Annex 1

Detailed description of measures in the household sector

Title of the energy efficiency improvement (EEI) measure	**A1) Ordinance of the Grand Duchy of 22 November 1995 on the thermal insulation of buildings (dwellings)**
Type of instrument	Regulatory 1.1. Thermal building standard and continuation
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Improved cavity wall insulation compared with pre-1996 levels (new buildings and conversions)
Effectiveness	Evidence of thermal insulation is provided by two methods: Method 1: Evidence by means of the building cavity's mean U-value. Takes into account solar radiation, geometric shape of the building and the building's mean internal temperature. Relates to buildings with a heated living area of 200 m^2 or greater. $U_{M,\ zul.} = C_0 * C_1 * C_2$ [W/m^2K] where $U_M \leq U_{M,zul.}$. Threshold C_0: 0.65 [W/m2K], recommended target value C_0: 0.55 [W/m2K], C^1: Shape factor C^2: Ambient air temperature factor. Method 2: Evidence by means of U-values of the individual components for buildings with a heated living area of under 200 m^2. Follow-up measure B1: Ordinance of the Grand Duchy of 30 November 2007 on improving the overall energy efficiency of buildings (dwellings) (WD2008).
Expected annual energy savings in 2016	385 GWh (2016). All savings from the period 1996-2007 (thereafter savings due to the 2008 Thermal Insulation Ordinance). Approx. 96 % is fuel, 4 % electricity for heating. Measure evaluation using building stock model. Important assumptions made for calculation: ➢ Household growth factor 1.3 %/a on average until 2020 ➢ Based on figures for the building stock and building areas by age category (3 age groups and 3 dwelling types) as well as specific energy requirement values ➢ Upgrading rate for old buildings under WD1996: 0.5 %/a. New building rate 2 %/a. Savings for old buildings: up to 19 %, for new buildings up to 47 % (depending on age and type of building) ➢ Taking account of 15 % non-compliance in new buildings and rebound effects.
Implementation status and exact timeframe	EEI measure implemented not earlier than 1996 and still effective in 2010 and 2016 Start/end of the measure: 01/01/1996 – 31/12/2007
Information	http://www.legilux.public.lu/leg/a/archives/1995/0992712/index.html

Title of the energy efficiency improvement (EEI) measure	**A2) Ordinance of the Grand Duchy of 17 July 2001 and 3 August 2005 on the promotion of rational energy use and renewables**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Promotion of energy-efficient new homes (new building compared with WD1996: low energy housing, passive housing) and efficient heating systems (condensing boilers)
Effectiveness	Extract from the Ordinance of the Grand Duchy of 3 August 2005: *Art. 7. Condensation boiler: Existing house with adjustable power output: €100; apartment building: amount multiplied by number of apartments, but not exceeding €600.*
Art. 11, New, high-energy-efficiency buildings *'Low-energy' house / 'passive' house* ➢ *Detached single-family house / terraced single-family house (net area S_n <150 m²): €77/m² / €140/m² per house;* ➢ *Apartment block (S_n <500 m²): €70/m² / €130/m² per apartment (S_n <80 m²);* ➢ *Apartment block (S_n 501-1000 m²): €60/m² / €110/m² per apartment (S_n <80 m²);* ➢ *Apartment block (S_n 1001-5000 m²): €50/m² / €90/m² per apartment (S_n <80 m²);* ➢ *Apartment block (S_n > 5000 m²): €45/m² / €70/m² per apartment S_n <80 m²);* *Follow-on measure B3: Promotion of efficient new building (new building compared with WD2008)*	
Expected annual energy savings in 2016	90 GWh (2016). All savings from the period 2001-2007 (thereafter savings due to the 2008 Thermal Insulation Ordinance). Approx. 96 % is fuel, 4 % electricity for heating. Measure evaluation using building stock model. Important assumptions made for calculation: ➢ Figures on delivery volumes and delivered units for efficient new buildings (specific fuel requirement values) and condensing boilers (20 % saving on annual efficiency)
Implementation status and exact timeframe	EEI measure implemented not earlier than 2001 and still effective in 2010 and 2016; no major adaptations planned – early action Start/end of the measure: Programme I (2001-2004) and Programme II (2005-2007)
Information	http://www.legilux.public.lu/leg/a/archives/2001/0992712/index.html http://www.legilux.public.lu/leg/a/archives/2005/1362308/index.html

Title of the energy efficiency improvement (EEI) measure	**B1) Ordinance of the Grand Duchy of 30 November 2007 on improving the overall energy efficiency of buildings (dwellings)**
Type of instrument	Regulatory 1.1. Thermal building standard and continuation
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Improved cavity wall insulation compared with pre-2008 levels (new buildings and conversions)
Effectiveness	The 2008 Energy Efficiency Ordinance (Ordinance of the Grand Duchy of 30 November 2007) implements European Building Directive 2002/91/EC for dwellings. At the same time, the requirements are raised by around 30 % compared with the 1996 Thermal Insulation Ordinance. It lays down the following minimum requirements, among other things: 1) Requirements in relation to heat transmission coefficients

Höchstwerte einzelner Wärmedurchgangskoeffizienten U_{max} in W/(m²K) [1) 2)]			
Bauteil / Bauteil	zu Außenklima	zu schwach beheizten Räumen	Flächen zu Erdreich oder zu unbeheizten Räumen
Wand und horizontaler unterer Gebäudeabschluss	0,30	0,50	0,40
Dach und horizontaler oberer Gebäudeabschluss	0,25	0,35	0,30
Fenster oder Fenstertür inklusive Rahmen [3) 4)]	1,5	2,0	2,0
Tür inklusive Rahmen	2,0	2,5	2,5

Höchstwerte einzelner Wärmedurchgangskoeffizient Umax in W/(m2K) 1) 2) = Highest values of the individual heat transmission coefficient Umax in W/(m2K) 1) 2)

Bauteil = Structural element

Bauteil = Structural element

Zu Aussenklima = To outside air

Zu schwach beheizten Räumen = To rooms with low-level heating

Flächen zu Erdreich oder zu unbeheizten Räumen = Areas to ground or unheated rooms

Wand und horizontaler obererer Gebäudeabschluss = Wall and horizontal lower end of building

Dach und horizontaler obererer Gebäudeabschluss = Roof and horizontal upper end of building

Fenster und Fenstertür inklusive Rahmen 1) 2) = Window or French window, including frame

Tür inklusive Rahmen = Door, including frame

2) Requirements in relation to the specific thermal heat requirement, q_H

Gebäudekategorie		$q_{H,max}$ [kWh/m²a] $0,2 < A/V_e < 0,8$	$q_{H,max}$ [kWh/m²a] $A/V_e \leq 0,2$	$q_{H,max}$ [kWh/m²a] $A/V_e \geq 0,8$
1	Wohnen MFH	21+93(A/Ve)	39,6	95,4
2	Wohnen EFH	39+73(A/Ve)	53,6	97,4

Gebäudekategorie = Building category

Wohnen MFH = Multi-family housing MFH

Wohnen EFH = Single-family housing EFH

<table>
<tr><td></td><td>3) Requirements in relation to the overall primary energy index, Q_P
<table>
<tr><th colspan="2">Gebäudekategorie</th><th>$Q_{P,max}$ [kWh/m²a] 0,2 < A/V$_e$ < 0,8</th><th>$Q_{P,max}$ [kWh/m²a] A/V$_e$ ≤ 0,2</th><th>$Q_{P,max}$ [kWh/m²a] A/V$_e$ ≥ 0,8</th></tr>
<tr><td>1</td><td>Wohnen MFH</td><td>53+130(A/Ve)</td><td>79,0</td><td>157,0</td></tr>
<tr><td>2</td><td>Wohnen EFH</td><td>71+102(A/Ve)</td><td>91,4</td><td>152,6</td></tr>
</table>
Gebäudekategorie = Building category
Wohnen MFH = Multi-family housing MFH
Wohnen EFH = Single-family housing EFH</td></tr>
<tr><td>Expected annual energy savings in 2016</td><td>348 GWh (2016). Values include savings that would result if the 1996 Thermal Insulation Ordinance were continued. Approx. 96 % is fuel, 4 % electricity for heating.
Important assumptions made for calculation:
➢ Improvement factor WD08 compared with WD96: 30 % for new buildings, compared with new buildings pre-1995: up to 63 %.
➢ Improvement compared with stock of existing buildings: up to 36 %.
➢ Other assumptions as for measure A1</td></tr>
<tr><td>Implementation status and exact timeframe</td><td>New EEI measure, implementation process started
Start of measure: from 1 January 2008</td></tr>
<tr><td>Information</td><td>http://www.legilux.public.lu/leg/a/archives/2007/2211412/index.html</td></tr>
</table>

Title of the energy efficiency improvement (EEI) measure	**B2) Building upgrading programme for old buildings (Ordinance of the Grand Duchy of 21 December 2007 and 20 April 2009 on promoting rational energy use and renewables)**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Improved cavity insulation in old buildings based on the Ordinance on improving the overall energy efficiency of dwellings
Effectiveness	Extract from the Ordinance of the Grand Duchy of 21 December 2007: *1. Financial aid to improve the energy efficiency of an existing dwelling (>10 years), complying with the necessary quality requirements; the Minister may grant aid equivalent to the amounts in the table on condition that an energy consultant has been involved in the upgrading, ….*

	Eligible element	**Special financial aid** [€/m^2 upgraded]
1	Insulating facade and/or insulating block and/or wooden element of a front wall	15
2	Thermal insulation of the inner surface of a front wall	15
3	Thermal insulation of a ground wall or unheated zone	10
4	Thermal insulation of a pitched roof	15
5	Thermal insulation of a flat roof	13
6	Thermal insulation of floor of unheated loft	10
7	Insulation of ceiling of unheated basement or of ground platform	8
8	Replacement of windows with double glazing	12
9	Replacement of windows with triple glazing	30

Title of the energy efficiency improvement (EEI) measure	B3) Promotion programme for energy-efficient new buildings (Ordinance of the Grand Duchy of 21 December 2007 and 20 April 2009 on promoting rational energy use and renewables)
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Low-energy housing, passive housing
Effectiveness	Extract from the Ordinance of the Grand Duchy of 21 December 2007: *For construction of a new 'low-energy' or 'passive' house complying with the required quality requirements, the Minister may grant financial aid of the amount detailed below. The allocated amounts are to be calculated on the basis of the eligible reference energy area given on the energy-performance certificate drawn up in accordance with the Ordinance of the Grand-Duchy of 30 November 2007 on the energy performance of houses. …*

	Eligible area A_n [m²]	Financial aid [euro / m^2]
Single-family house		
I	Up to 150	45 / 160
II	Between 150 and 200	27 /105
Apartment which is part of an apartment block with a total area ≤ 1,000 m²		
I	Up to 80	40 / 139
II	between 80 and 120	25 / 87
Apartment which is part of an apartment block with a total area > 1,000 m²		
I	Up to 80	34 / 99
II	between 80 and 120	21 / 57

A_n = reference energy area stated on the energy performance certificate,

I: A_n <= 150 m2 for a single-family house or <= 80 m2 for an apartment,

II: A_n > 150 m2 for a single-family house or > 80 m2 for an apartment.

The measure was updated and modified in some points with the Ordinance of the Grand Duchy of 20 April 2009.

New building calculated against WD2008

Expected annual energy savings in 2016	15 GWh (2016). Approx. 96 % is fuel, 4 % electricity for heating. Measure evaluation using building stock model. Important assumptions made for calculation: ➢ Figures on delivery volumes and delivered units for efficient new buildings (specific fuel requirement values)
Implementation status and exact timeframe	New EEI measure, implementation process started Start/end of the measure: 1 January 2008 to 31 December 2012.
Information	http://www.legilux.public.lu/leg/a/archives/2007/2473112/index.html http://www.legilux.public.lu/leg/a/archives/2009/0083/index.html

Title of the energy efficiency improvement	**B10 – Promotion of efficiency labelling**

(EEI) measure	
Type of instrument	2.1 Focussed information campaigns
Regional application	Effective nationwide
Target group	Electricity consumption (for electrical appliances) in the household sector: 0.9 TWh or 3 % of the final energy consumption addressed by the ESD.
EEI action targeted	Promotion of particularly efficient electricity appliances
Effectiveness	Customer awareness and information
Expected annual energy savings in 2016	13 GWh (2016). Important assumptions made for calculation: ➢ Incomplete data for household equipment rate for electrical appliances and energy efficiency classes in Luxembourg. Similar rates to Germany assumed. Reconciliation with the electricity balance in Luxembourg. ➢ Depending on type of electrical appliance, consumption of appliances purchased approx. 5-20 % lower than standard.
Implementation status and exact timeframe	New EEI measure, implementation process started Start of measure: 01/01/2010

Title of the energy efficiency improvement (EEI) measure	B11) – Promotion of heating upgrade programme
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Renewal of the oldest heating systems
Effectiveness	Extract from the Ordinance of the Grand Duchy of 21 December 2007 and 20 April 2009: Article 11: To replace a central heating boiler with a condensation boiler with adjustable power output to heat an existing building : € 100. If the installation is in an apartment block the above amount may be multiplied by the number of apartments, up to a limit of € 600 and 10% of actual costs.
Expected annual energy savings in 2016	12 GWh (2016). Approx. 96 % is fuel, 4 % electricity for heating. Measure evaluation using building stock model. Important assumptions made for calculation: ➢ 2 000 subsidised heating systems per year ➢ 20 % annual efficiency saving
Implementation status and exact timeframe	New EEI measure, implementation process started Duration of the measure: 01/01/2008-31/12/2012
Information	http://www.legilux.public.lu/leg/a/archives/2007/0247/index.html http://www.legilux.public.lu/leg/a/archives/2009/0083/index.html

Title of the energy efficiency improvement (EEI) measure	B12) Ordinance of the Grand Duchy of 19 December 2008 on the introduction of financial incentives for A++ refrigeration appliances (renewed on 11 December 2009 and 17 December 2010)
Type of instrument	Financial instruments – 3.1 Subsidies
Regional application	Effective nationwide
Target group	Electricity consumption (for electrical appliances) in the household sector: 0.9 TWh or 5 % of the final energy consumption addressed by the ESD.
EEI action targeted	Promotion of particularly efficient refrigerators
Effectiveness	Extract from the Ordinance of the Grand Duchy of 19 December 2008: "Financial aid will be granted … for the acquisition of new, low-energy refrigerators of energy efficiency class A++ as defined in the Annex to Directive 2003/66/EC: refrigerators, freezers and their combinations. The aid amount shall be: - € 150 for appliances with a total useable volume greater than or equal to 175 litres; - € 100 for appliances with a total useable volume of less then 175 litres." The Ordinance of the Grand Duchy was updated twice.
Expected annual energy savings in 2016	2 GWh (2016). Important assumptions made for calculation: ➢ Figures on delivery volumes and delivery units of A++ refrigeration appliances ➢ Consumption of appliances purchased 40 % lower than that of standard ones (A appliances)
Implementation status and exact timeframe	New EEI measure, implementation process started Start of measure: 01/10/2008-31/07/2011
Information	http://www.legilux.public.lu/leg/a/archives/2008/0219/index.html http://www.legilux.public.lu/leg/a/archives/2009/0245/index.html http://www.legilux.public.lu/leg/a/archives/2010/0234/index.html

Title of the energy efficiency improvement (EEI) measure	**C1) – Expansion of the upgrading programme for old buildings**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Improved cavity insulation in old buildings based on the Ordinance on improving the overall energy efficiency of dwellings
Effectiveness	Details of the measures are not yet available. Action mechanism similar to that of measure B2.
Expected annual energy savings in 2016	31 GWh (2016). Approx. 96 % is fuel, 4 % electricity for heating. Measure evaluation using building stock model. Important assumptions made for calculation: ➢ Renovation rate 0.5 %/a. (approx. 1 000 dwellings per year) Savings rate of 43-45 % compared with the state before upgrading.
Implementation status and exact timeframe	New EEI measure, implementation process not yet started Start of measure: 01/01/2013
Information	-

Title of the energy efficiency improvement (EEI) measure	**C3) – Increase in energy-efficient new build programmes**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Low-energy housing, passive housing
Effectiveness	Details of the measures are not yet available. Action mechanism similar to that of measure B3.
Expected annual energy savings in 2016	6 GWh (2016). Approx. 96 % is fuel, 4 % electricity for heating. Measure evaluation using building stock model. Important assumptions made for calculation: ➢ Rate for particularly efficient new buildings: 0.5 % of new buildings per year ➢ Savings of 70 % compared with pre-1995 buildings (17.5 - 25 kWh/m²a depending on type of building).
Implementation status and exact timeframe	New EEI measure, implementation process not yet started Start of measure: 01/01/2013
Information	-

Title of the energy efficiency improvement (EEI) measure	**C4) Tightening of the Ordinance of the Grand Duchy of 30 November 2007 on improving the overall energy efficiency of buildings (dwellings)**
Type of instrument	Regulatory 1.1. Thermal building standard and continuation
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Improved energy efficiency of domestic buildings compared with pre-2012 levels (new buildings and conversions)
Effectiveness	Compared to measure B1, a further tightening up of requirements for total energy efficiency of buildings is assumed. 2011 2012 2014 2016 Thermal insulation class D C B A Primary energy class D B A A Only the tightening of requirements before 2016 has an effect within the time frame in question.
Expected annual energy savings in 2016	62 GWh (2016). The values represent additional savings that would result from measure B1. Approx. 96 % is fuel, 4 % electricity for heating. Important assumptions made for calculation: ➢ Improvement factor WD2012 compared with WD2008: 30 % in new buildings and old building refurbishment. ➢ Other assumptions as for measure A1
Implementation status and exact timeframe	New EEI measure, implementation process not yet started Start of measure: From 1 July 2012
Information	http://www.ml.public.lu/pictures/fichiers/paquet_logement_avril_2011.pdf

Title of the energy efficiency improvement (EEI) measure	C10) – Promotion of heating upgrade programme
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD.
EEI action targeted	Renewal of the oldest heating systems Continuation of the heating upgrade programme Promotion of condensing boilers
Effectiveness	Details of the measures are not yet available. Action mechanism similar to that of measure B11.
Expected annual energy savings in 2016	11 GWh (2016). Approx. 96 % is fuel, 4 % electricity for heating. Measure evaluation using building stock model. Important assumptions made for calculation: ➢ 1 000 subsidised heating systems per year
Implementation status and exact timeframe	New EEI measure, implementation process not yet started Start of measure: 01/01/2013
Information	-

Annex 2

Detailed description of measures in the tertiary sector (including agriculture)

Title of the energy efficiency improvement (EEI) measure	**A3) Ordinance of the Grand Duchy of 22 November 1995 on the thermal insulation of buildings (tertiary sector)**
Type of instrument	Regulatory 1.1. Thermal building standard and continuation
Regional application	Effective nationwide
Target group	Final energy consumption for heating in the tertiary sector (new buildings and major conversions of existing buildings): 2.9 TWh in 2008 or 15 % of the final energy consumption addressed by the ESD (including hot water)
EEI action targeted	Improved cavity wall insulation compared with pre-1996 levels (new buildings and conversions)
Effectiveness	Description see measure A1 In the tertiary sector, evidence of thermal insulation must be included with the application for building permit for the following buildings: Office and administrative buildings, schools and libraries, buildings for sports and meeting purposes, hospitals and care homes, buildings involved in the catering industry, department stores and other shops… Follow-up measure B4: Improvement in U-values of non-domestic buildings (WD2008)
Expected annual energy savings in 2016	171 GWh (2016). 100 % is thermal for heating. Measure evaluation by assessing the energy application purposes in the tertiary sector (predominantly office-type buildings), taking account of investigations conducted on similar buildings in Germany. Important assumptions made for calculation: ➢ Tricky data situation: No division into different sectors. ➢ Growth factor TCS 4.5 % on average until 2020 ➢ Renovation and renewal rate below WD1996: 2 %/a. Savings 25 % compared with the pre-1996 situation
Implementation status and exact timeframe	EEI measure implemented no earlier than 1996 and still effective in 2010 and 2016; no major adaptations planned – early action Start/end of the measure: 01/01/1996 – 31/12/2007
Information	http://www.legilux.public.lu/leg/a/archives/1995/0992712/index.html

Title of the energy efficiency improvement (EEI) measure	**B4) Ordinance of the Grand Duchy of 30 November 2007 on improving the overall energy efficiency of buildings (provisions for no-domestic buildings)**
Type of instrument	Regulatory 1.1. Thermal building standard and update
Regional application	Effective nationwide
Target group	Final energy consumption for heating in the tertiary sector (new buildings and major conversions of existing buildings): 2.9 TWh in 2008 or 15% of the final energy consumption addressed by the ESD (including hot water)
EEI action targeted	Improved U-values for non-domestic buildings compare to the Ordinance of 1996 (new buildings and conversions)
Effectiveness	*Art. 15. Ordinance of the Grand-Duchy of 22 November 1995 on the thermal insulation of buildings is amended as follows:*

1. Article 1 is supplemented with the following:

"This Ordinance of the Grand-Duchy covers buildings not falling within the scope of Ordinance of the Grand-Duchy of 30 November 2007 on the energy performance of houses."

2. "Annex 1", paragraph 3(b) of the Annex thereto is amended as follows: The phrase "Threshold value: C0 = 0.65" is replaced by "Threshold value: C0 = 0.45". The phrase "Target: C0 = 0.55" is replaced by "Target: C0 = 0.40".

3. The text and table of "Annex 2" to the Annex to the above Ordinance of the Grand-Duchy are replaced by the following: "Requirements in relation to heat transmission coefficients for individual structural elements: The heat transmission coefficients must not exceed the values shown in the following table:

Structural elements	Max. Heat transmission coefficients [W/m^2K]	
	In relation to outside air	In relation to unheated rooms or ground
External walls	0.32	0.40
Windows including frame	1.50	2.00
Doors including frame	2.00	2.50
Pitched/flat roof, loft	0.25	0.30
Floors, cellar ceiling	0.30	0.40

Follow-up measure B14) Ordinance of the Grand Duchy of 31.08.10 on improving the overall energy efficiency of non-domestic buildings

Expected annual energy savings in 2016	89 GWh (2016). 100 % is thermal for heating. Measure evaluation by assessing the energy application purposes in the tertiary sector (predominantly office-type buildings), taking account of investigations conducted on similar buildings in Germany. Important assumptions made for calculation: ➢ Renewal rate: 2%/a. Savings 50 % compared with pre-1996 situation, 25 % compared with WD1996. ➢ Additional assumptions similar to those for measure A3
Implementation status and exact timeframe	New planned EEI measure, implementation process started Start/end of the measure: 01/01/2008 – 31/12/2010
Information	http://www.legilux.public.lu/leg/a/archives/2007/2211412/index.html

Title of the energy efficiency improvement (EEI) measure	B14) Ordinance of the Grand Duchy of 31 August 2010 on improving the overall energy efficiency of non-domestic buildings
Type of instrument	Regulatory 1.1. Thermal building standard and continuation
Regional application	Effective nationwide
Target group	Final energy consumption for heating in the tertiary sector (new buildings and major conversions of existing buildings): 2.9 TWh in 2008 or 15% of the final energy consumption addressed by the ESD (including hot water)
EEI action targeted	Improved energy efficiency of non-domestic buildings (new buildings and conversions)
Effectiveness	Action mechanism similar to that of measure B1. The measure was introduced in 2011. Compared to pre-1996 buildings, there is a saving of 65 %.
Expected annual energy savings in 2016	193 GWh (2016). The figures include savings that were determined by the continuation of the Thermal Insulation Ordinance of 1996. 100 % is thermal for heating. Measure evaluation by assessing the energy application purposes in the tertiary sector (predominantly office-type buildings), taking account of investigations conducted on similar buildings in Germany. Important assumptions made for calculation: ➢ A further saving of 15 % compared with the U-values of non-domestic buildings set out in the Ordinance of the Grand Duchy of 2007. ➢ Additional assumptions similar to those for measures A3 and B4.
Implementation status and exact timeframe	New planned EEI measure, implementation process started Start of measure: From 1 January 2012
Information	http://www.legilux.public.lu/leg/a/archives/2010/0173/index.html

Title of the energy efficiency improvement (EEI) measure	**C6) Realising electricity savings potential**
Type of instrument	e.g. Information/audits/energy services by energy distributors/incentive schemes 2.4 Energy audits 2.7 Exemplary role of the public sector 3.1. Subsidies 4 Voluntary agreements and cooperative instruments 5 Energy services for energy savings 6.1. Obligations on energy companies to offer energy savings: 'white certificates' 6.2 Voluntary agreements with energy producers and distributors 6.3 Energy efficiency fund
Regional application	Effective nationwide
Target group	Electricity consumption in the tertiary sector: 2.1 TWh in 2008 or 11% of the final energy consumption addressed by the ESD.
EEI action targeted	Measure aims to realise electricity savings potential in the TCS sector: Cross-cutting technologies (lighting, pumps, air-conditioning…), particularly I&C technologies (computers, servers…)
Effectiveness	Details of the measures are not yet available. The measure could be introduced as of 2012.
Expected annual energy savings in 2016	106 GWh (2016). Important assumptions made for calculation: ➢ Technical information from various European studies/projects on cross-cutting technologies ➢ Information from sectoral analyses in Germany on office-type buildings
Implementation status and exact timeframe	New planned EEI measure, implementation process not yet started Possible start of measure: From 1 January 2012
Information	-

Annex 3

Detailed description of measures in industry excluding ETS

Title of the energy efficiency improvement (EEI) measure	**A6) Voluntary agreement between the Luxembourg Government and FEDIL on improving energy efficiency in the industrial sector**
Type of instrument	4 Voluntary agreements and cooperative instruments
Regional application	Effective nationwide
Target group	Energy consumption in industry (excluding ETS): 3.2 TWh in 2008 or 16% of the final energy consumption addressed by the ESD.
EEI action targeted	Measure aims at realising energy savings potential in industry (excluding ETS). Apart from cross-cutting technology (compressed air systems, pumps, ventilators, industrial cooling, electromotors, lighting, space heating), process technologies were also briefly considered. Improvement of energy efficiency in participating industrial companies by 1 % per year.
Effectiveness	The voluntary agreement must incentivise the FEDIL member companies to save energy by improving the energy efficiency of their production installations and processes. All the major Luxembourg companies have signed up to the agreement. The objective of the first agreement, signed in March 1996, was to improve the energy efficiency of the industry by 10% by the end of 2000, taking 1990 as the reference year. This first voluntary agreement expired at the end of 2000; a new voluntary agreement, signed in April 2002, covered 2000-06. In May 2005 that agreement was amended: penalties relating to the objectives were added. Under the agreement some 80 companies undertook to guarantee a minimum level of energy management and to make progress towards a more rational use of energy by together improving their efficiency by an average of 1% per year compared to 1990. In addition, the 'major users', exceeding a consumption of 500 000 GJ per year, committed to performing energy audits in order to identify objectively their potential for saving. The voluntary agreement underwent further minor amendments and was renewed twice: firstly at the beginning of 2007 with an expiry date of 31 December 2008, and secondly at the end of 2008 with an expiry date of 31 December 2010. The signatories set a target of improving energy efficiency by 20%, measured by the general efficiency index over the period 1990-2010 for the companies which signed up to the agreement.
Expected annual energy savings in 2016	254 GWh (2016). Important assumptions made for calculation: ➢ Savings of 1 % of final energy per year. ➢ Consideration of 15 % non-compliance
Implementation status and exact timeframe	EEI measure implemented not earlier than 1996 and still effective in 2010 and 2016 Start/end of the measure: 01/01/1996 – 31/12/2007
Information	http://www.gouvernement.lu/publications/informations_gouvernementales/rapports_activite/rapports-activite-2009/07-eco/eco-com.pdf

Title of the energy efficiency improvement (EEI) measure	B15) Voluntary agreement between the Luxembourg Government and FEDIL on improving energy efficiency in the industrial sector
Type of instrument	4 Voluntary agreements and cooperative instruments
Regional application	Effective nationwide
Target group	Energy consumption in industry (excluding ETS): 3.2 TWh in 2008 or 16% of the final energy consumption addressed by the ESD.
EEI action targeted	Measure aims at realising energy savings potential in industry (excluding ETS). Apart from cross-cutting technology (compressed air systems, pumps, ventilators, industrial cooling, electromotors, lighting, space heating), process technologies were also briefly considered. Improvement of energy efficiency in participating industrial companies by 1 % per year.
Effectiveness	Action mechanism as per measure A6 The voluntary agreement underwent further minor amendments and was renewed twice: firstly at the beginning of 2007 with an expiry date of 31 December 2008, and secondly at the end of 2008 with an expiry date of 31 December 2010.
Expected annual energy savings in 2016	47 GWh (2016). Important assumptions made for calculation: ➢ Savings of 1 % of final energy per year. ➢ Consideration of 15 % non-compliance
Implementation status and exact timeframe	New EEI measure, already finalised Duration of the measure: from 1 January 2008 to 31 December 2010
Information	http://www.gouvernement.lu/publications/informations_gouvernementales/rapports_activite/rapports-activite-2009/07-eco/eco-com.pdf

Title of the energy efficiency improvement (EEI) measure	**B16) Voluntary agreement between the Luxembourg Government and FEDIL on improving energy efficiency in the industrial sector**
Type of instrument	4 Voluntary agreements and cooperative instruments
Regional application	Effective nationwide
Target group	Energy consumption in industry (excluding ETS): 3.2 TWh in 2008 or 16% of the final energy consumption addressed by the ESD.
EEI action targeted	Measure aims at realising energy savings potential in industry (excluding ETS). Apart from cross-cutting technology (compressed air systems, pumps, ventilators, industrial cooling, electromotors, lighting, space heating), process technologies were also briefly considered. Improvement of energy efficiency in participating industrial companies by 1 % per year.
Effectiveness	Action mechanism similar to that of measures A6 and B15
Expected annual energy savings in 2016	102 GWh (2016). Important assumptions made for calculation: ➢ Savings of 1 % of final energy per year. ➢ Consideration of 15 % non-compliance
Implementation status and exact timeframe	New planned EEI measure, implementation process started Duration of the measure: from 1 January 2011 to 31 December 2016
Information	http://www.eco.public.lu/documentation/rapports/rapport_ministere/index.html under Rapport d'activité 2010

Title of the energy efficiency improvement (EEI) measure	**C7) Realising potential in industrial cross-cutting technologies**
Type of instrument	e.g. Information/audits/energy services by energy distributors/incentive schemes 2.1 Focussed information campaigns 2.4 Energy audits 2.7 Exemplary role of the public sector 3.1. Subsidies 4 Voluntary agreements and cooperative instruments 5 Energy services for energy savings 6.1. Obligations on energy companies to offer energy savings: 'white certificates' 6.2 Voluntary agreements with energy producers and distributors 6.3 Energy efficiency fund
Regional application	Effective nationwide
Target group	Electricity consumption in industry (excluding ETS): 1.2 TWh in 2009 or 6% of the final energy consumption addressed by the ESD.
EEI action targeted	Measure aims at realising electricity savings potential in industry (excluding ETS). Apart from cross-cutting technology (compressed air systems, pumps, ventilators, industrial cooling, electromotors, lighting, space heating), process technologies were also briefly considered.
Effectiveness	Details of the measures are not yet available. The measure could be introduced as of 2012.
Expected annual energy savings in 2016	55 GWh (2016). Important assumptions made for calculation: ➢ Technical information from various European studies/projects on cross-cutting technologies (e.g. Germany: 'Compressed air efficient' ➢ Not for companies/systems of European CO^2 certificate trade ➢ Focus on motor and process technologies
Implementation status and exact timeframe	New planned EEI measure, implementation process not yet started Possible start of measure: From 1 January 2012
Information	http://www.druckluft-effizient.de

Annex 4

Detailed description of measures in the transport sector

Title of the energy efficiency improvement (EEI) measure	**B7) Rise in the price of domestic fuel**
Type of instrument	Fiscal instrument 3.2 Tax on fuel
Regional application	Effective nationwide
Target group	Final energy consumption for people and goods transport (petrol/diesel): 7.2 TWh in 2008 or 37 % of the final energy consumption addressed by the ESD.
EEI action targeted	Driving behaviour aimed at lower fuel consumption (in the short-term); buying decisions that favour fuel-efficient vehicles (in the longer term)
Effectiveness	Increase of miner oil tax by an additional 'Kyoto Cent'. The tax on petrol was increased by 2 Cent/l by January 2007 and that on diesel in two stages, on 1 January 2007 and 1 January 2008 by 1.25 Cent/l respectively.
Expected annual energy savings in 2016	104 GWh (2016). Measure evaluation about the adoption of short-term and longer-term price elasticity. Important assumptions made for calculation: ➢ Strong growth of diesel use (40 %) in the reference development; petrol remains constant ➢ The calculation is based on assumptions (based on empirical studies of FIFO) about price elasticity that, at any rate, must be considered as rather modest (approx. 0.5 % in the short term; up to 1.6 % in the long term)
Implementation status and exact timeframe	New EEI measure, implementation process started Start of measure: 1 January 2007 and 1 January 2008
Information	http://www.legilux.public.lu/leg/a/archives/2006/0239/a239.pdf http://www.legilux.public.lu/leg/a/archives/2006/0244/a244.pdf#page=27 http://www.legilux.public.lu/leg/a/archives/2007/0245/a245.pdf#page=10

Title of the energy efficiency improvement (EEI) measure	**B8) Ordinance of the Grand Duchy of 22 December 2006 […] on the definition of special measures in the field of social and environmental policy (CO^2-related vehicle taxes)**
Type of instrument	Fiscal instrument 3.2 motor vehicle tax
Regional application	Effective nationwide
Target group	Final energy consumption for people and goods transport (petrol/diesel): 7.2 TWh in 2008 or 37% of the final energy consumption addressed by the ESD.
EEI action targeted	Influence of purchasing decisions in favour of fuel-efficient vehicles (longer term)
Effectiveness	

*1) For vehicles registered from 1 January 2001 (cat. M1) the calculation formula is: tax (in euro) = a*b*c*

a = CO_2 emission in g/km (information supplied by constructor on the European conformity certificate),

b = a coefficient: 0.9 for vehicles with a diesel engine; 0.6 for vehicles with an engine other than diesel,

c = represents a factor of 0.5 for vehicles with CO_2 emissions of less than 90 g/km increasing by 0.10 for each extra 10 g or part thereof,

If diesel engine particulate emissions are less than or equal to 10 mg/km a maximum reduction of €50 will be granted (valid every year).

2) For vehicles registered prior to 1 January 2001 (cat. M1)

Cc:	Fuel other than diesel:	diesel:
1 to 1600 cc	6	6
1601 to 2000 cc	7	7
2001 to 3000 cc	9.50	10.0
3001 to 4000 cc	11.50	13.0
Over 4000 cc	12.50	15

Expected annual energy savings in 2016	122 GWh (2016). Measure evaluation about the adoption of longer-term price elasticity. Important assumptions made for calculation: ➢ The calculation is based on assumptions about price elasticity Savings of approx. 5.5 % for petrol, 3.4 % for diesel ➢ Investigation of the effects in a EU-wide study
Implementation status and exact timeframe	New EEI measure, implementation process started Start of measure: 01/01/2007
Information	http://www.legilux.public.lu/leg/a/archives/2006/2442912/index.html

Title of the energy efficiency improvement (EEI) measure	**B9) Ordinance of the Grand Duchy of 5 December 2007 for the granting of financial support to low CO^2 emissions vehicles**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for people and goods transport (petrol/diesel): 7.2 TWh in 2008 or 37 % of the final energy consumption addressed by the ESD.
EEI action targeted	Influence of purchasing decisions in favour of fuel-efficient vehicles
Effectiveness	Extract from the Ordinance of the Grand Duchy of 5 December 2007 for the granting of financial support to low CO_2 emissions vehicles ➢ *Financial aid of €750 granted to physical persons owning a passenger car* ➢ *Car registered in the Grand-Duchy and put on the road for the first time between 1 June 2007 and 31 December 2009* ➢ *Car with CO_2 emissions not exceeding :* • *120g CO_2/km (equivalent to 5 litres petrol per 100 km or 4.5 litres diesel per 100 km);* • *160g CO_2/km for vehicles with six seats or more; vehicle-owner is part of a household of at least 6 persons;* • *160g CO_2/km for hybrid- or LNG-fuelled vehicles.* The ordinance was extended in stages and CO_2 emission values reduced. Modifications of this Ordinance, most recently on 11 July 2011.
Expected annual energy savings in 2016	71 GWh (2016). Important assumptions made for calculation: ➢ Figures on delivery volumes and delivered units ➢ Specific CO_2 emissions for vehicles
Implementation status and exact timeframe	New EEI measure, implementation process started Start of measure: 01/01/2008
Information	http://www.legilux.public.lu/leg/a/archives/2007/2221412/index.html http://www.environnement.public.lu/actualites/2007/12/Aides_financieres/conf__rence_de_presse_28_janvier_2008.pdf

Annex 5

Detailed description of cross-cutting measures and renewable energy sources

Title of the energy efficiency improvement (EEI) measure	**A4) Promotion of decentralised renewables in the building sector by 2007**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD. Electricity consumption (for electrical appliances) in the household sector: 0.9 TWh in 2008 or 5% of the final energy consumption addressed by the ESD.
EEI action targeted	Installation of solar panels and heat pumps for domestic water use/heating, of PV installations to produce electricity and of modern biomass heating in the household sector
Effectiveness	Ordinance of the Grand Duchy of 17 July 2001 and 3 August 2005 on the promotion of rational energy use and renewables For solar thermal installations: Investment cost subsidies of 50 % of attributable costs, up to a maximum of EUR 3 000/5 000 for solar thermal installations with/without heating support, as well as EUR 38 000 for multi-story housing. Minimal specific output: 525 kWh/m^2/a. For heat pumps: Investment cost subsidies of 40 % of the attributable costs, up to a maximum of EUR 4 000 for detached houses and EUR 10 000 for multi-story housing. For biomass (including pellet heating): Investment cost subsidies of 30% of the attributable costs, up to a maximum of 4 000 EUR for detached houses and 20,000 EUR for apartment blocks. The financial support programme is enhanced by information campaigns and the possibility of obtaining technical advice. Support is based on the Ordinance of the Grand Duchy of 3 August 2005 on the introduction of a programme promoting rational energy use and the upgrading of renewables for private individuals. PV installations for private individuals with an output not exceeding 30 KW$_p$, the construction of which is promoted by the Ordinance of 3 August 2008 (investment subsidies of 15 % of the attributable costs, up to a max. of 900 EUR/kW$_p$), receive a supply remuneration of 0.56 EUR/kWh. PV installations operated by local authorities receive 0.28 EUR/kWh. The support is based on the Ordinance of 14 October 2005, which contains the currently applicable provisions on supply tariffs from electricity from renewables. Follow-up measures: B5 (promotion of decentralised renewables)
Expected annual energy savings in 2016	47 GWh (2016). All savings from the period 1995-2007. The energy produced by solar and PV installations and also biomass and heat pumps is evaluated as an overall saving in the building sector.
Implementation status and exact timeframe	EEI measure implemented no earlier than 1995 and still effective in 2010 and 2016 Start/end of the measure: Different measures 1 January 1996, 31 December 2007, recently 3 August 2005 and 14 October 2005 - 31 December 2007.
Information	http://www.legilux.public.lu/leg/a/archives/2001/0852307/index.html http://www.legilux.public.lu/leg/a/archives/2005/1362308/index.html

	http://www.legilux.public.lu/leg/a/archives/2005/1811411/index.html

Title of the energy efficiency improvement (EEI) measure	**A5) Ordinance of the Grand Duchy of 30 May 1994 for the production of electrical energy based on renewables and CHP[1]**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Predominantly: Final energy consumption for heating in the tertiary sector: 2.9 TWh in 2008 or 15% of the final energy consumption addressed by the ESD; electricity consumption in the tertiary sector: 2.1 TWh in 2008 or 11% of the final energy consumption addressed by the ESD.
EEI action targeted	Accelerated extension of decentralised CHP
Effectiveness	Compensation for electrical energy fed into the electricity network ('Règlement grand-ducal modifié du 30 mai 1994')[1]
➢ 1 ≤ rated electrical power (kW) ≤ 150: tariff 0.0731 (0.65+0.35 (I6m/I0)) (EUR/kWh) ➢ 151 ≤ rated electrical power (kW) ≤ 1500: Tariff power 111.55 x R (EUR/kW); daytime energy 0.0570 x R (EUR/kWh); night-time energy: 0.0297 x R (EUR/kWh) Annual use efficiency ≥ 80 %, annual full load hours ≥ 2 500 for both power ratings I_{6m}:Consumer price index in the accounting month, 6-month average consumer price index, relating to a reference value of 1 January 1948 (as at January 2004: 656.94) I_0:Reference value January 1993: 529.21 $R = 0.45+0.55 (I_{6m}/I_0)+0.30 (G/G_0)$ G:Price of natural gas for the city of Luxembourg (as at 1 quarter 2004: 0.2407 EUR/Nm^3) G_0:Reference value January 1993: 0.176 EUR/Nm^3) Remuneration for the power depends on participation in covering peak load needs on the grid (average contribution based on the 3 peak values).	
Expected annual energy savings in 2016	206 GWh (2016). All savings from the period 1998-2007. Important notes: ➢ Electricity production from CHP <150 kWel: 1.15 GWh/a Electricity production from CHP>150 kWel: 198 GWh/a (excluding ETS) (2004) ➢ CHP plants included in ETS not taken into account ➢ Primary energy evaluation
Implementation status and exact timeframe	EEI measure implemented not earlier than 1996 and still effective in 2010 and 2016; no major adaptations planned – early action Start/end of the measure: Effective since 1998
Information	http://www.legilux.public.lu/leg/a/archives/1994/0621207/index.html

[1] Amended by Ordinance of the Grand-Duchy of 14 October 2005 1) on the supply of electrical energy based on renewables, and 2) amending Ordinance of the Grand-Duchy of 30 May 1994 on the production of electrical energy based on renewables or on cogeneration and Ordinance of the Grand-Duchy of 22 May 2001 on the introduction of a compensation fund as part of the organisation of the electricity market.)

Title of the energy efficiency improvement (EEI) measure	**B5) Ordinance of the Grand Duchy of 21 December 2007 on the promotion of rational energy use and renewables**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD. Electricity consumption (for electrical appliances) in the household sector: 0.9 TWh in 2008 or 4% of the final energy consumption addressed by the ESD.
EEI action targeted	Installation of solar panels and heat pumps for domestic hot water /heating and of PV installations to generate electricity in the household sector and biomass use in households, such as in pellet heating systems.
Effectiveness	*Art. 7. Solar heat installation: Financial aid of 50% of actual cost (maximum of €3 000 for domestic hot water production and €5 000 for domestic hot water and auxiliary central heating. For an apartment block the amounts are to be multiplied by the number of apartments (maximum €15 000 and 50% of actual cost).* *Art. 8. Photovoltaic solar installation: 1. Financial aid of 30% for installing an individual photovoltaic installation on the roof or facade or integrated into a building's envelope, with a maximum aid of €1 650 per peak kW (maximum eligible power 30 kWpeak),* *Art. 9. Heat pump: For a geothermal-source heat pump, i.e. with horizontal or vertical collectors / for an air-source heat pump: 40% (€6 000/€3 000 maximum) in a single-family house; 40% (€4 000/€2 000 maximum) for an apartment which is part of an apartment block. There is a ceiling of €20 000/€10 000 per apartment block.* *Art. 10: Biomass boiler: Financial aid for installing a central heating appliance or an integrated stove in the central heating circuit (staged combustion boiler for billets, boiler for wood chips or pellets, straw-fired boiler complying with the precise criteria laid down in Annex II.* *Central heating from boiler using wood chips or pellets or straw: 30% (max. € 4 000) for a single-family house; 30% for an apartment block. The above ceiling of € 4 000 will in that case be multiplied by the number of apartments (to a maximum of € 20 000).* *Wood-pellet stove: 30% (max. € 2 500) for a single-family house.* *Biomass boiler together with a solar heating installation for hot water production: flat-rate aid of € 300.* *Central heating used staged wood billet burning: 25% (max. € 2 500) for a single-family house; ceiling of € 2 000 per apartment for an apartment block. In the latter case the above ceiling is multiplied by the number of apartments up to a maximum of € 20 000.* The measure was extended and some of its points amended with the Ordinance of the Grand Duchy of 20 April 2009 on the promotion of rational energy use and renewables.
Expected annual energy savings in 2016	40 GWh (2016). All savings from the period 2008-2012. The energy produced by solar and PV installations, as well as the renewable share of energy produced by heat pumps are evaluated as an

	overall saving in the building sector. Important assumptions made for calculation: ➢ trajectory pursuant to the Luxembourg Action Plan for Renewable Energy
Implementation status and exact timeframe	New planned EEI measure, implementation process started Start/end of the measure: 1 January 2008 to 31 December 2012.
Information	http://www.eco.public.lu/documentation/rapports/Luxemburger_Aktionsplan_f__r_erneuerbare_Energie.pdf http://www.legilux.public.lu/leg/a/archives/2007/2473112/index.html http://www.legilux.public.lu/leg/a/archives/2009/0083/index.html

Title of the energy efficiency improvement (EEI) measure	**C8) Continuation and expansion of support for decentralised renewables (solar thermal installations, heat pumps, PV installations, biomass)**
Type of instrument	Financial instrument 3.1. Subsidies
Regional application	Effective nationwide
Target group	Final energy consumption for hot water and heating in the housing sector: 5.2 TWh in 2008 or 27 % of the final energy consumption addressed by the ESD. Electricity consumption (for electrical appliances) in the household sector: 0.9 TWh in 2008 or 5% of the final energy consumption addressed by the ESD.
EEI action targeted	Installation of solar panels and heat pumps for domestic hot water /heating and of PV installations to generate electricity in the household sector and realisation of the potential of decentralised renewables in the building sector (biomass use in households, such as in pellet heating systems)
Effectiveness	trajectory pursuant to the Luxembourg Action Plan for Renewable Energy
Expected annual energy savings in 2016	164 GWh (2016). All savings from the period 2008-2012, as well as the renewable share of energy produced by heat pumps, are evaluated as an overall saving in the building sector. Important assumptions made for calculation: ➢ assumptions pursuant to the Luxembourg Action Plan for Renewable Energy
Implementation status and exact timeframe	New planned EEI measure, implementation process not yet started Start of measure: From 1 January 2013
Information	http://www.eco.public.lu/documentation/rapports/Luxemburger_Aktionsplan_f__r_erneuerbare_Ener gie.pdf