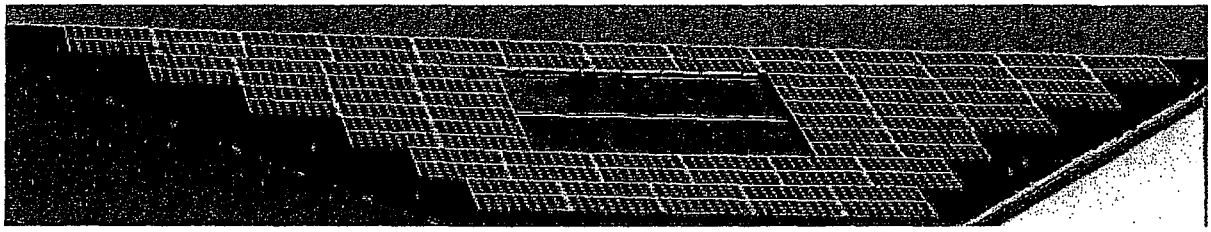
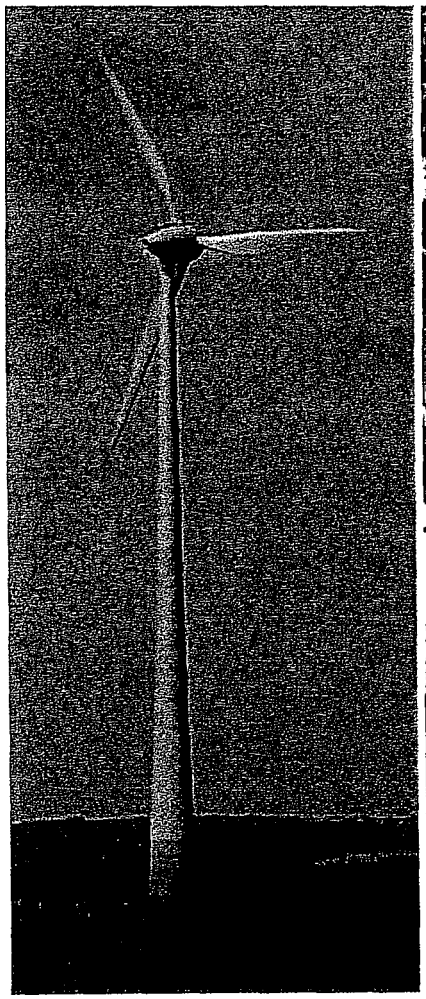
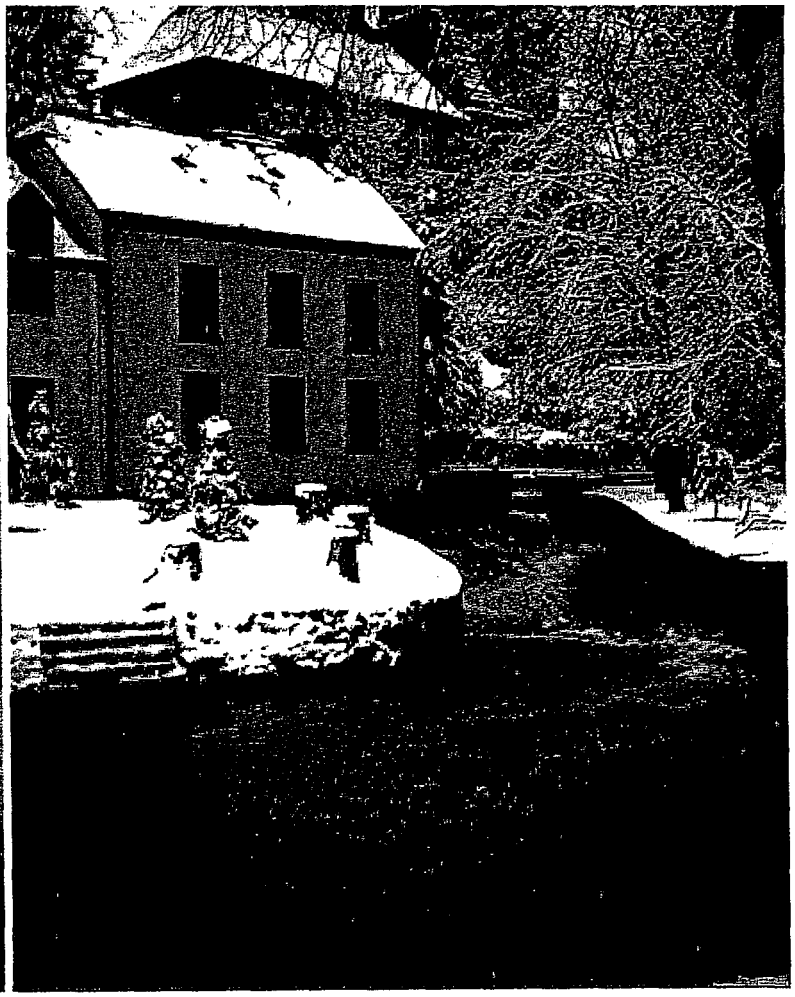


Report by Luxembourg published in accordance with Article 3(3) of Directive 2001/77/EC of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market and national indicative targets for future consumption of electricity produced from renewable energy sources





1. The legal context of the Directive

Article 3(3) of Directive 2001/77/EC requires Member States to publish, no later than 27 October 2003 and thereafter every two years, a report which includes an analysis of success in meeting the national indicative targets and which indicates to what extent the measures taken are consistent with the national climate change commitment.

The reference values in the Annex to the Directive

The purpose of the Directive is to set individual targets for each Member State for the percentage of electricity produced from renewable energy sources in relation to gross electricity consumption in 2010.

The Annex to Directive 2001/77/EC gives the following figures for Luxembourg:

	Production of electricity from renewable energy sources in 1997 in TWh	Proportion of electricity from renewable energy sources divided by gross inland electricity consumption in 1997 expressed as a percentage	Proportion of electricity production from energy sources divided by gross inland electricity consumption in 2010 expressed as a percentage
Luxembourg	0.14	2.1	5.7

This Annex also contains the following statement by Luxembourg:

'Taking into account the indicative reference values set out in this Annex, Luxembourg takes the view that the objective set for 2010 can be achieved only if:

— total electricity consumption in 2010 does not exceed that of 1997,

— wind-generated electricity can be multiplied by a factor of 15,

— biogas-generated electricity can be multiplied by a factor of 208,

— electricity produced from the only municipal waste incinerator in Luxembourg, which in 1997 accounted for half the electricity produced from renewable energy sources, can be taken into account in its entirety,

— photovoltaically generated electricity can be raised to 80 GWh, and

in so far as the above points can be achieved from the technical standpoint in the time allowed.

In the absence of natural resources, an additional increase in electricity generated by hydroelectric power stations is ruled out.'

Given that Luxembourg is only 2 586 km^2 in size and is highly industrialised, it is highly likely that it will be extremely difficult for this little country to achieve the indicative targets for 2010 proposed in the Directive. The abovementioned statement by Luxembourg in the Annex to the Directive is in fact merely an illustration of these difficulties.

While Luxembourg is not in the best possible position to meet the indicative targets set by Directive 2001/77, the fact remains that Luxembourg fully subscribes to the imperative need to ensure sustainable management of resources. The promotion of electricity generation based on

renewable energy sources thus forms part of Luxembourg's overall policy with regard to sustainable development.

2. The legislative framework in Luxembourg

The main legislative instruments for achieving the objectives for Luxembourg are as follows:

- the amended Law of 5 August 1993 on the rational use of energy,
- the amended Law of 1 August 2007 on the organisation of the electricity market, and
- the amended Law of 23 December 2004 establishing a greenhouse gas emissions quota trading system.

The first Law referred to above lays the foundations for various measures to promote renewable electricity, while the second sets out the legal framework for access to the network of renewable energy sources.

The abovementioned laws constitute the legal basis for a number of Regulations:

- The amended Regulation of 30 May 1994 concerning the production of electricity based on cogeneration.

  This Regulation imposes an obligation to purchase electricity based on cogeneration and sets rates for feeding current into the grid.

- The amended Regulation of 22 May 2001 concerning a compensation fund.

- The Regulation of 21 December 2007 establishing an aid scheme for individuals in respect of the promotion of rational use of energy and the development of renewable energy sources.

- The Regulation of 20 April 2009 establishing an aid scheme for promoting the rational use of energy and the development of renewable energy sources.

  This Regulation, which replaces that of 21 December 2007, provides amongst other things for aid for investment in active (thermal and photovoltaic) solar energy.

- The Regulation of 8 February 2008 concerning the production of electricity based on renewable energy sources.

  This Regulation sets feed-in tariffs for the supply of electricity generated using renewable energy sources and introduces a system of guarantees of origin for electricity produced from renewable energy sources.

  The feed-in tariffs introduced by the Regulation are based on the conclusions of a study carried out jointly by the Economy and Foreign Trade Ministry and the Environment Ministry with the aim of analysing the potential of renewable energy sources and developing strategies and measures for ensuring increased and efficient use of renewable energy sources while taking economic constraints into account.

  The feed-in tariffs are designed to ensure that, while the compensation for electricity fed into the grid and the investment aid form a whole, they do not lead to excessive subsidisation. It is above all a question of endeavouring to ensure that the system of premiums is such as to ensure that the commitments in relation to Directive 2001/77/EC are met.

3. The effects of the implementation of Directive 2001/77/EC in Luxembourg.

The small size of the country and its location in the middle of Western Europe mean that Luxembourg is not particularly well-off in terms of renewable energy resources. Variations in consumption therefore have a greater influence on the percentage of production of electricity from renewable sources than efforts deployed to promote renewable energy sources under Directive 2001/77/EC. However, the implementation of the above-mentioned legislative instruments has enabled Luxembourg to move in the right direction towards achieving its stated objectives in the Annex to the Directive, achieving an increase of approximately 64% in electricity production from renewables between 2001 and 2008..

The production of electricity from renewable energy sources

(Table headings only – please see original for figures)

Year: Waste: Photovoltaics: Biogas: Wind turbines: Hydropower: Total inland consumption: Proportion of renewables

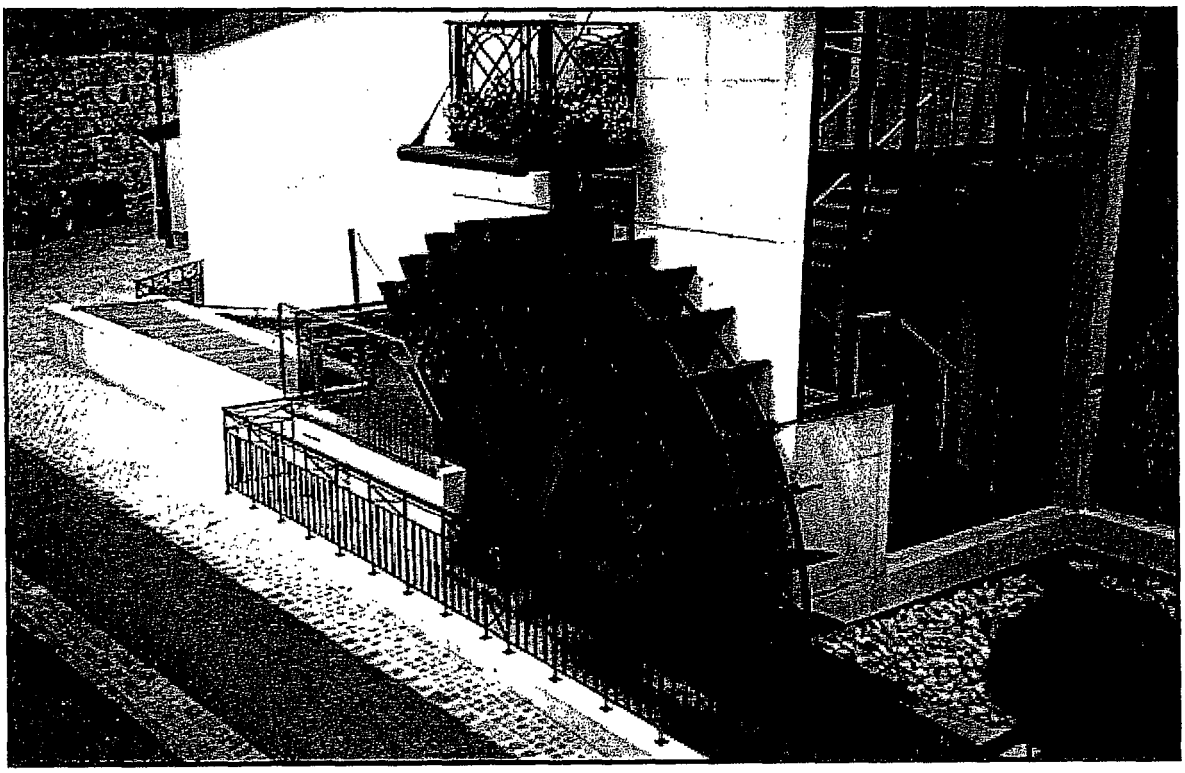
The sectoral analysis of the various fields concerned leads to the following conclusions:

3.1. Hydropower

Year	GWh
2000	124.54
2001	119.25
2002	101.53
2003	79.55
2004	104.26
2005	92.94
2006	111.31
2007	116.70
2008	132.11

Hydropower resources are exploited more or less to the full now that thirty or so small hydroelectric power plants have been either brought back into service or upgraded over the last ten years; the smallest of these plants produces less than 10 KW.

A dozen or so more small hydroelectric power plants could be brought back into service or upgraded in the next few years, but they are unlikely to increase the production of electricity based on hydropower significantly, given that, altogether, the 27 existing small hydroelectric power plants produce only about 5 GWh a year.

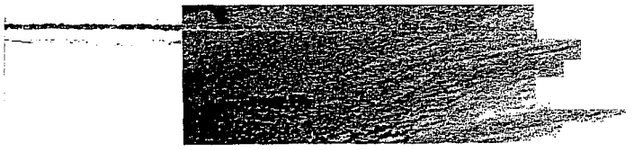


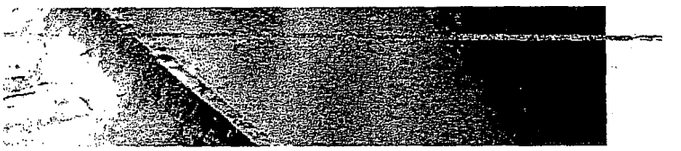
Large hydroelectric plants in Luxembourg

Site	Power (kW)	River
Esch-sur-Sûre	**See orig. for figures**	Sauer •
Rosport		Sauer
Grevenmacher		Mosel
Palzem		Mosel
Schengen		Mosel
Lohmühle / Staumauer Vianden		Our
1 **Subtotal**		

Small hydroelectric plants in Luxembourg

Site	Power (kW)	River •
Bettendorf	**50**	Sauer
Birtrange	**105**	Alzette
Bourscheid	**35**	Sauer
Cruchten	**105**	Alzette
Erpeldange	**85**	Sauer
Essingen	**93**	Alzette
Ettelbruck	**200**	Alzette
Moestroff	**140**	Sauer
Schüttburg	**26**	Clerf
Backesmühle	**10**	Weiße Emz
Bannmühle	**40**	Attert
Bigonville	**48,5**	Sauer
Bissermühle	**45**	Attert
Bounsmühle	**60**	Syr
Clouterie/Bissen	**140**	Attert
Fausermühie	**40**	Syr
Felsmühle	**45**	Syr
Fockenmühle	**30**	Eisch
Maulusmühle	**11**	Woltz
Neumühle	**15**	Weiße Emz
Reisermühle	**15**	Weiße Emz
Hessenmühle	**22**	Weiße Emz
Steckenmühle	**48**	Syr
Stolzemburg	**66**	Our
Tuchfabrik / Bettbom	**15**	Roudbaach
Useidingen	**45**	Attert
Subtotal	**1 534.5**	
Nospelt SEBES	**429**	Turbine in potable water line
Total power (kW)	**42 963.5**	





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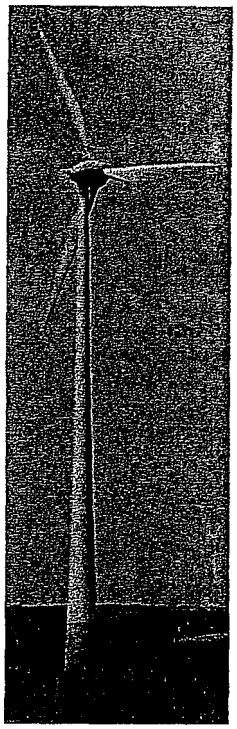
3.2. Wind energy

Its location means Luxembourg is not particularly conducive to the development of wind energy since there are not many sites where annual average wind speeds exceed 6 m/s. The fact that the wind turbines now available on the market are becoming increasingly powerful and increasingly large enables better use to be made of regions with low average wind speeds but this causes other environmental problems related to the physical size of these facilities, particularly as regards noise, possible interference with airport guidance facilities, optical shading problems, obligatory distances from dwellings and also difficulties with connecting to the grid since the existing network in rural areas suitable for the development of wind energy is not big enough to allow the feeding-in of electricity from a wind farm easily exceeding 6 MW.



In addition, the sites available for the exploitation of wind energy are also much sought after for the development of industrial or commercial zones or new housing developments or are located in nature reserves and/or recreation areas.

However, the legislative framework established in 1993 with the adoption of the Law of 5 August 1993 on the rational use of energy and the aid scheme for this technology, in particular as regards remuneration for the production of electricity from wind turbines have contributed over the last decade to the development of a large number of wind farm projects in Luxembourg.

Wind farm projects in chronological order of date of bringing into service:

No	Location	Operator	Power	Brought into service
1.	Mompach	Windpower S.A.	4x 500 kW	January 1997
2	Nachtmanderscheid	Wandpark op der Hei sari.	1 x 850 kW	July 1997
3.	Heinerscheid 1	Wandpark Gemeng Hengischt	3x 600 kW	December 1998
4.	Heiderscheid	Wand a Waasser S.A.	3x 500 kW	December 1998
5.	Remerschen	Agence de l'Energie S.A.	lx 600 kW	December 1998
6.	Derenbach/Wincrange	Megawind/Nordwand S.A.	4x 600 kW	January 1999
7.	Nachtmanderscheid	Wandpark op der Hei sari.	lx 850 kW	September 1999
8.	Heinerscheid 2	Wandpark Gemeng Hengischt	5 x 1000 kW	November 1999
9-	Bettbom/Reimberg	Energi Atelier Réiden	2x 600 kW	November 2002
10.	Heinerscheid 3	Wandpark Geméng Hengischt	3x1800 kW	June 2003
11.	Kehmen-Bourscheid	Wandpark Kehmen-Heischent	7x1800 kW	September 2004
12	Stockem	Haardwand S.A.	2x 600 kW	Oct./Dec. 2004
13.	Mompach	Burer Bierg S.A.	4 x 2000 kW	August 2008

This table shows that no fewer than eight wind farms were built in six different locations across the country between 1997 and 1999. After a lean period in 2000 and 2001, five new projects – the most

recent in August 2008 - swelled the total wind farm capacity in Luxembourg since 1999, with the result that a total of 40 turbines with a nominal capacity in excess of 500 KW are currently connected to the public grid, giving a total installed nominal capacity of 43 400 KW. Consequently, since 1997 Luxembourg has increased the installed capacity of its wind turbines by 28% a year on average.

The total production of electricity based on wind turbines built in Luxembourg since 1996 is about 398.6 GWh, of which 60,6 GWh in 2008. Electricity production based on wind turbines has grown by almost 33% a year on average since 1997.

In 2008, the annual production of the 36 wind turbines currently in service was thus the equivalent of the electricity consumption of 14 000 households.

Wind turbines: Installed power and production

Power (KW)

Production (MWh)

(Please see original for figures)

3.3. Biomass

Production

Year	MWh
1997	120
1998	520
1999	101O
2000	4540
2001	8 200
2002	9 300
2003	15130
2004	20 344
2005	27 220
2006	32 595
2007	36 590
2008	38 507

The biomass sector still has promising development potential. To date, 27 cogeneration plants based on biogas and three plants based on landfill gas are in service. However, these plants have a very low capacity (a few hundred KW).

Output has risen by about 68% a year on average, and the increase in installed capacity is approximately 43% a year on average.

Installed capacity

Year	KW
1997	150
1998	230
1999	367
2000	1322
2001	2067
2002	2 985
2003	3868
2004	4623
2005	4623
2006	5 868
2007	5868
2008	7776

Biogas: Installed capacity and production

(NB: Just the text, please see original for figures).

Capacity (kW) Production (MWh

The figures for 1997 for the production of electricity from renewable energy sources still included the total production of electricity from Luxembourg's only waste incineration plant, while the figures for 2010 no longer contain the biodegradable fraction of waste used for power generation

Since there is only one waste incineration plant in Luxembourg (SIDOR), the actual potential for producing electricity from this plant is limited to about 20 GWh on average. In 2008 the production of electricity from biodegradable waste accounted for approximately 9% of the total electricity produced from renewable energy sources.

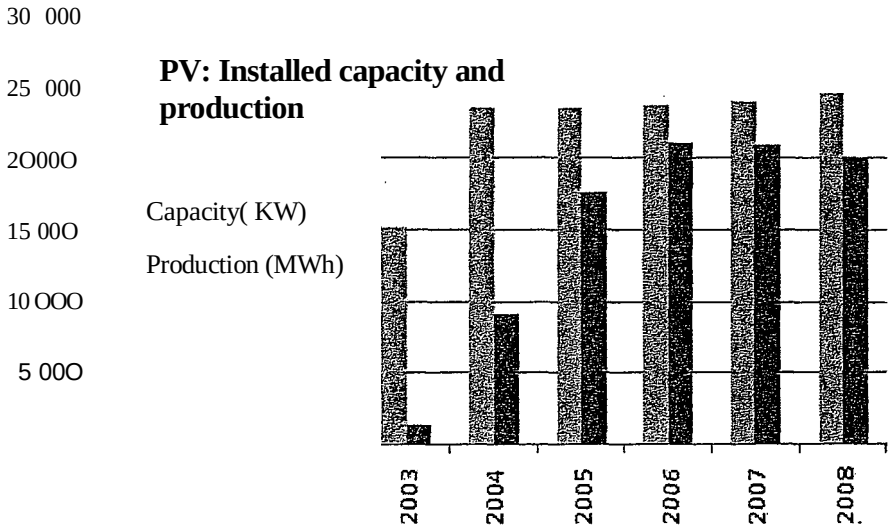
Year	GWh
1997	16.927
199S	16.619
1399	18.986
2000	18.951
2001	18.810
2002	19.072
2003	17.724
2004	20.712
2005	17.648
2006	21.075
2007	24.294
2003	24.056

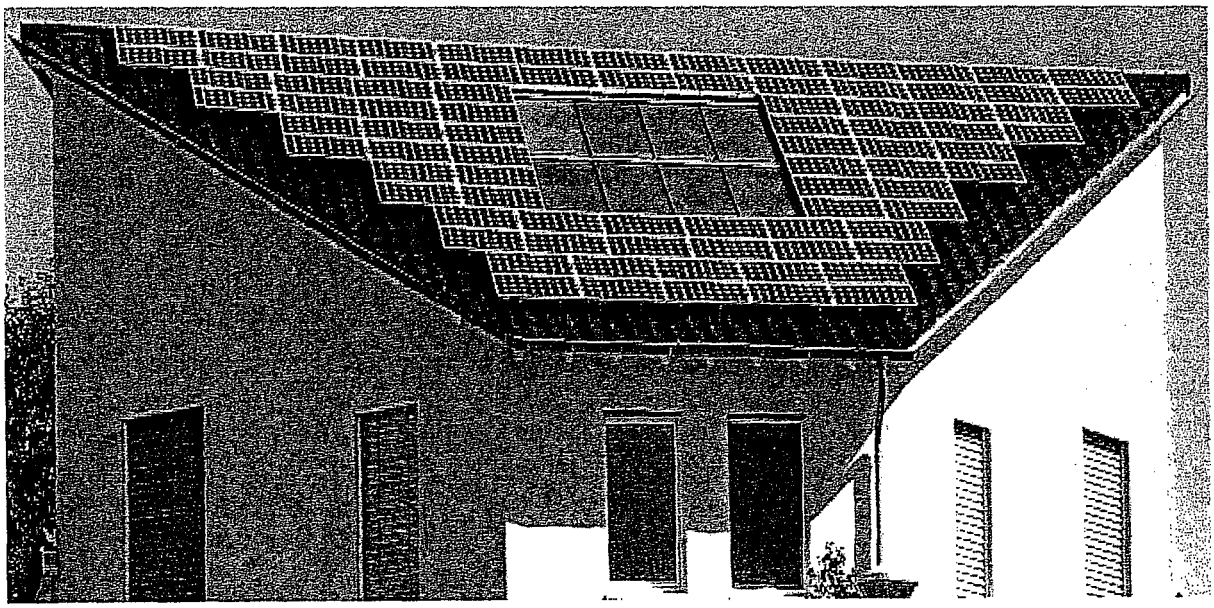
3.4. Photovoltaic energy

Year	MWh	Year	KW
Production		**Installed capacity**	
2000	40	2000	71
2001	46	2001	160
2002	83	2002	1 593
2003	1 360	2003	15 170
2004	9 199	2004	2 356
2005	17 698	2005	23 583
2006	21 114	2006	23 696
2007	20 900	2007	23 934
2008	20 031	2008	24 562

Photovoltaic energy experienced an extraordinary boom in the period 2002 to 2004 thanks to Regulations implementing financial support schemes for this technology in Luxembourg. Luxembourg is now well placed in terms of installed capacity per capita in comparison with the average for the EU in terms of domestic PV installations. However, it seems unrealistic to imagine that it will ever be possible achieve the electricity production target of 80 GWh by 2010 as envisaged by Luxembourg in the context of the basic assumptions underlying the Directive.

The revised Regulations of 20 July 2004 amending those of 17 July 2001 and 28 December 2001 certainly had the effect of slowing down the momentum of photovoltaic energy in the period 2002-04, with the result that electricity production based on PV now appears limited in the medium term to about 20-25 GWh a year.





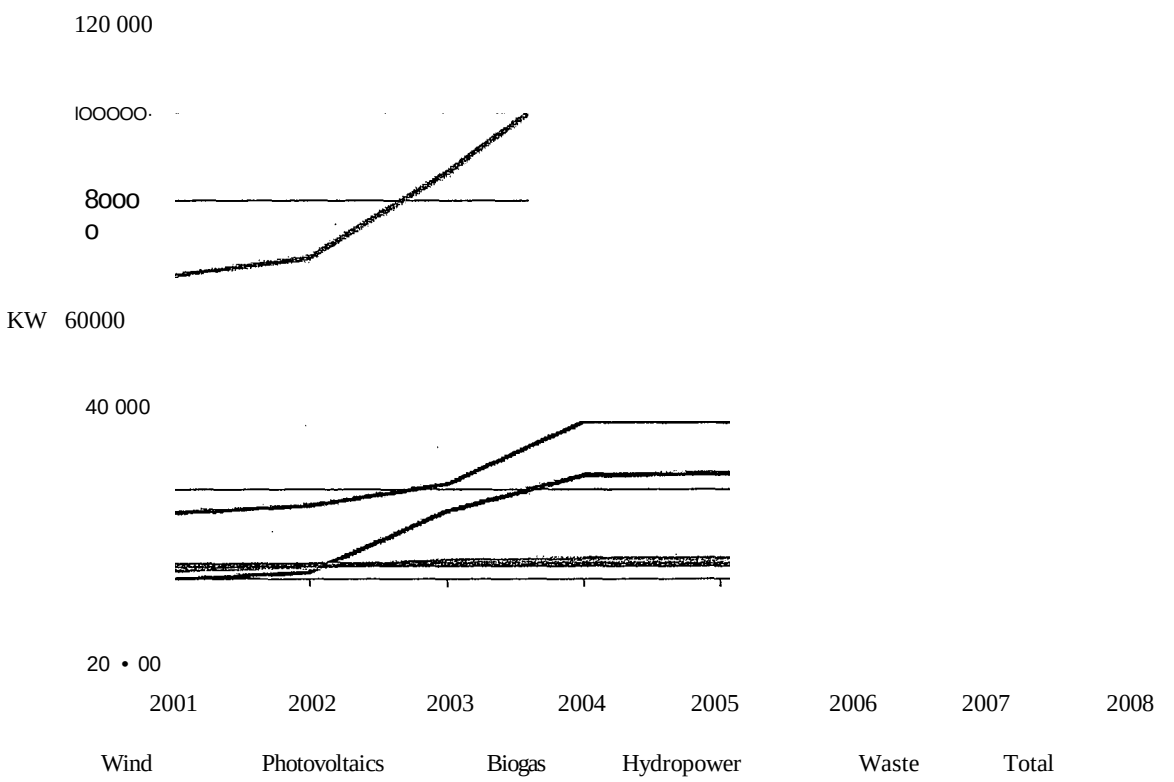
4. Conclusions

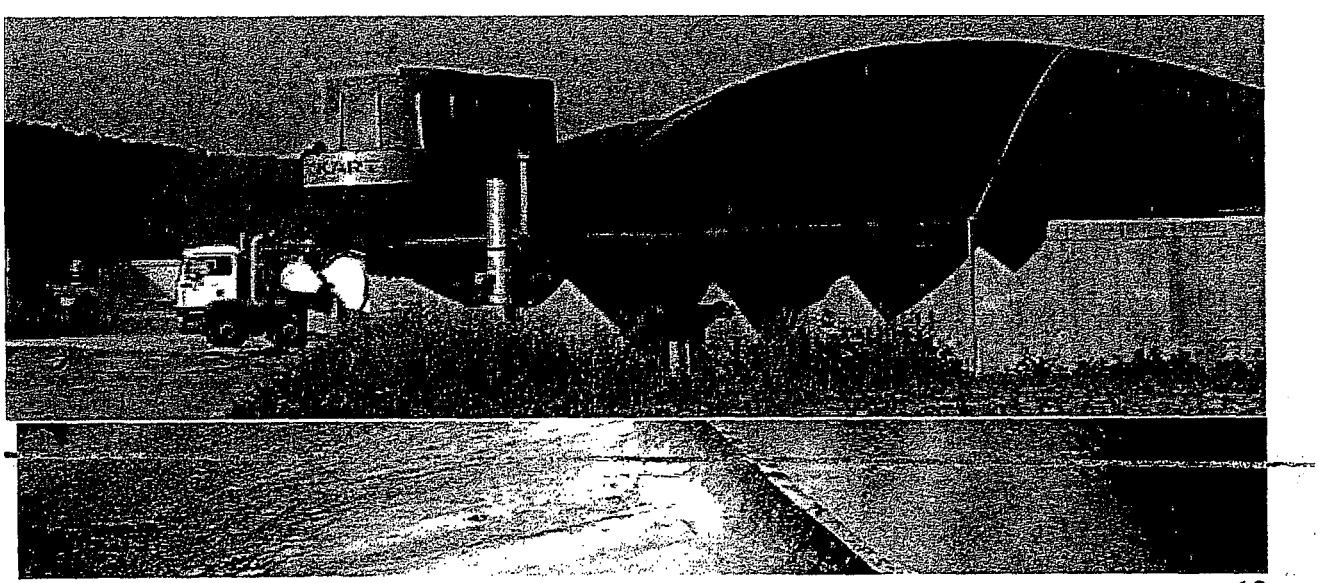
The development of installed electricity capacity in the renewable energy sector in Luxembourg can be summarised as follows:

Capacity (kW)	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Wind	14 913	16 443	21 513	35 313	35 313	34 900	. 34 900	43 400
Photovoltaics	160	1 598	15 179	23 517	23 561	23 696	23 934	24 562
Biogas	2 067	2 985	3 868	4 623	4 623	5 868	5 868	7 776
Hydropower	42 964	42 964	42 964	42 964	42 964	42 964	42 964	42 964
Incineration	3 126	3 126	3 126	3 126	3 126	3 126	3 126	3 126
Total	63 230	67 116	86 650	109 543	109 587	110 554	110 792	121 828

Installed electricity capacity increased by 92% over seven years (between 2001 and 2008)!

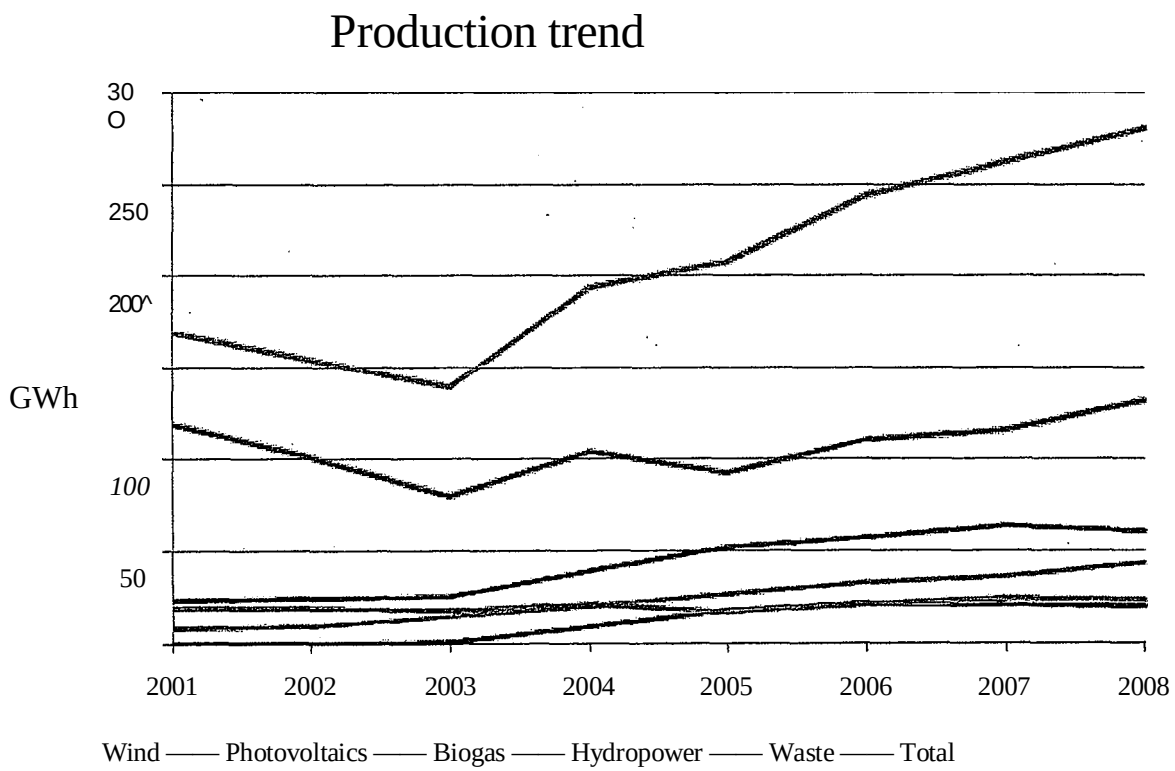
Trend in installed capacity





Electricity generation based on renewable energy sources in Luxembourg has evolved as follows:

Production (GWh)	2001	2002	2003	2004	2005	2006	2007	2008
Wind	23.70	24.73	26.17	39.40	52.45	57.99	64.29	60.59
Photovoltaics	0.05	0.08	1.36	9.20	17.70	21.11	20.90	20.03
Biogas	8.20	9.30	15.13	20.34	27.24	32.60	36.59	43.83
Hydropower	119.25	101.53	79.55	104.26	92.94	111.31	116.70	132.11
Waste	18.81	19.07	17.72	20.91	17.65	21.08	24.29	24.06
Total	170.01	154.71	139.93	194.11	207.97	244.08	262.77	280.61



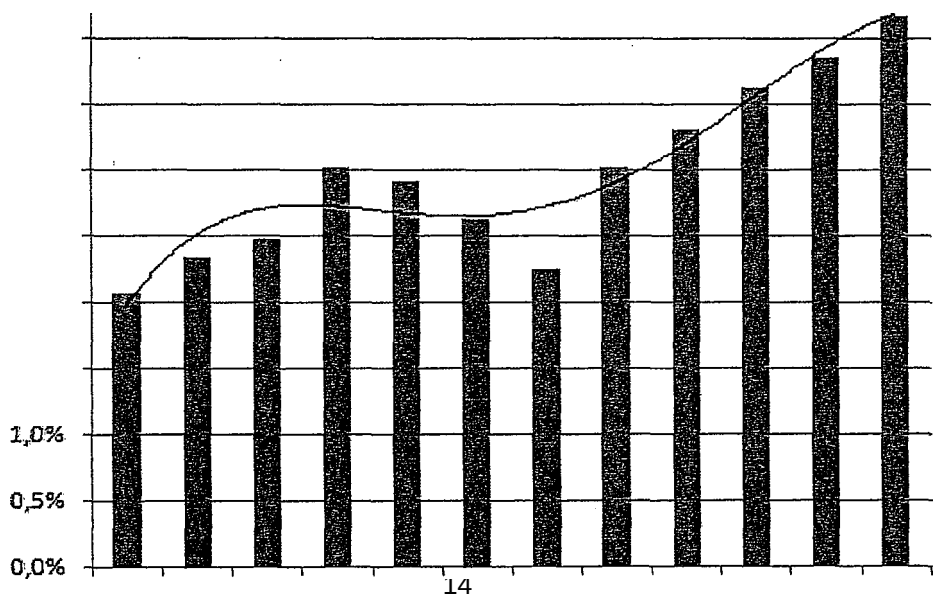
The share of renewable energy sources in electricity consumption in Luxembourg:

Year	*Production based on renewables*	*Inland consumption*	*Proportion of renewable electricity*
1997	104.98	5 068.95	2.07%
1998	120.54	5 117.38	2.36%
1999	136.74	5 509.94	2.48%
2000	172.81	5 717.29	3.02%
2001	170.01	5 813.03	2.92%
2001	154.71	5 864.44	2.64%
2003	139.93	6 215.70	2.25%
2004	194.11	6 421.09	3.02%
2005	207.97	6 259.91	3.32%
2006	244.08	6 717.77	3.63%
2007	262.77	6 797.54	3.87%
2008	280.61	6 703.14	4.19%

The proportion of electricity based on renewable energy sources in relation to total electricity consumption in Luxembourg increased from 2.07% in 1997 to 4.19% in 2008, an increase of 102.4% over 11 years (despite total consumption growth of 32% over the same period) but was quite low in absolute terms (an increase of 169.862 GWh), despite the very great efforts deployed to promote renewable energy in Luxembourg. If total consumption had remained at the 1997 levels the share of renewables in national consumption would now be 5.54%)!

Trend in the proportion of electricity produced from renewable sources in relation to total electricity consumption in Luxembourg

(NB: Please see original for figures)



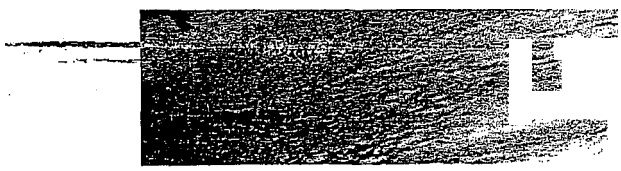
The IPCC methodology for calculating GHG emissions and the specific features of Luxembourg

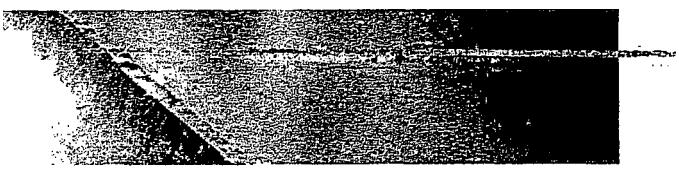
With regard to the commitments made by Luxembourg under the Kyoto Protocol on reducing emissions of greenhouse gases, it should be noted that the territorial principle of the IPCC method places Luxembourg in a very special situation, since taking into account, without exception, the quantities of motor fuels sold in Luxembourg is hardly favourable to our country in view of the disparity between the rates of duty applied in neighbouring countries and the rapid growth in transit traffic through our country.

On the other hand, this method provides that electricity imports are not recorded in the importing country, with the result that any electricity production, whether the electricity is consumed within or outside the country of production is recorded in the producer country

As a result of this IPCC methodology, the Twinerg 'turbine-gas-steam' plant and the development of cogeneration in Luxembourg automatically have adverse effects on the national CO2 emissions balance, whereas that same electricity previously generated by foreign power plants, which were often more polluting, previously had no effect on the emissions balance. Moreover, under the first national allocation plan established pursuant to Directive 2003/87/EC, the 'turbine-gas-steam' plant received quotas of 1.1 million tonnes of CO2. This represents over 30% of the total amount of quotas allocated to the sector of activities subject to quota trading.

The same applies to the use of renewable energy in Luxembourg instead of importing electricity. All these efforts deployed for a dozen of so years to promote renewable energy in the Grand Duchy have had a neutral effect on our national emissions balance and that is the major problem facing Luxembourg where electricity generation is concerned: **we are investing in renewable energy but these investments have no effect on our commitments vis-à-vis the Kyoto Protocol.**





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