buildings must meet efficiency class C. Compared to the previous standard, this intensification corresponds to savings of 15 %. Effect of the measure approximately 2 years after the respective closing date.
Implementation status and timeframe	At planning stage Will enter into force on 1 July 2015.
Important measure parameters	Average rate of new construction: 2.0 %/a
Anticipated energy savings in 2020	Final energy savings: 44 GWh
Financing	The implementation of the energy efficiency requirements is financed by the market for non-residential construction.
Legislative basis	Draft Grand-Ducal Regulation amending the Amended Grand-Ducal Regulation of 31 August 2010 concerning the energy performance of non-residential buildings
Further information	http://www.chd.lu/wps/PA_RoleEtendu/FTSByteServingServletImpl/?path=/export/exped/sexpdata/Mag/127/319/132168.pdf http://www.energyefficient.lu

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 been obliged to meet efficiency class D. Compared to buildings before the introduction of this regulation, savings of around 40% in lighting electricity 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: 2.0 %/a
Anticipated energy savings in 2020	Final energy savings: 78 GWh
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 concerning the energy performance of non-residential buildings
Further information	http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html http://www.energyefficient.lu

The figure below shows the expected final energy savings as a result of energy efficiency measures in buildings. It is clear that the continual intensification of the energy efficiency standards in new buildings is proportionally having the greatest effect. After 2017, the listed support instruments will generate no additional energy savings, as they will only be in force up to that point. An extension or improvement of the financial incentives could further increase the energy savings by 2020.



German	**English**
Jährliche Endenergieeinsparungen [GWh/a]	Annual final energy savings [GWh/a]
Beleichtung im Neubau nach Energieeffizienzverordnung	Lighting in new builds in accordance with the Energy Efficiency Regulation
Neubau nach verschärfter Energieeffizienzverordnung (geplant)	New builds in accordance with a stricter Energy Efficiency Regulation (planned)
Renovierung nach Energieeffizienzverordnung	Renovation in accordance with the Energy Efficiency Regulation
Neubau (Nichtwohnungsbau) nach Energieeffizienzverordnung	New builds (non-residential construction) in accordance with the Energy Efficiency Regulation
Förderung Solarthermie und Wärmepumpen	Support for solar thermal energy and heat pumps
Förderung energetische Renovierung	Promotion of energy renovation
Förderung energieeffizienter Neubau	Promotion of energy-efficient new builds
Neubau (Wohnungsbau) nach Energieeffizienzverordnung	New builds (housing construction) in accordance with the Energy Efficiency Regulation

Figure 3: Anticipated development of final energy savings in the period 2013–2020 as a result of energy efficiency measures in buildings

The building measures described, particularly in the area of building renovation, require accompanying measures to reinforce their effect. The actions taken and planned in this regard are explained in more detail in section 3.1 (Horizontal measures), in section 3.3 (Energy efficiency measures in public bodies)

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)
- Consideration of the creation of a public financial institution to facilitate investment in energy efficiency and renewable energy (see section 3.1.7.1)
- 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)

Article 4 of the EED requires Member States to plan a long-term strategy for mobilising investment in the renovation of buildings. The full strategy document is contained in Annex A to this report.

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

The recasting 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 modified regulations, the market and the sector must 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 buildings is summarised in the next section and can be downloaded using the following link: http://www.eco.public.lu/documentation/rapports/Nationaler_Plan_Luxemburgs_zur_Erhhung_der_Zahl_der_Niedrigstenergiegebude.pdf.

In the meantime, the Grand-Ducal Regulation of 26 May 2014 has now stipulated that with effect from 1 January 2019 all new buildings (residential and non-residential) must meet the nearly zero-energy standard. This regulation may be found here: http://www.legilux.public.lu/leg/a/archives/2014/0099/index.html.

3.2.2.1 Summary of the national plan for increasing the number of nearly zero-energy buildings[28]

The successful and speedy introduction of nearly zero-energy buildings into construction practice requires measures and actions to be taken in a wide variety of areas.

As far as **research and development** is concerned at a scientific level, theoretical and technical principles and opportunities and accounting methods should be developed and key factors identified, which are essential to the successful implementation in construction practice. It must be ensured that the criteria for success identified in this way are consistent with construction practice. To this end, pilot projects must be carried out and evaluated.

Economic incentives need to be created for the implementation of projects in the near future by means of **start up aid programmes** adapted in good time for nearly zero-energy buildings in both the public and private sectors. The support programmes should be designed in such a way as to enable quantitative evaluation by technical means so that the pilot projects will become useful sources of information.

The **energy performance certificate** is of major importance in demonstrating the energy performance of buildings. The current method of assessment should be expanded to include nearly zero-energy buildings; at the same time, the **quality** of energy performance certificates and of the construction and technical implementation should be further improved through monitoring mechanisms and central recording of all energy performance certificates.

Current **training programmes** must be adjusted to the new requirements for nearly zero-energy buildings and to the findings from the monitoring and pilot projects. In particular, the training must cover the practical incorporation of renewable energies and the potential for building systems to use them.

The provision of **information** at different levels (experts, public, citizens etc.) is an important key element contributing to a successful introduction of nearly zero-energy buildings and to increasing the level of acceptance for them. Findings and information obtained through research projects, pilot projects etc. should be compiled for the individual target groups.

The current legislation must be amended to reflect the new requirements for nearly zero-energy buildings; this should come into force at a time consistent with the aims of their introduction and the provisions of the Directive. The findings in all areas must be reflected in the **implementation of national regulations**.

[28] Source: Government of the Grand Duchy of Luxembourg, *National Plan for Luxembourg to increase the number of nearlyzero-energy buildings*, Luxembourg, July 2013

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 and development
  - Priority given to these issues at the national level
  - Aid for research activities
  - Aid for the development of simple tools
- Support programmes
  - Adjustments to the requirements and levels of support
- Quality assurance and energy passport
  - Further linking of the energy performance certificate with support instruments
  - Quality assurance by means of automatic plausibility checking
  - Preparation of a central database for energy performance certificates
  - Quality control by means of 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 BUILD UP project) and creation of the link to the nZEB proposal.
- Implementation in national legislation
  - Intensification of requirements for non-residential buildings
  - Introduction of the methodological basis and definition of the requirement level for nZEBs.

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(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 explicitly in the following list. For the other measures, please refer to the appropriate sections.

- Intensification of 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 2019, all new buildings must 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
- Energy services (section 3.1.6)
- Other horizontal measures (section 3.1.7)
  - Support 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
  - Consideration of the creation of a public financial institution to facilitate investment in energy efficiency and renewable energy
- 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 must 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 on buildings, 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 may be downloaded using the following link: http://www.eco.public.lu/documentation/rapports/Berechnung_kostenoptimaler_Niveaus_von_Mindestanforderungen_an_die_Gesamtenergieeffizienz_fr_neue_und_bestehende_Wohn-_und_Nichtwohngebude.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 evolution 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 estimates of this dependence and the associated monetary effects will ultimately be crucial in determining the speed of introduction and the design of future efficiency standards.

3.3 Energy efficiency measures in public bodies

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 on the total floor area of buildings with a useful floor area over 500 m^2 that do not meet the minimum energy performance requirements. That threshold will be lowered to 250 m^2 as of 9th July 2015.

To calculate this renovation obligation, Luxembourg created an inventory of the public buildings affected. 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 159 500 m^2 of total useful floor area to be used for determining the annual target. It follows from this that 4 785 m^2 of useful floor area is to be renovated each year, i.e. approximately 33 500 m^2 from 2014 to 2020. Luxembourg also informed the European Commission that it would not be opting to use the alternative approach referred to in Article 5(6).

The government programme[29] confirms that the state will strive to play an exemplary role by means of an ambitious renovation programme for government buildings. The efforts over recent years are being further 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(7) of the EED requires that public bodies that are not part of central government should be encouraged to demonstrate their exemplary role in the energy efficiency of buildings. The corresponding measures in relation to municipalities and social housing bodies governed by public law are explained below.

3.3.2.1 Municipalities

The **Climate Pact**, which has a statutory basis, entered into force in January 2013. This central

[29] *Government programme 2013–2018*, Luxembourg, 2013

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. Each participating municipality undertakes to implement the eea and to set up an energy management system, in return for financial and technical support from the state. This mutual obligation, which is valid until 2020 and which takes account of European climate change objectives, is set out in a convention between the state and the municipalities. myenergy manages the Climate Pact on behalf of the Ministry of Sustainable Development and Infrastructure. The Climate Pact website may be found here: http://www.pacteclimat.lu/.

The eea is a pragmatic and comprehensive instrument that has been developed by municipalities and which assists each municipality, via various stages, to achieve a sustainable energy, transport, climate change and environmental policy. The main instrument is a catalogue of around 80 measures in 6 different areas: Development and spatial planning, municipal buildings and facilities, utility supply and waste disposal, mobility, internal organisation, communication and cooperation. A significant proportion of these measures may contribute to an improvement in energy efficiency within the municipality. This is reflected, for example, in the creation and analysis of reference values for the energy efficiency of heating and electricity. The process begins with an inventory of the municipality based on the catalogue of measures. The second step involves drawing up concrete action plans aimed at increasing energy efficiency and promoting renewable energy. The implementation of the action plan is documented in an annual report. The process cycle begins again with the adaptation of the inventory and the updating of the action plan.

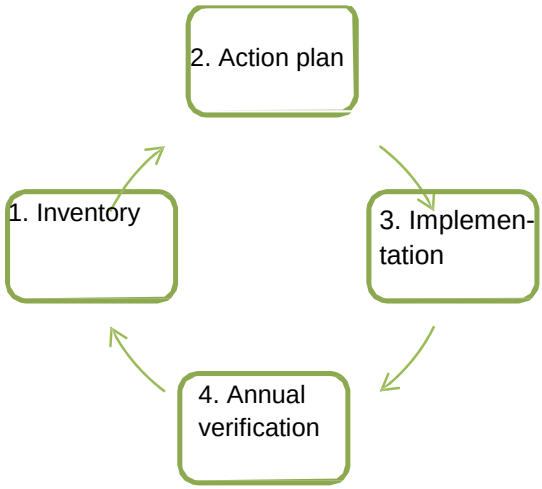


Figure 4: The process cycle of the Climate Pact / European Energy Award ®

In addition, the eea contains a certification scheme designed to reinforce the municipal energy and climate change policy with measurable effects and to supply additional motivation. The financial support provided by the Climate Pact is based on 3 certification levels which have been introduced in Luxembourg.

The obligation enshrined in the Climate Pact to set up an energy management system for municipal

buildings, street lighting and vehicle fleets provides a solid basis of data for the representation of the actual situation. The 'EnerCoach' energy accounting software has been developed for the harmonisation of data collection and an analysis of the results; this software is made available to the municipalities free of charge. The results provide the basis for the creation of concepts for the renovation of buildings. Furthermore, the Climate Pact also encourages municipalities to renovate their properties and to voluntarily implement higher standards for new builds.

Technical support is provided to the participating municipalities by an 'environmental consultant'. Depending on the size of the municipality, the consultant is available to the municipality for between 25 and 50 days a year. He/she supplies basic advice at local level and guides the municipality through the quality management process.

In July 2014, 88 of the 106 Luxembourg municipalities were participating in the Climate Pact. List of participating municipalities in alphabetical order: Bech, Beckerich, Berdorf, Bertrange, Bettembourg, Bettendorf, Betzdorf, Bissen, Biwer, Boevange-sur- Attert, Boulaide, Bourscheid, Bous, Clervaux, Consdorf, Contern, Dalheim, Diekirch, Differdange, Dudelange, Echternach, Ell, Erpeldange, Esch-sur-Alzette, Esch-sur-Sûre, Eschweiler, Ettelbruck, Fischbach, Flaxweiler, Frisange, Goesdorf, Grevenmacher, Grosbous, Hesperange, Junglinster, Käerjeng, Kayl, Kehlen, Kiischpelt, Koerich, Lac de la Haute-Sûre, Larochette, Lintgen, Lorentzweiler, Luxembourg, Mamer, Manternach, Mersch, Mertert, Mertzig, Mompach, Mondercange, Mondorf, Niederanven, Parc Hosingen, Pétange, Préizerdaul, Putscheid, Rambrouch, Redange, Remich, Reisdorf, Roeser, Rumelange, Troisvierges, Tuntange, Saeul, Sandweiler, Sanem, Schieren, Schifflange, Stadtbredimus, Steinfort, Steinsel, Schuttrange, Tandel, Useldange, Vallée de l'Ernz, Vianden, Vichten, Wahl, Waldbillig, Walferdange, Weiler- la-Tour, Wiltz, Wincrange, Winseler, Wormeldange.

At the same time, 6 municipalities were certified. Three of them were at certification level 2: Parc Hosingen, Stadtbredimus and Tandel. And another three at certification level 1: Clervaux, Lintgen and Lorentzweiler. In July 2014, around 10 additional audits were planned by October 2014, so that this list will continue to grow. Given that the Climate Pact was only introduced at the start of 2013, the results so far are considered to be a great success and suggest that there will be further dynamic development.

In addition to the Climate Pact, the **Environmental Protection Fund** provides financial support to the municipalities for investments in energy efficiency and renewable energy. At building level, the support programme encourages, among other things, the implementation of energy renovation measures and the construction of new buildings in a particularly energy-efficient manner. Local authorities are also encouraged to develop and implement energy savings contracts. In conjunction with the Climate Pact, the Environmental Protection Fund therefore provides an integrated approach, from the preparation of action plans to the implementation of measures. A more detailed description of the Environmental Protection Fund may be found in section 3.1.7.

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 stock of rental housing. A large number of energy renovations have already been carried

out. In accordance with a regulation[30] from 2012, after any renovation or conversion of an existing SNHBM residential building, the building must meet at least efficiency class D. In addition, the installation of a mechanical ventilation system with heat recovery and the performance of an air tightness test are mandated. In a recent pilot project, 2 rental residential buildings from the 1950s were renovated from efficiency class I to passive house standard (energy efficiency class A).

Since 2012, many of the SNHBM's new construction projects have been carried out to passive house standard (efficiency class A). In accordance with the aforementioned regulation, any new build must meet at least energy performance class A and thermal insulation class B.

The **Fonds du Logement** (Housing Fund) is also fulfilling its exemplary role, with new projects being carried out to passive house standard and its stock of rental housing being gradually renovated and improved 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 (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, an amendment is being made to 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').

Moreover, the government programme[31] 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 buildings[32], the energy efficiency

[30] Grand-Ducal Regulation of 28 June 2012 amending and supplementing the 9th construction programme of supported housing projects as well as the state's shareholdings: http://www.legilux.public.lu/leg/a/archives/2012/0131/index.html

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

[32] 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 stipulates that with effect from 1 January 2019 all new buildings (residential and non-residential) must meet the nearly zero-

requirements on all new non-residential buildings will be intensified. With effect from 1 July 2015, non-residential buildings will have to meet efficiency class C (regulation in legislative procedure). Furthermore, Directive 2010/31/EU specifies that by 31 December 2018 the buildings occupied and owned by public authorities should be nearly zero-energy buildings. To reinforce the state's exemplary role, the government programme stipulates that in 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 Municipalities

At municipal level, the **Climate Pact** raises awareness and supports the municipalities in the energy-efficient procurement of products, services and buildings (see section 3.3.2.1 for a more detailed description of the Climate Pact). It therefore creates an incentive to act even more efficiently than is anticipated by the legal requirements.

The setting up of an energy management system for municipal buildings, street lighting and vehicle fleets, which is mandated by the Climate Pact, provides a solid basis of data for the representation of the actual situation. The results provide the basis for the creation of concepts for the renovation of buildings, the use of energy-efficient lighting systems and the efficient deployment of vehicles. In addition, the Climate Pact also encourages municipalities to voluntarily implement higher standards for new builds. Thanks to the integrated approach of the catalogue of measures, the municipal authorities are also supported in the procurement of energy-efficient products and services. This relates, for example, to the establishment of procurement guidelines for office supplies, electrical appliances and building maintenance based on energy efficiency criteria.

The municipalities receive financial support for the procurement of energy-efficient buildings and products via the **Environmental Protection Fund**. A more detailed description of the Environmental Protection Fund may be found in section 3.1.7.

3.3.3.3 Other initiatives in the area of energy-efficient procurement

The www.oekotopten.lu web portal introduces consumers to the most efficient and environmentally friendly products in various fields (e.g. household appliances, office equipment, mobility, entertainment, lighting, construction). It is described in more detail in section 3.1.4.2.

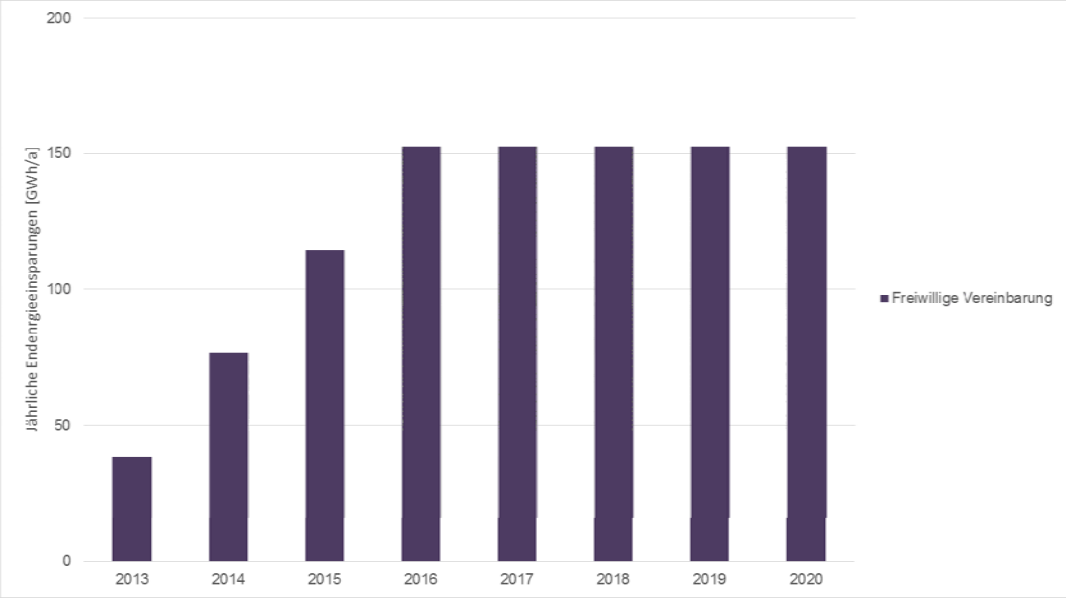
The Akaf [plus] initiative by the Emweltberodung Lëtzebuerg and other partners is aimed primarily at municipalities, but also at other large consumers, such as the public administration. Guidelines offer practical advice on purchasing sustainable products. Further information may be found at http://www.ebl.lu/.

3.4 Energy efficiency measures in industry

energy standard.

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 is described in more detail below. In this respect, myenergy supports the participating enterprises with monitoring and assists them in their first steps in the implementation of measures, e.g. by means of seminars on a particular theme.

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. 60) participate.
Mechanism of action	The aim of the voluntary agreement is to improve energy efficiency by 7 % between 2011 and 2016. The average for 2009 and 2010 is used as a reference. The development of energy efficiency is measured using a general efficiency characteristic value, 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. 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. Enterprises that fail to meet their obligations – including annual reporting requirements – may be excluded from the agreement.
Implementation status and timeframe	1 January 2011 to 31 December 2016
Important measure parameters	Improvement in energy efficiency: 0.7%/a. The 7 % target within the 6-year period was adjusted for autonomous progress (0.5 %/a). 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.
Anticipated energy savings in 2020	Final energy savings: 152 GWh
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	http://www.eco.public.lu/documentation/rapports/rapport_ministere/Rapport_annuel_2013_-_Final_21.pdf (p. 90) http://entreprises.myenergy.lu/grandes-entreprises-et-industries/accord- volontaire-fedil/



German	English
Jährliche Endenergieeinsparungen [GWh/a]	Annual final energy savings [GWh/a]
Freiwillige Vereinbarung	Voluntary agreement

Figure 5: Anticipated development of final energy savings as a result of the voluntary agreement with industry

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

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 3.1.7.1)
- Consideration of the establishment of a public financial institution to facilitate investment in energy efficiency and renewable energy (see section 3.1.7.1)

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 (+EUR 0.015/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: 86 GWh
Financing	The tax increase is borne by the consumer.
Legislative basis	Amended Act of 17 December 2010 specifying the excise duty and similar taxes on energy products…
Further information	http://www.do.etat.lu/acc/Taux_droits_accise/Documents/Tableau_Accises_2005-2014.pdf

CO_2 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 01/01/2007
Important measure parameters	Rate of improvement in the specific fuel consumption of new vehicles: 2%/a
Anticipated energy savings in 2020	Final energy savings: 66 GWh
Financing	The tax increase is borne by the vehicle owner.
Legislative basis	Act of 22 December 2006 … concerning … the reform of road vehicle tax …
Further information	http://www.do.etat.lu/vehaut/Taxes/index.htm

The anticipated final energy savings achieved by the two fiscal measures

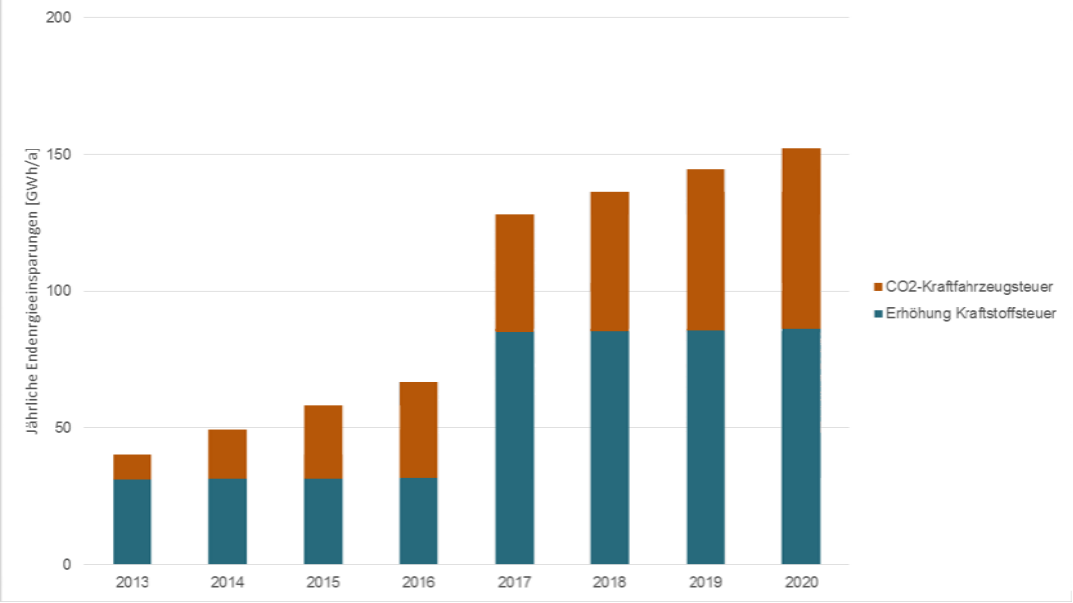
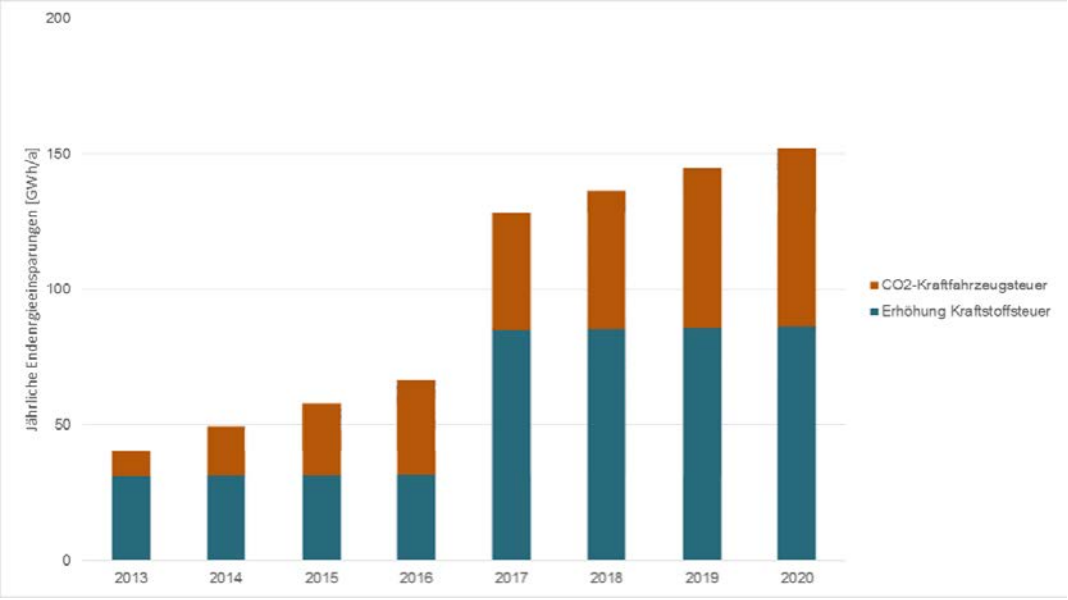


Figure 6. The gradual development of the estimated savings as a result of increasing the fuel tax is based on the assumed price elasticities[33].



German	English
Jährliche Endenergieeinsparungen [GWh/a]	Annual final energy savings [GWh/a]

[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) must meet the nearly zero-energy standard

CO2-Kraftfahrzeugsteuer	CO2 vehicle tax
Erhöhung Kraftstoffsteuer	Increase in fuel tax

Figure 6: Anticipated development of final energy savings 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' (mobilité durable))[34], which aims to reduce the negative impacts of traffic by promoting public transport and soft mobility.

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 strategy is also the promotion of alternative mobility, e.g. parking space management, park & ride, carpooling or car sharing and a reduction in motorised traffic by an increase in the proportion of soft mobility in everyday traffic and especially on short trips.

Other objectives of the strategy include the creation of mobility chains by combining various forms of transport (train-tram-bus) and the establishment of a global network for public passenger transport, increasing the capacity of the rail network, the introduction of a tram, the creation of capacities in the road network as a result of a more efficient bus service and the consistent development of soft mobility as a fully-fledged means of transport. The policy targets for 2020 are:

- a modal proportion of 25 % for public transport and
- a modal share of 25 % of traffic volume for soft mobility.

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

While the strategic considerations are covered by 'MoDu', the sectoral transport plan[35] in turn gives a detailed description of the various projects and measures for which a legislative framework is required, and thus represents a reference instrument for regional planning and the planning of mobility and infrastructure.

An essential step towards improving the modal choice in favour of public transport will be the commissioning of the tram system in the City of Luxembourg with associated peripheral stations. In accordance with the parliamentary financing decision, it is anticipated that by 2020/21 the tram will be operating over the entire route from Cloche d'Or to Findel, and will be running on the central section from 'Pont Rouge' to Luxexpo as early as 2017.

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 of capacity by 2020).

The energy efficiency of public transport will be improved by, among other things, a regular renewal of bus fleets or the replacement of urban buses by the aforementioned tram system. The entire railway network of Luxembourg is electrified.

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 cities offer bike-sharing facilities.

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 2005 and 2010. 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. By 2020, about 10 % of the vehicle population (40 000 vehicles) should be electrically powered. Whether this goal is achieved depends firstly on the availability of electric cars that meet customers' needs. And,

[35] Further information at:
http://www.dat.public.lu/plans_caractere_reglementaire/plans_sectoriels/transports/index.html

secondly, Luxembourg needs to set up a comprehensive recharging infrastructure.

In a study[36] on the coordinated introduction of electromobility in Luxembourg, a strategy for the establishment of a standard, public recharging infrastructure was prepared, which will now be further developed and implemented by a national working group. 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 recharging 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. A Grand-Ducal Regulation will define 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 for electric vehicles by 2020.

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.
- Since 2007, the purchase of an electric car has been supported by state aid. A subsidy of EUR 5 000 will be granted until the end of 2014. A precondition for this is the signing of a supply contract for green electricity.
- By 2013, around 50 charging stations 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.

3.6 Promotion of efficient heating and cooling (Article 14)

3.6.1 Comprehensive 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 into the potential use of high-efficiency cogeneration plants[37] that was conducted in

[36] Schwartz and Co, *Technical and economic study into the national implementation of electromobility in Luxembourg*, Luxembourg, December 2011 (http://www.eco.public.lu/documentation/etudes/2012/Etude_ElectroMobilite.pdf)

[37] Fraunhofer Institute for Systems and Innovation Research and the Bremen Energy Institute, *Final report for the study into the potential of high-efficiency cogeneration plants in Luxembourg*,

2008.

3.6.2 Further measures to promote efficiency in heating and cooling

The efficiency of systems for supplying heating and cooling (hereafter simply called 'heating') can be promoted by means of various measures and strategies:

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

Which measures and strategies are the most appropriate depends on the framework conditions. For example, a district heating system including cogeneration may be the best solution for a neighbourhood with a high energy density, while efficient, decentralised heating supply systems, possibly using renewable energy sources, would be preferable in a new housing estate containing highly energy-efficient homes.

In the context of Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market, Luxembourg conducted a national study into the potential use of high-efficiency cogeneration plants[38]. This calculated the potential for the use of high-efficiency cogeneration plants in four areas of application. These were combined heat and power generation for the provision of district heating or for supplying individual buildings, industrial applications and the exploitation of CHP potential through the use of biomass.

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 2013, Luxembourg had around 130 cogeneration plants in various performance classes. Total electrical output was 116 MW, and in total these plants generated approx. 359 GWh of electricity in 2013. Moreover, since 2011 the waste heat from the Twinerg CCGT (total output of 350 MW_{el}) has been decoupled and used for the supply of heating to a nearby district.

In addition to its domestic power generation, which is based mainly on the aforementioned plants, Luxembourg imports the majority of the electricity it requires. Although a further expansion of high-efficiency cogeneration in Luxembourg would increase energy efficiency and reduce CO_2 emissions in the EU, it would, in the accounting of greenhouse gas emissions, lead to an increase in emissions on the Luxembourg balance, on account of the displacement of imported electricity and the principle of territoriality[39].

Partly for this reason, in the development of high-efficiency cogeneration, as well as in heating generally, Luxembourg is focusing primarily on renewable energy sources. This strategy makes it possible to improve the efficiency of heating without adversely affecting the greenhouse gas emission balance, while

[38] Fraunhofer Institute for Systems and Innovation Research and the Bremen Energy Institute, *Final report for the study into the potential of high-efficiency cogeneration plants in Luxembourg*, Luxembourg, April 2008

[39] With the exception of ETS installations, which are accounted for at a European level in the period 2012–2020.

at the same time contributing to the renewable energy target. When fossil-fired cogeneration plants have to be decommissioned, e.g. for reasons of age, it is hoped that the current funding incentives will enable a supply of the corresponding heat sinks of cogeneration plants based on renewable energy sources.

To implement this strategy, Luxembourg is supporting the use of renewable energy by means of various support programmes, as described in section 3.1.7.1. In this context, the remuneration of electricity generated from renewable energy sources should be noted. The current tariffs entered into force in 2014[40] and apply to biomass and biogas plants, among others. 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 described in section 3.3.2.1 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 Kiowatt plant commissioned in 2014 represents a good example of heating and cooling[41]. This is a combined heat, power and cooling plant, which is fired by waste wood. The thermal energy generated in steam generators (11 MW) is converted into electricity by means of a turbine (2.7 MW_{el}), and then the residual heat is used for the following three applications:

- heating the drying air in the dryer of a pellet production plant;
- cooling a neighbouring data centre by means of an absorption chiller;
- injection into the adjacent municipal heating network.

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 will be transposed into national law in Luxembourg by amending the amended Act of 1 August 2007 concerning the organisation of the electricity market and the amended Act of 1 August 2007 concerning the organisation of the gas market. Since mid-2014, these provisions have been in the legislative procedure, which should soon be completed.

3.7.1 Energy efficiency criteria in network tariffs and regulation

Pursuant to Article 54(1)(d) of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 51(1)(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

[40] Grand-Ducal Regulation of 1 August 2014 relating to the generation of electricity from renewable energy sources, http://www.legilux.public.lu/leg/a/archives/2014/0154/index.html
[41] http://www.kiowatt.lu/de

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 documents currently in the legislative procedure specify that in future 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 improving the overall efficiency of the system, including demand response. Network tariffs must also reflect cost savings in networks achieved from demand-side and demand-response measures and distributed generation (including savings from lowering the cost of delivery or 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(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.

The documents currently in the legislative procedure specify that in future, in accordance with Article 54(2), new subsections u) and v), of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 51(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 connection, 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

The documents currently in the legislative procedure specify that in future, in accordance with Article 27, new paragraph 14 of the amended Act of 1 August 2007 concerning the organisation of the electricity market and Article 33(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. The relevant Minister must be notified of these measures and investments, as well as the timeframe, by 30 June 2015 at the latest.

ANNEX A:

BUILDING RENOVATION STRATEGY

1 Introduction

The national building renovation strategy concerns the long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private, in accordance with Article 4 of the Directive. The building renovation strategy contains:

- a description of the current state of energy renovation in Luxembourg;
- an overview of the national building stock based, and a description of the energy characteristics of the building stock;
- the strategies and measures for supporting energy renovation;
- the future perspectives for guiding the investment decisions of individuals, the construction industry and financial institutions.

2 Overview of national building stock

This Chapter processes the national building stock data and presents the main findings. Thanks to the 2011 census, relatively recent data is available for residential buildings. With regard to non-residential buildings, only limited statistical data is available on the building stock, so that this area can only be examined to a limited extent.

2.1 Development of the energy efficiency of buildings in the case of renovation

In 1995, the Thermal Insulation Regulation introduced the first legal requirement to limit the energy consumption of buildings. The Thermal Insulation Regulation limited losses of heat via the building envelope and guaranteed a minimum level of thermal insulation. These requirements also had to be met in the case of large-scale renovations.

In 2008, the Energy Saving Regulation came into force for residential buildings[42] in Luxembourg; this is based on the requirements of Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings[43]. For all buildings that were being modernised, this placed minimum requirements on the thermal insulation of components that were to be renewed. Since that time, new and existing buildings have been classified according to a system of energy efficiency classes from A to I. The Energy Saving Regulation of 2008 intensified the requirements on the thermal insulation of new and existing non-residential buildings.

With the Energy Saving Regulation for non-residential buildings[44] of 31 August 2010, all the energy performance requirements were extended to new non-residential buildings (entry into force January 2011). Since 2011 there have been requirements in this area on thermal insulation and primary energy demand, as well as a classification system for new and existing buildings based on energy efficiency classes.

2.2 National building stock

The national building stock may be divided into three categories:

- single-family houses: detached single-family houses, semi-detached and terraced houses, and farmhouses;

[42] Grand-Ducal Regulation of 30 November 2007;
http://www.legilux.public.lu/leg/a/archives/2007/0221/2007A3762A.html
[43] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings
[44] Grand-Ducal Regulation of 31 August 2010;
http://www.legilux.public.lu/leg/a/archives/2010/0173/2010A2850A.html

- apartment blocks;
- non-residential buildings, i.e. buildings in which less than 90 % of the floor space is used for residential purposes.

Below, three periods are used for the building categories: the period before 1971, the period from 1971 to 1995 and the period from 1995 onwards. In the 1970s, in the wake of the oil crisis, which was accompanied by sharp increases in crude oil prices, the first measures and policies were developed with regard to saving energy. In 1995, the first regulation on the thermal insulation of new buildings was introduced in Luxembourg.

Furthermore, it is assumed that the whole territory of Luxembourg is located in a single climate zone.

2.2.1 National residential building stock

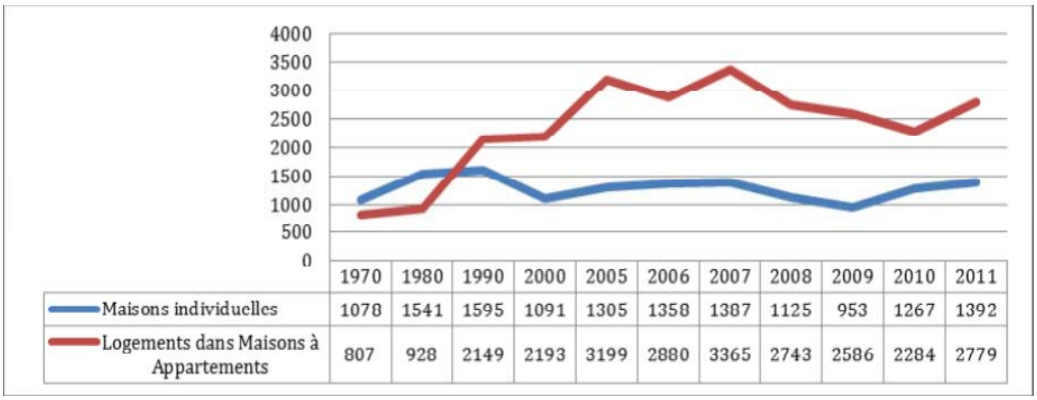
The figures and calculations used below originate from the National Statistics Office (STATEC) and are based on the census performed in 2011.

The number of dwellings in the national building stock has developed as follows in recent decades:

Table 2: Number of single-family houses and dwellings in apartment blocks [source: Statec, 2011 Census]

Year of construction	Single-family houses	Dwellings in apartment blocks	Total
before 1971	62 324	33 305	95 629
1971–1995	37 887	26 629	64 516
after 1995	20 685	27 129	47 814
Total	**120 896**	**87 063**	**207 959**

Luxembourg's residential building stock consists predominantly of single-family houses. These account for approximately 58.1 % of residential buildings. Apartment blocks are gaining in importance, so that in terms of the residential buildings built after 1995 the proportion of apartment blocks is greater than that of single-family houses.



	1970	1980	1990	2000	2005	2006	2007	2008	2009	2010	2011
Maisons individuelles	1078	1541	1595	1091	1305	1358	1387	1125	953	1267	1392
Logements dans Maisons à Appartements	807	928	2149	2193	3199	2880	3365	2743	2586	2284	2779

French	**English**
Maisons individuelles	Single-family houses
Logements dans Maisons à Appartements	Dwellings in apartment blocks

Figure 1: Number of single-family houses and dwellings in apartment blocks built each year [source: Statec]

Since 1990, almost three times more dwellings in apartment blocks have been built than single-family houses.

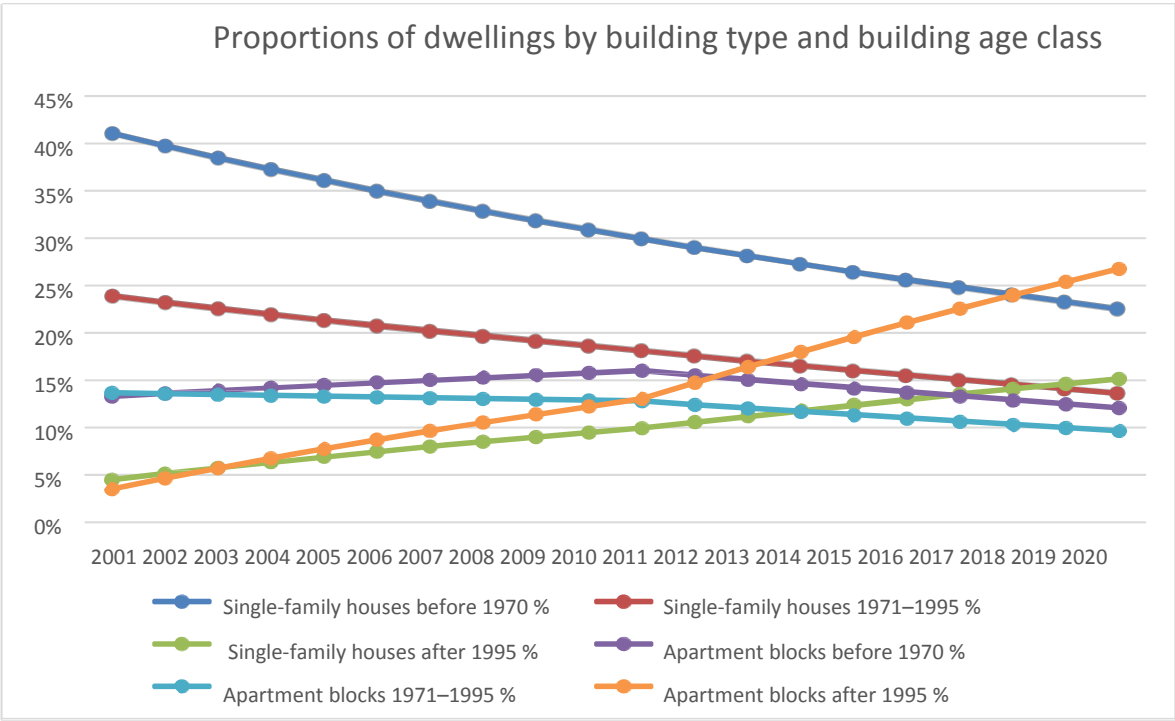


Figure 2: Development of the proportions of residential buildings (single-family houses and apartment blocks) [source: NEEAP calculation model 2014]

From Figure 2 it can be seen that in the overall residential building stock the proportion of apartment blocks that were built after 1995 has risen from 5 % in 2001 to 13 % in 2011. In 2013 it had already

reached 16 %, and it is expected that the proportion will rise to 27 % by 2020.

With regard to the proportion of single-family houses built after 1995, a steady increase may be observed from 5 % in 2001 to 11 % in 2013. It is expected that the proportion will rise to 16 % by 2020.

As a result of the sharp rise in the proportion of apartment blocks in the overall residential building stock, the ratio of apartment blocks to single-family houses has changed from approximately 30 % to 70 % in 2001 to approximately 43 % to 57 % in 2011. It is expected that by 2020 this ratio will be approximately 49 % to 51 %.

Table 3: Year of construction of residential buildings [source: Statec, Census 2011]

Year of constructio	Single-family houses	Apartment blocks
before 1971	56%	44%
1971–1995	28%	27%
after 1995	16%	29%

According to the census performed in 2011, 16 % of single-family houses and 29 % of apartment blocks were built after the entry into force of the Thermal Insulation Regulation in 1995. This indicates that there is considerable potential for savings in energy consumption through the renovation of existing single-family houses and, to an even greater extent, the renovation of apartment blocks, simply on account of their age structure.

Table 4: Number of renovations between 2001 and 2010 in single-family houses, dwellings in apartment blocks and housing units in non-residential buildings [source: Statec, Census 2011]

Year of renovation	Number of renovations
2001–2010	18 330

Between 2001 and 2010, a total of 18 330 renovations were carried out in single-family houses, dwellings in apartment blocks and housing units in non-residential buildings. This covers all types of renovations, including energy renovation. However, the number of purely energy renovations cannot be seen from the latest available statistics.

Table 5: Average living area of single-family houses and dwellings in apartment blocks in 2010 [source: Statec, Census 2011]

Year of constructio	Single-family houses	Dwellings in Apartment blocks
before 1971	149.20	80.20
1971–1995	170.24	85.80
after 1995	185.77	89.70

The average floor space of dwellings in residential buildings in Luxembourg is 129.9 m^2. With owner-occupied dwellings, the average floor space of dwellings in residential buildings is 147.7 m^2.

It should be noted here that the average dwelling sizes in single-family houses are rising faster than the dwelling sizes in apartment blocks.

Table 6: Occupancy of dwellings

	Households	Persons
Owner	69.0%	73.0%
Occupied rent-free	2.7%	2.1%
Tenant	28.3%	24.7%
Tenant of an unfurnished dwelling	22.6%	20.9%
Tenant of a furnished dwelling	4.5%	2.9%
Lodger	0.8%	0.6%

The occupation of dwellings in Luxembourg is characterised by a high proportion of owner-occupiers who, according to the available statistical surveys, represent 73 % of all registered persons in the dwellings. The proportion of homeowners varies greatly from region to region; for example, in the city of Luxembourg the occupancy rates show that only 47.9 % of registered persons are owner-occupiers.

2.2.2 National non-residential building stock

The statistical basis for non-residential buildings is less complete than that for residential buildings. In particular, there is an absence of statistical data for the period before 1970, as well as a lack of data on

the type of heating in non-residential buildings.

The following tables show an overview of the total number of buildings completed between 1970 and 2011, broken down by type of building.

Table 7: Number, construction volume and useful floor space of non-residential buildings completed between 1970 and 2011 [source: Statec, 2011 Census]

Type of building	Number	Construction volume (in m³)	Usable floor space (in m²)
Mixed-use building	1 618	7 544 741	2 179 294
Commercial buildings	936	14 877 014	3 268 224
Industrial and commercial	541	7 007 454	1 083 577
Agricultural buildings	471	1 383 830	306 822
Administrative building	262	6 418 599	1 415 209
Other buildings	508	3 977 195	700 417

Table 8: Useful floor space of residential and non-residential buildings completed between 1970 and 2011 [source: Statec, 2011 Census]

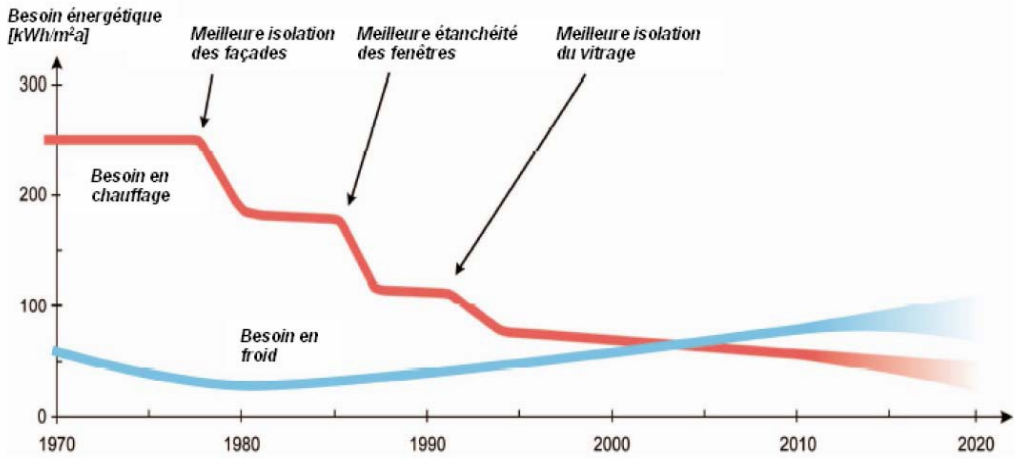
Year of constructio	Useful floor space of residential buildings		Useful floor space of non-residential buildings	
	in m^2	in %	in m^2	in %
1970–1995	10 908 866	41%	4 780 469	17%
1995–2011	6 904 994	26%	4 173 074	16%
Total	17 813 860	67%	8 953 543	33%

With respect to the residential and non-residential buildings built since 1970, the proportion of useful floor space in residential buildings represents 67 % of the total useful floor space in residential and non-residential buildings.

2.2.3 Public buidlings

Official statistical data is only available to a limited extent for public buildings.

The Public Buildings Administration does, however, have access to a survey that shows the development of the energy requirements of administrative buildings between 1970 and 2020.



French	English
Besoin énergétique [kWh/m2a]	Energy requirement [kWh/m^{2}a]
Meilleure isolation des façades	Better insulation of façades
Meilleure étamchéité des fenêtres	Better tightness of windows
Meilleure isolation du vitrage	Better insulation of glazing
Besoin chauffage	Heating requirement
Besoin en froid	Cooling requirement

Figure 1: Development of the energy requirements of administrative buildings (1970–2020) [source: Public Buildings Administration (2007)]

Thanks to a wide variety of measures, in recent years the Luxembourg government has succeeded in reducing the energy consumption of public buildings. There has also been an increasing focus on the use of environmentally friendly building materials:[45]

- Since 1995, the value of the thermal insulation class for new builds has been 10 % better than the average value of the thermal insulation class introduced by the Energy Saving Regulation of 2008.
- Since 1999, in the construction of public buildings for which the Public Buildings Administration is responsible, environmentally friendly building materials have been used, which take into account

[45] Public Buildings Administration; Publication *'State Energy Policy'*; http://www.abp.public.lu/publications/documents-presentation/concept-energie/concpt- energie.pdf

the requirements of the 'Ecological Guidelines'[46] and the 'Guidelines for sustainable construction and renovation'[47].

- Since 2001, approximately 1 % of the construction budget for public buildings for which the Public Buildings Administration is responsible that has been allocated for the use of renewable energy.
- Since 1998, detailed energy audits have been carried out in connection with the construction of a large number of public buildings. This is applies in particular to the Geeseknäppchen campus, Philharmonie, and Esch/Raemerich Technical High School projects. Furthermore, a universal energy concept for school buildings has been developed by the Public Buildings Administration.

2.3 Energy characteristics of the building stock

The representation of the energy characteristics of the building stock is independent of the distinction between residential and non-residential buildings, and is based on the periods defined in the previous section and on the energy sources used.

2.3.1 Classification in thermal insulation classes

In accordance with the amended Grand-Ducal Regulation of 30 November 2007 on the energy efficiency of residential buildings and the amended Regulation of 31 August 2010 on the energy efficiency of non-residential buildings, all new buildings are divided into energy classes. The heating requirement of a building is defined by the thermal insulation class, which takes into account the thermal quality of the building envelope and the ventilation system used.

Studies have shown that the age of buildings tends to correlate with the thermal insulation class.

Table 8: Representation of thermal insulation class as a function of building age [source: Goblet Lavandier et Associés (2014), *Characteristic values for the final energy assessment of structural and technical modernisation measures*]

Year of constructio	Thermal insulation class
before 1971	I – H
1971–1995	H – E
after 1995	E - A

2.3.2 Description of the energy characteristics

In the context of calculating the cost-optimal levels of minimum energy performance requirements for new

[46] http://www.crtib.lu/Leitfaden
[47] http://www.crtib.lu/Leitfaden

and existing residential and non-residential buildings[48] the energy characteristics were defined in accordance with various thermal insulation classes. When applied to the building age classes in the previous section, this yields the following representation.

Table 9: Description of the energy characteristics of buildings before 1971 [source: Government of the Grand-Duchy of Luxembourg, *Calculation of cost-optimal levels of minimum energy performance requirements for new and existing residential and non-residential buildings*, Luxembourg, April 2014]

Building age		**Before 1971**
U-value (W/m^{2}K)	Floor	1.08–1.0
	Masonry	1.70–1.10
	Windows and External Doors	5.00–3.20
	Roof	1.95–1.23
Thermal insulation class		I - H
Air exchange rate n50 (1/h)		6.0

[48] Government of the Grand-Duchy of Luxembourg, *Calculation of cost-optimal levels of minimum energy performance requirements for new and existing residential and non-residential buildings*, Luxembourg, April 2014

Table 10: Description of the energy characteristics of buildings between 1971 and 1995 [source: Government of the Grand-Duchy of Luxembourg, *Calculation of cost-optimal levels of minimum energy performance requirements for new and existing residential and non-residential buildings*, Luxembourg, April 2014]

Building age	**1971–1995**	
U-value (W/m^{2}K)	Floor	1.00–0.50
	Masonry	1.10–0.45
	Windows and External Doors	3.20–1.90
	Roof	1.23–0.30
Thermal insulation		H – E
Air exchange rate n50 (1/h)		6.0–4.0

Table 11: Description of the energy characteristics of buildings after 1995 [source: Government of the Grand-Duchy of Luxembourg, *Calculation of cost-optimal levels of minimum energy performance requirements for new and existing residential and non-residential buildings*, Luxembourg, April 2014]

Building age	**after 1995**	
U-value (W/m^{2}K)	Floor	0.50–0.15
	Masonry	0.45–0.12
	Windows and External Doors	1.90–0.78
	Roof	0.30–0.10
Thermal insulation		E - A
Air exchange rate n50 (1/h)		4.0–0.6

2.3.3 Energy sources

For a representation of the distribution of energy sources over the various types of buildings, information

is only available for residential buildings[49]. The representation uses the building age classes defined in the previous section.

Table 12: Number of buildings by building type, year of construction and fuel for private households [source: Statec, 2011 Census]

Building type and Year of construction		Natural gas	Fuel oil	Wood	Electricity	Other
Single-family houses	< 1971	49%	38%	3%	4%	7%
	1971–1995	40%	50%	2%	3%	5%
	> 1995	43%	42%	3%	3%	9%
Apartment blocks	< 1971	61%	30%	1%	3%	6%
	1971–1995	61%	34%	0%	3%	2%
	> 1995	74%	22%	0%	1%	3%

It appears that private households mainly use fossil fuels as energy sources for heating. The proportion of natural gas and petroleum represents over 90 % of total consumption. The consumption of renewable energy may be assessed as low, the proportions of solar energy and biomass other than wood are included in the 'Other' category.

2.3.4 Test certificate for technical systems

The Grand-Ducal Regulation of 27 February 2010 on gas equipment specifies that gas equipment (e.g. gas boilers, gas water heaters, convectors etc.) with a total capacity of more than 4 kW should be inspected every four years. This inspection includes a check of the proper operating condition of the gas equipment's safety device, the location of the gas equipment, the ventilation of the rooms, the flue gas discharge and the quality of combustion and firing efficiency. Upon completion of this inspection, the user receives a test certificate. In addition to general information on the user and the inspector, this contains the results of the measurement of carbon monoxide emissions and the determination of firing efficiency, information on the type of system, if applicable a confirmation that the gas burner's safety device is in good working condition, the correct installation location of the boiler and that the flue gas discharge is in order. The same regulation also specifies a one-off inspection of gas installations with boilers with a rated power of between 20 kW and 3 MW, which are 15 or more years old, which includes a check of the boiler efficiency and boiler dimensioning in relation to the building's heating requirement. In this inspection, the dimensioning is checked and the user is given recommendations.

The Grand-Ducal Regulation of 7 October 2014 on liquid fuel-fired combustion plants specifies that oil-

[49] Statec, 2011 Census

fired plants with a rated output of more than 11 kW should be inspected every four years. After this inspection, the user receives a test certificate. In addition to general information on the user and the inspector, this contains the results of the determination of the soot level, the measurements of oil residues, carbon dioxide, combustion gas temperature, ambient temperature, firing efficiency and information on the type of plant. The same regulation also specifies a one-off inspection of boilers fired by fuel oil with boilers with a rated output of more than 20 kW, which are 15 or more years old, which includes a check of boiler efficiency and boiler dimensioning in relation to the building's heating requirement. Based on the inspection results, the user will be provided with advice.

This new regulation, which implements some of the provisions of Directive 2010/31/EU, in particular introduces a new requirement that wood heating systems must be inspected every two years and that the dimensioning of the heating installation must be checked during the next periodic inspection. Furthermore, in future a certified installer must make recommendations to the operator with regard to how the energy efficiency of the heating system can be improved.

To facilitate the implementation of these partial provisions of Directive 2010/31/EU and to ensure that certified installers can obtain a simple and practical assessment of the content and implementation of the improvement recommendations, the Environmental Office has developed the 'HeizungsCheck' ('Heating Check')[50]) tool.

2.4 Economic procedure for renovation and cost functions

In accordance with Regulation No 244/2012 supplementing Directive 2010/31/EU on the energy performance of buildings, all European Member States must 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 on buildings, 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 may be downloaded using the following link:
http://www.eco.public.lu/documentation/rapports/Berechnung_kostenoptimaler_Niveaus_von_Mindestanforderungen_an_die_Gesamtenergieeffizienz_f_r_neue_und_bestehende_Wohn-_und_Nichtwohngebude.pdf.

The main cost functions and parameters for structural measures used in this study are shown below.

Table 13: Number of buildings by building type, year of construction and fuel for private households [source: Ministry of the Economy, Department of Energy (2014), *'Calculation of cost-optimal levels of minimum energy performance requirements for new and existing*

[50] More information on HeizungsCheck is available from www.heizungscheck.lu

residential and non-residential buildings, in accordance with Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings (recast)']

Building envelope Component	New construction RB[9]	New construction NRB	Existing residential buildings	Existing non-residential buildings
External wall	EUR 2.53/(m^2·cm)	A10 EUR 3.79/(m^2·cm) B EUR 3.22/(m^2·cm) C EUR 2.53/(m^2·cm)	NB + EUR 90.9/m^2	NB + EUR 90.9/m^2
Roof	EUR 2.30/(m^2·cm)	EUR 2.30/(m^2·cm)	NB + EUR 90.9/m^2	NB + EUR 90.9/m^2
Windows in EUR/m^2	$U_{w0.78}$ A[(+)] 410/480[11] $U_{w0.85}$ B 380/460 $U_{w1.05}$ C 360/440 $U_{w1.34}$ D 330/410 $U_{w1.90}$ E 320/380	$651.3 \cdot U_{CW}^{-0.41}$ min 432.8 max 754.2 [12]	as for New construction	as for New construction
Floor	EUR 1.42/(m^2·cm)	EUR 1.42/(m^2·cm)	NB + EUR 42.4/m^2	NB + EUR 42.4/m^2
Airtightness and thermal bridges[13]	A EUR 20/m^2 B EUR 15/m^2 C EUR 13/m^2 D EUR 10/m^2 E EUR 6/m^2	as for Residential buildings	as for New construction	

3 Strategies and measures for supporting energy renovation

The provisions of Directives 2012/27/EU and 2010/31/EU (EPBD) are in line with the government's existing efforts to promote energy efficiency in buildings and in particular have made it possible to create a more ambitious and coherent strategic framework.

In addition to the support programmes for new construction and energy renovation, which have been in force since 2001, the provision of information, energy advice and awareness-raising play an important role in the area of energy renovation. myenergy, the national body for information and advice in the fields of energy efficiency and renewable energy, provides support to all sectors in the renovation of buildings.

With a view to further expanding the renovation of existing buildings, the following section describes the barriers that currently exist, what measures have been implemented in this area and what measures are planned for the future.

3.1 Market barriers

Various market analyses by myenergy have identified the existence of barriers in the area of renovation. The analyses were supplemented by findings from the LuxBuild2020 initiative, the national implementation of the European Commission's Build-up programme. The barriers that have been identified may be found in the areas of information, the perceptions of building owners and financing, among others.

3.1.1 Information and perceptions

Despite intensive efforts in the provision of information about the benefits of energy renovations, it can be seen that this information is not reaching the majority of building owners. In addition, owners often believe that this information does not directly affect them. In one of the market analyses carried out by myenergy in Luxembourg, 39 % of respondents said that they have never tried to obtain information on energy savings. Similar studies from other countries have come to similar conclusions.[51]

Building owners often do not take the development of energy costs into account in their investment decisions. Without any objective knowledge of the actual energy costs of their buildings, building owners tend to underestimate the importance of energy costs and their development in the future.

Especially in the residential building sector, it can be seen that owners often do not correctly understand the situation and the boundary conditions of energy consumption. Based on a purely personal opinion, e.g. that they live in a relatively well-insulated house and that the heating costs are not too high, or based on their assessment that their house is in a good aesthetic condition, they may come to the conclusion that carrying out renovation work does not make any sense or will not be profitable. Surveys by myenergy confirm that building owners often do not see the economic and comfort benefits of energy renovations and therefore do not seek to implement them.

In addition, the public debate surrounding the renovation of buildings often includes opinions and statements that in many cases do not stand up to scientific scrutiny. For example, in recent years the issue of ‘breathing walls’ or mould growth caused by insulated walls has been the subject of frequent discussion. Such opinions are often very persistent in the public debate, and act as a deterrent, in particular on the owners of residential buildings.

3.1.2 Motivation of building owners

The implementation of an energy renovation requires detailed preparation and often results in inconvenience for the residents while the work is being carried out. The preparation for a renovation includes the definition of the necessary work, the selection of appropriate companies to plan and carry out the work, the analysis of quotations received, the placing of the order, and the monitoring and supervision of the measures. Furthermore, the work itself often leads to disruption for the building users, in particular as a result of dirt, the non-availability of residential areas or temporary relocations. The amount of work and organisation involved may discourage building owners who do not possess the necessary resources, in terms of organisational capabilities and time, from investing in renovations.

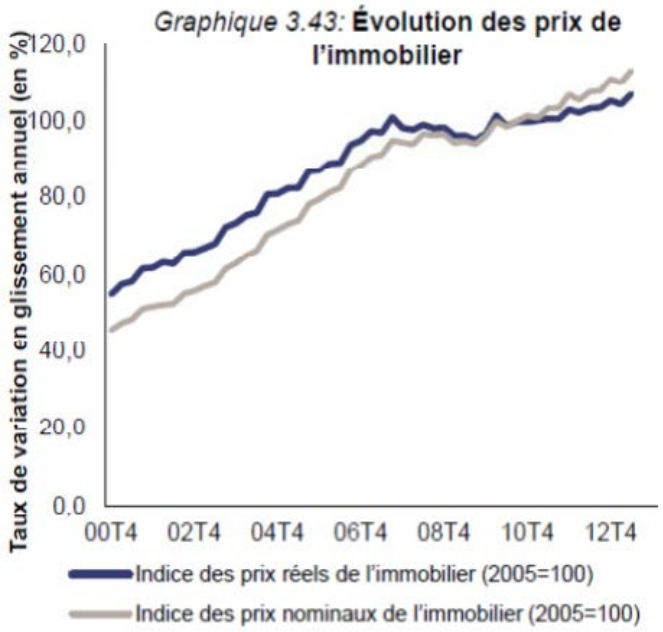
3.1.3 Financial barriers

Energy renovations require a financial investment that may, depending on the complexity of the renovation, be significant and which must be provided by the owner. Even if, in the household or municipal sectors, some of the investment might under special circumstances be reimbursed by an ex-post subsidy, advance financing is required from the owner. This fact represents a major barrier to energy

[51] Steven Fawkes (2013), *Energy Efficiency: The definitive Guide to the cheapest, cleanest, fastest Source of Energy,* Gower Publishing Limited

renovations. Private building owners in the household sector often cite this as the reason for not carrying out renovation work.

On account of the housing prices in Luxembourg, which have risen by an average of 8.1 % a year since 2000[52], there are indications that the acquisition of a property means that owners have little financial scope for carrying out a major energy renovation.



Source: Eurostat, BCE et services de la Commission.

French	German
Taux de variation en glissement annuel (en %)	Year-on-year rate of change (in %)
Graphique 3.43: Évolution des prix de l'immobilier	Figure 3:43: Changes in property prices
Indice des prix réels de l'immobilier (2005=100)	Real property price index (2005=100)
Indice des prix nominaux de l'immobilier (2005=100)	Nominal property price index (2005=100)
Source: Eurostat, BCE et services de la Commission.	Source: Eurostat, ECB and Commission services.

In addition to the general financial barriers, the investor/user dilemma may also be seen as a significant barrier in the rental sector: An owner's interest in energy-saving investments is usually very low, since the energy cost savings will only benefit the users, in this case the tenants.

3.1.4 Services associated with energy renovation

Service providers in the field of energy renovation may include planners (architects and engineers), energy advisors and tradespersons. All these providers require appropriate professional training in order

[52] EC (2014), *Macroeconomic imbalances – Luxembourg 2014*

to meet the requirements of energy renovation in the best possible way. A lot has happened in Luxembourg in recent years in the area of training. The range of training courses available in the field of energy efficiency has been steadily increasing, as have the numbers of participating actors. Nonetheless, there is still potential for further improvement, in particular by a sharper focus on energy renovation in the courses on offer. A major part of the structuring of the future national training programme in the trades sector is currently being carried out via the Luxbuild2020 initiative, the national implementation of the European Commission's Build-up programme.

Furthermore, in both the planning and the execution of energy renovations, there is potential for standardising procedures, calculations and designs, which could lead to an improvement in services and thus to a wider range of energy renovation services on offer in the market.

3.1.5 Other barriers

Municipal building regulations for energy renovations may represent another major barrier. In fact, some provisions, especially with regard to distances from adjacent buildings or public spaces, may be significant barriers to the implementation of renovation measures on the building envelope.

3.2 Existing measures

In recent years, Luxembourg has led the way with a wide variety of measures for promoting the energy renovation of buildings. These range from regulatory measures, by way of financial incentives, through to information and advisory measures and education/training.

3.2.1 Regulatory framework

The following table summarises the most important regulatory measures associated with energy renovation.

Overview	
Grand-Ducal Regulation of 30 November 2007 on the energy efficiency of residential buildings (as amended by the Grand-Ducal Regulation of 5 May 2012) [53]	Introduction of requirements in the field of energy efficiency and a calculation method for residential buildings Introduction of energy performance certificates for residential buildings Definition of minimum requirements in the event of the conversion or renovation of existing non-residential buildings

[53] http://www.legilux.public.lu/leg/a/archives/2012/0096/index.html

Grand-Ducal Regulation of 31 August 2010 on the energy efficiency of non-residential buildings (as amended by the Grand-Ducal Regulation of 5 May 2012)[54]	Introduction of requirements in the field of energy efficiency and a calculation method for non-residential buildings Introduction of energy performance certificates for non-residential buildings Definition of requirements in the field of energy efficiency for existing non-residential buildings

3.2.2 Information and awareness-raising

Great efforts have been made in Luxembourg in recent years to create structures and initiatives to provide energy consumers with detailed information on the subject of energy renovation. 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.

Further details and explanations may be found in section 3.1.4 of the Third National Energy Efficiency Action Plan.

3.2.3 Financial and fiscal incentives

In Luxembourg, households, enterprises and municipalities are encouraged by means of support programmes to invest in energy renovations.

Further details and explanations may be found in section 3.1.7 of the Third National Energy Efficiency Action Plan.

3.2.4 Public buildings and programmes

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/. This model can in principle be applied to energy renovations.

In cooperation with the Public Buildings Administration, myenergy is currently supporting pilot projects in order to use the experience gained to further develop the energy services market.

As part of the financial assistance which municipalities may receive via the reform of Environmental

[54] http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html

Protection Fund, in 2014 the possibility was introduced of both the project management costs and any subsidy of energy savings contract construction costs being, under certain conditions, eligible for public aid. Further information may be found on the following page:
http://particuliers.myenergy.lu/fr/subvention/communes.

Since 2008, the state housing association **Société Nationale des Habitations à Bon Marché** (SNHBM) has been working on improving its stock of rental housing. A large number of energy renovations have already been carried out. In accordance with a regulation[55] from 2012, after any renovation or conversion of an existing SNHBM residential building, the building must meet at least efficiency class D. In addition, the installation of a mechanical ventilation system with heat recovery and the performance of an air tightness test are mandated. In a recent pilot project, two rental residential buildings from the 1950s were renovated from efficiency class I to passive house standard.

The Fonds du Logement (Housing Fund) is also fulfilling its exemplary role, with its stock of rental housing being gradually renovated and improved in terms of energy usage.

3.2.5 Qualification and certification schemes

In the development of European and national energy and climate change policies, the requirements on the skills of professionals are constantly increasing, hence the need to equip them with the necessary qualifications. In this respect, several initiatives for the training of the relevant professional groups have emerged in the recent past. Some of the initiatives relate more to energy-efficient new builds, but the knowledge is partly transferable to renovation.

Further details and explanations may be found in section 3.1.5 of the Third National Energy Efficiency Action Plan.

3.2.6 Energy audits

Energy audits can contribute to increasing the volume and quality of energy renovation. 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 described below.

Further details and explanations may be found in section 3.1.2 of the Third National Energy Efficiency Action Plan.

3.3 Measures in preparation

Despite the measures that are already in existence, additional measures are being planned or are being implemented, in order to further stimulate activities in the field of energy renovation.

[55] Grand-Ducal Regulation of 28 June 2012 amending and supplementing the 9th construction programme of supported housing projects as well as the state's shareholdings:
http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html

3.3.1 Introduction of an energy efficiency obligation scheme

Luxembourg has decided to introduce a national energy saving obligation scheme in accordance with Article 7 of the Energy Efficiency Directive. As obligated parties, energy suppliers in the electricity and gas sectors, are assigned the public service task of achieving the energy savings target imposed on Luxembourg under Article 7 of the Directive. Energy savings may be achieved by the obligated parties in the household, services, industry and transport sectors. In addition to savings in gas and electricity, the obligated parties can also record savings in other energy sources, such as fuel oil, as part of their obligation. The obligation scheme is intended to apply from 1 January 2015 to 31 December 2020. In the household and services sector in particular, it is anticipated the obligations will also be fulfilled by means of energy renovation measures.

Further details and explanations may be found in section 3.1.1 of the Third National Energy Efficiency Action Plan.

3.3.2 Consideration of the creation of a public financial institution to facilitate investment in energy efficiency and renewable energy

To further boost investment in renewable energy and energy efficiency, the government programme[56] is also considering the creation of a public financial institution under the name 'Climate Bank'. This new structure should, among other things, solve the problem of capital-related financing constraints. In contrast to ex-post investment aid, the investments would be financed by loans. The main areas of activity are to include projects in the field of building renovation for private individuals and enterprises. It is intended, in cooperation with existing credit institutions, to offer loans at preferential rates. The initial considerations and discussions have already begun.

3.3.3 Energy efficiency information portal

The national advisory body myenergy is currently in the process of fundamentally overhauling its website and expanding it into a more powerful information portal on energy efficiency issues. Energy renovation will be given a prominent place in this. In this connection, myenergy will be developing various communication tools for optimising the information on energy renovation. For example, the whole energy renovation procedure will be described using infographics in order to provide consumers with practical explanations of the information available, planning, the execution of the work, final acceptance, applications for grants and the appropriate contact persons.

3.3.4 Implementation of a process for the further development of the national renovation strategy

In view of the significant potential for energy savings in the building stock, its importance within

[56] Government programme 2013–2018, Luxembourg, 2013 https://www.gouvernement.lu/3322796/Programme-gouvernemental.pdf

Luxembourg's energy policy and the provisions of Article 4 of the European Energy Efficiency Directive, the Ministry of the Economy intends, in collaboration with myenergy, to implement a national energy renovation initiative. As part of this initiative, and in conjunction with the relevant actors in the construction sector, Luxembourg's energy renovation strategy will be developed further. The implementation of the initiative will include:

- An introductory workshop with the relevant actors, in which the process for the developing the national renovation strategy will be explained. This building renovation strategy will be used as the basis for this process. The event will include a presentation of the renovation strategies of other European Member States, as well as projects that have actually been implemented. An initial exchange of information between the participating actors will form part of the workshop. There will also be an opportunity for introducing written comments into the process.
- Other theme-based workshops will then further analyse the barriers to energy renovation and come up with potential solutions. The various themes will be decided on the basis of the results of the introductory event. The potential solutions will be collected in a catalogue of measures and discussed with the actors involved, and the corresponding responsibilities for their implementation will be defined.
- The ministries concerned will analyse the results of the workshops in cooperation with myenergy and will develop the necessary strategic elements.
- The main elements of the further development of the national building renovation strategy will be presented and discussed in a final workshop.

The intention is to implement the first steps towards the further development of the national building renovation strategy, in accordance with the process described above, during the first six months of 2015. Subsequently, and in the course of implementing the catalogue of measures, further adjustments may be initiated in order to enable a regular revision of the further development of the strategy.

3.3.5 Further measures

- **Interest-free loans for low-income households**

During discussions on extending the support programme for households described in section 3.2.3, the consideration of an interest-free loan for low-income households for the financing of an energy renovation was suggested. This measure could come into force in 2016.

- **Accelerated tax write-off**

The current government programme[57] provides for the introduction of an accelerated tax write-off of investments in energy renovations. At present, the competent authorities are examining the details of

[57] *Government programme 2013–2018,* Luxembourg, 2013

implementation. This measure could make an important contribution to resolving – at least partially – the investor/user dilemma.

3.4 New measures

Based on the findings of the previous section, other new measures could be envisaged in addition to the existing measures the measures being prepared. During the preparation of this document, an initial consideration was given to potential new measures. These could be taken into account as part of the further development of the renovation strategy. To what extent they might lead to concrete plans can only be determined by means of a detailed analysis. The individual measures are described briefly below.

- **Measures in apartment blocks**

Given the ever-increasing proportion of dwellings in apartment blocks, the question arises as to whether there should be an increased focus on measures in apartment blocks. This would also include identifying and implementing new and viable solutions for the investor/user dilemma.

In this connection, the possibility of a greater involvement of residential property managers in the dissemination of information on energy efficiency measures should also be analysed and, if a need is identified, the actions in this area should be intensified.

In principle, an analysis of the law on tenancy and rental property is required; this analysis might yield suggestions for adaptations, with regard to simplifying energy renovations in apartment blocks. Another approach to eliminating barriers to financing might include an obligation, linked to the efficiency standard of the building, to create a reserve for energy renovations.

- **Convoy renovations**

To increase the relatively low energy renovation rates in residential buildings, consideration is being given to implementing so-called ‘convoy renovations’ in specific neighbourhoods, potentially with a uniform building structure. In this respect, concerted group advice sessions, an iterative planning process and a supported renovation process could result in savings in time and money for the relevant target groups. Further synergies could also be achieved with regard to standardisation and quantity discounts. Corresponding project ideas have already been carried out abroad and their feasibility in Luxembourg should now be examined.

- **Improving the quality of energy renovation**

Appropriate quality management programmes with consultants, planners and tradespersons may result in a substantial increase in the quality of energy renovations. At the same time, standardised renovation offers could simplify the implementation process and also lead to higher quality. The implementation of these programmes needs to be clarified with the relevant actors and may also help to increase the acceptance of energy renovation among building owners.

- **Eliminating barriers to renovation in the municipal building regulations**

Energy renovations are often made more difficult or prevented by specific provisions in municipal building

regulations. The relevant aspects must be analysed and then suggestions for amending the legal texts could be submitted to the municipalities.

- **Other measures**

In addition to the market analyses that have already been carried out, surveys relating specifically to energy renovation could be conducted with an increased level of detail, in order to identify other aspects and barriers that require analysis. As part of these surveys, some of the new measures described above could be tested for their market acceptance.

Documented demonstration projects of successful renovations could help to improve the availability of information and thus promote acceptance among owners and building users.

In the context of the possible reform of the property tax, it could be examined to what extent the property tax rate could be linked to the energy efficiency of the building.

ANNEX B:

Luxembourg's second annual monitoring report 2014

in accordance with Article 24(1)

of

'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'

1 Introduction

In accordance with Article 24(1) of 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 (EED), Member States must produce annual reports showing an overview of the progress achieved towards national energy efficiency targets. This second monitoring report fulfils the reporting requirements for 2014.

In the context of the first monitoring report in 2013[58] Luxembourg set itself, in accordance with Article 3(1) of the EED, a preliminary final energy target for 2020 of 49 292 GWh or 4 239.2 ktoe. Expressed in terms of primary energy, the target was 52 111 GWh or 4481.6 ktoe.

2 Key statistics for 2011–2012

The following table summarises the key statistics for 2011 and 2012. The figures reported for 2011 in 2013 have, where necessary, been adjusted to the current statistics.

Table 1: Key statistics in accordance with Annex XIV Part 1 to the EED [source: Statec]

	Unit	2011	2012
i) Primary energy consumption[1)]	GWh	52 699	51 407
ii) Total final energy consumption	GWh	49 961	48 595
iii) Final energy consumption by sector			
- Industry	GWh	7 649	6 735
- Transport	GWh	31 718	30 195
of which transit traffic	GWh	22 528	21 441
- Households	GWh	5 558	5 410
- Services	GWh	4 942	6 169
- Agriculture	GWh	94	85

58 http://www.eco.public.lu/documentation/rapports/Erster_j__hrlicher_Monitoringbericht_Luxemburgs_2013.pdf

iv) Gross value added by sector			
- Industry	EUR million	3 729	3 808
- Services	EUR million	25 999	25 799
v) Disposable income of households	EUR million	16 354	17 047
vi) Gross domestic product (GDP)	EUR million	33 348	33 289
vii) Electricity generation from thermal power stations[2)]	GWh	100[6)]	96
viii) Electricity generation from combined heat and	GWh	2 396[6)]	2 446
ix) Heat generation from thermal power generation	GWh	49	46
x) Heat generation from combined heat and power plants, including industrial waste heat	GWh	828[6)]	810
xi) Fuel input for thermal power stations[3)]	GWh	345[6)]	337
xii) Passenger kilometres	Gpkm	9	9[5)]
xiii) Tonne kilometres[4)]	Gtkm	9	9[5)]
xv) Population	1000 inhab.	512	525

Notes:

[1)] Gross inland consumption, excluding non-energy uses.

[2)] Data corresponds to gross production.

[3)] Data does not include fuel used in cogeneration plants.

[4)] Excluding river freight.

[5)] Provisional data.

[6)] Changes compared to the figures reported in 2013 are the result of the conversion of Luxembourg's largest power station (CCGT Twinerg) into a cogeneration plant. The waste heat from the power plant has been decoupled since 2011 and is used for the supply of heating to a nearby district.

The energy consumption data corresponds to the calorific value and is not temperature-adjusted.

3 Analysis of energy consumption trends

In Table 1 it can be seen that, with a stagnating gross domestic product, primary energy consumption and total final energy consumption both fell in 2012 by approximately 2.5 % compared to 2011, despite a growth in the population of around 2.5 %.

With the exception of the service sector, final energy consumption declined in all other sectors. According to the energy statistics, the service sector consumed around 25 % more energy in 2012 than in 2011. Given the revision that was carried out in 2014 of the national accounts in the energy statistics, it cannot, however, be completely ruled out that there was a methodological impact on the statistics from 2012. This aspect, which concerns the energy statistics for 2012 in general and the consumption by the service sector in particular, should be subjected to a detailed analysis in 2014.

Secondly, it may be observed that, in spite of the economic crisis, the service sector continues to grow, even if at a slower rate. In 2012, the sector employed almost 300 000 people. This was 3.1 % more than in the previous year [source: Statec].

4 Major measures implemented in the previous year

All significant measures are described in detail in Chapters 2 and 3 of the Luxembourg Energy Efficiency Action Plan 2014.

5 Central government buildings

As explained in section 3.3.1 of the Luxembourg Energy Efficiency Action Plan 2014, the inventory records a figure of approximately 159 500 m^2 of total useful floor area, which in accordance with Article 5 of the EED is to be used for determining the annual target.

6 Energy saving obligation scheme

The introduction of an energy savings obligation scheme is being planned. Further information may be found in section 3.1.1 of the Luxembourg Energy Efficiency Action Plan 2014.