

Ministry of Employment and the Economy
Energy Department
[Finland]

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**Finland's national action plan for promoting energy from renewable sources
pursuant to Directive 2009/28/EC**

1. SUMMARY OF NATIONAL POLICY ON RENEWABLE ENERGY

The main outlines of the approach to increasing the use of renewable energy are set out in the Long-term Climate and Energy Strategy submitted as a report to the Finnish Parliament in November 2008 (VNS 6/2008 vp). On account of the general development of the economy and the structural change taking place in the forestry industry, the government supplemented these outlines in April 2010. The general approach to increasing the use of renewable energy as primary energy is described below on a source-by-source basis, indicating the economic instruments to be used to promote each energy source.

In 2020 it is estimated that 56 TWh will be available in fuels dependent on forestry industry production (residual lyes and industrial wood waste). The estimate is based on the production of 13.7 m tons of paper and board. It is estimated that in the same year renewable energy sources yielding 77 TWh will be the subject of policy measures, as against 37 TWh in 2005. Final energy consumption in 2020 is estimated at 327 TWh.

1.1 Wind power

According to the Climate and Energy Strategy, wind power production will rise to 6 TWh by 2020. In order to promote wind power, there are plans to introduce a market-based feed-in tariff scheme in 2011, to be funded from the State budget. The feed-in tariff will be equivalent to the difference between the target price and the market price of electricity. The intention is to set the target price for electricity production as part of the feed-in tariff scheme at €83.50 per megawatt-hour. However, until the end of 2015 the target price for electricity produced from wind power would be €105.30 per megawatt-hour, on the basis of which the feed-in tariff would be paid for a maximum of three years. The feed-in tariff would be paid only to new wind power plants. A power plant receiving the feed-in tariff would not be eligible for any other State aid. The costs of the support scheme with a production of 6 TWh are estimated at around €23 m in 2011 and around €10 m in 2020, if the market price of electricity is €50 per megawatt-hour.

Wind power plants which were not covered by the feed-in tariff scheme would continue to receive a fixed subsidy of €6.90 per megawatt-hour.

€1.5 m per annum is to be earmarked for promoting the planning of construction of wind power capacity.

1.2 Wood chips/other energy from wood

At present the potential scope for logging is not being fully exploited.

The use of wood chips in CHP production and separate heat production will be increased to 13.5 million m³. This is equivalent to at least 28 TWh of fuel. In 2009 some 5 million m³ of wood chips were used. The target for use of wood chips in the Climate and Energy Strategy was 12 million m³ in 2020.

The bulk of the growth in the exploitation of forest energy should be achieved using small-sized wood and stumps, but of these, the harvesting costs of small-sized wood in particular are

currently too high for energy undertakings to afford. There is therefore a need for new forms of support to increase the use of forest energy.

In order to increase the use of forest energy, a three-part aid package has been devised which will increase the competitiveness of forest energy to a level at which the required growth can happen. The support package to be presented comprises energy support for small-sized wood, a feed-in tariff to compensate for the difference in costs between wood chips and alternative fuels, and a feed-in tariff for small CHP plants.

(a) Energy subsidies for small-sized wood

The existing subsidies under the Sustainable Forestry Financing Law ('Kemera') would remain as they are in other respects, but the subsidies would be restricted to cases where the remaining tree has a diameter of less than 13 cm at chest height (the present limit is 16 cm). Energy support for small-sized wood could be paid for all wood chips obtained from trees at first thinning and made available for energy use. The support would not be paid for use of timber as a material but only for energy use.

Restricting area support and harvesting support under the Kemera to trees with smaller diameters would be more effective than the current system in encouraging the performance of forestry management measures in good time. Energy support for small-sized wood would improve the viability of integrated wood harvesting during first thinning, so that it would also have a favourable impact on the supply of pulpwood to the forestry industry. In this way the system would also increase first thinning. According to an initial rough estimate, the costs of energy support for small-sized wood would be approximately €8 million under present conditions and approx. €6 million in 2020.

Arrangements for introducing energy support for small-sized wood are in preparation.

(b) Support for electricity production from wood chips (feed-in tariff)

The greatest problem in increasing forest energy is wood's poor competitiveness with fuels which cause carbon dioxide emissions while prices of carbon emission permits remain low, or in other words energy plants' inability to afford the forest energy to be obtained. At nearly all the power stations in Finland where wood is used, the 'ability to pay for wood' is calculated on the basis of the price of peat and the cost impact of emission permits for peat.

The effect of fluctuations in the price of emission permits can be stabilised by linking electricity production support to the price of emission permits, in which case the competitiveness of forest energy is guaranteed in relation to peat, irrespective of the price of emission permits. Variable production support for electricity would increase the proportion of the fuel for Finland's energy production accounted for by wood chips.

It is planned that production support for electricity produced from wood chips (a feed-in tariff) should be introduced from the beginning of 2011, as follows:

A market-based feed-in tariff scheme will be introduced, to be funded from the State budget. The support (feed-in tariff) will be paid for electricity produced using wood chips. The scale used to

determine the support would be such that when the cost of an emission permit was €10 per ton of CO₂, the support would be €18/MWh, and when the cost of an emission permit was €23 per ton of CO₂, the support would be €0/MWh. If the cost of an emission permit rose to €20 per ton of CO₂, the support would be less than the tax subsidy currently payable under the Electricity Tax Law (€6.90/MWh).

By means of production support it would be possible to obtain some 19 TWh from wood chips. With the current price of emission permits, the additional cost of the support would be more than €10 million per annum, as electricity generators would no longer receive tax subsidies under the Electricity Tax Law for electricity produced from wood chips. In 2011 the total cost of the support is estimated at €27 million, and in 2020 at around €2 million.

Electricity production from wood chips not covered by the feed-in tariff scheme would continue to benefit from a fixed subsidy of €6.90 per MWh.

It is intended that the use of coal to produce electricity and heat (currently around 15 TWh) should be partially (7-8 TWh) replaced with renewable biofuels. The work to determine the economic instruments to be used is under way, but the intention is to assess the feasibility of variable production support and investment subsidies.

(c) Feed-in tariff for small CHP plants

It is possible to use the heat loads of municipalities and industry more effectively by replacing heat boilers with small CHP units. However, the cost of generating electricity in small CHP plants is higher than the market price, and support is needed for the investment. A feed-in tariff scheme is used as an instrument to support small CHP units using wood fuel.

It is intended that a feed-in tariff for small CHP units should be introduced at the beginning of 2011 as follows:

A market-based feed-in tariff scheme will be introduced, to be funded from the State budget. The feed-in tariff will be equivalent to the difference between the target price and the market price of electricity. The target price for electricity produced using wood fuel at a power plant covered by the feed-in tariff scheme would be €83.50 per megawatt-hour. In CHP production, in addition, a heat premium of €20 per megawatt-hour would be paid for electricity produced from wood fuel by way of a supplement to the feed-in tariff. The maximum feed-in tariff would be limited per plant, and would not exceed €750 000 per annum for any one plant. The feed-in tariff would be paid only to new power plants. A power plant benefiting from the feed-in tariff would not be eligible for any other State aid. The intention is to channel aid so that it is most remunerative to new plants with a capacity of less than 3 MW and a thermal input of around 20 MW. The size category would correspond to the size limit for emissions trading.

The feed-in tariff for small CHP plants will facilitate as many as 60 new investments by 2020 and increase the use of wood fuel by 1-1.5 TWh. However, the increase in electricity generation secured in this way is estimated to be relatively small – some 0.2 TWh – on account of the low power to heat ratio of small CHP plants. The cost of the support scheme is estimated at around €3.75 million in 2011 and around €34 million in 2020 if the market price for electricity is €50 per MWh.

1.3 Other renewable energy sources

1.3.1 Hydro power

According to the Climate and Energy Strategy, hydro power production is to be increased by around 0.5 TWh per year of average water flow, to 14 TWh in 2020. The increase comprises increased capacity at existing power plants and small hydro power. Small hydro power is promoted by means of the existing investment support scheme (energy support). The Ministry of Employment and the Economy is drafting an amendment to the guidelines for granting support which will make it possible to grant support for plants of up to 10 MW, rather than the current maximum of 1 MW.

Electricity generated from hydro power will continue to benefit from a fixed subsidy of €4.20 per MWh.

1.3.2 Small-scale use of wood

The aim is to maintain the use of small-sized wood for heating purposes at its present level of 12 TWh. Improving the energy efficiency of buildings reduces the specific consumption of heating, as well as the amount of wood used on a small scale.

There are plans to increase the flexibility of demand on the electricity market by means of hourly metering. Hourly metering makes it possible to apply electricity tariffs which vary hour by hour. This provides incentives to use wood as a source of extra heating when the market price of electricity is high.

1.3.2.1 Heat pumps

Renewable energy production by heat pumps should be increased to 8 TWh by 2020. Measures to promote this are currently being prepared.

1.3.3 Transport biofuels

The use of transport biofuels is to be increased to 7 TWh by 2020. The target quoted in the Climate and Energy Strategy was still 5 TWh. Promotion of the use of biofuels would be based primarily on a distribution obligation incumbent on vendors of transport fuels. The aim is to set the biofuel distribution obligation as high as 20% (taking into account the double counting referred to in the RES Directive) in 2020. Use of biofuels will also be promoted by means of the tax reform which is being prepared.

In Finland it may be possible to construct capacity to produce between 120 000 and 150 000 tons of cereal-based bioethanol. This quantity could cover some 15% of the aforementioned 7 TWh target. Production would take place on a commercial basis, but it is estimated that some €120 million in investment could be financed by means of normal aid to businesses. One precondition for the support is that cereal-based bioethanol should comply with the sustainability criteria laid down in the RES Directive.

1.3.4 Biogas

According to the Climate and Energy Strategy, the use of biogas should be increased to 0.7 TWh by 2020. In order to promote CHP production using biogas (reactor plants) a market-based feed-in tariff scheme will be introduced, financed from the State budget. The feed-in tariff will be equivalent to the difference between the target price and the market price of electricity. The tariff will be paid only to new power plants. The target price for electricity produced from biogas covered by the feed-in tariff scheme would be €33.50 per MWh. In CHP production, in addition, a heat premium of €50 per megawatt-hour would be paid for electricity produced from biogas by way of a supplement to the feed-in tariff. The cost of the biogas electricity support scheme is estimated at around €2 million in 2011 and around €10 million in 2020 if the market price for electricity is €50 per MWh.

Electricity generated from biogas not covered by the feed-in tariff scheme will continue to benefit from a fixed subsidy of €4.20 per MWh.

Use of landfill gas will be promoted using the energy subsidy.

1.3.5 Pellets

The target for use of pellets is 2 TWh in 2020. Measures to promote this are currently being prepared.

1.3.6 Recycled fuels as part of renewables

The target for recycled renewables is 2 TWh. The use of recycled fuels is subsidised, *inter alia*, by means of a fixed subsidy payable on the basis of electricity generation at the rate of €2.40 per MWh.

1.3.7 Other small-scale renewables

Support for solar heating and solar power generation systems will continue with the aid of the energy subsidy in accordance with current practice. In the case of one-family houses, solar heating systems are promoted through the tax system by granting an offset for the household.

1.4 Other measures to promote forestry

1.4.1 Information about forest resources

In 2011, the use level of information about forest resources collected by forestry centres will be improved by introducing an electronic forest resources database which will be kept up to date. The database and the Metsään.fi service linked to it will make it possible for all owners of woods to consult information about the forest resources they own electronically and to make them available to other operators in the field, *inter alia*, to maintain the woods or to sell wood. This will substantially improve the use made of the information available.

1.4.2 Developing the wood market

The efficiency of wood sales will be improved by developing price statistics systems to make them more up-to-date, precise and comprehensive. Market information will be produced through a portal, so that parties will be able to access almost in real time price information on raw wood. More precise, up-to-date price information will help the wood market to function.

In addition, the possibilities will be examined for introducing rapidly in the wood trade new schemes for encouraging markets to take a longer-term view and compensate for fluctuations (such as the inclusion of price indexes in purchase contracts).

1.4.3 Developing measuring methods

A research and development project will be launched for measuring energy wood. The main aim of the project is to improve the reliability, practicality and comprehensiveness of methods of measuring energy wood which are already in use so that the various operators on the energy wood market accept them and that their use becomes an established commercial practice. It is intended to initiate a complete overhaul of the legislation on wood measurement, and this will include measuring of energy wood.

1.4.4 R&D

Support for R&D will focus on the harvesting of energy wood and development of transport technology.

2. ESTIMATED FINAL CONSUMPTION OF ENERGY IN 2010-2020

Estimated final consumption of energy in Finland for purposes of heating, cooling, electricity generation and transport in 2020 is shown in Table 1 in Annex 1, taking into account the impact of energy efficiency and energy saving measures between 2010 and 2020 (ktoe).

3. TARGETS AND DEVELOPMENT TRAJECTORIES FOR RENEWABLES

3.1 National overall target

Renewables as a proportion of total final energy consumption – the situation in 2005 and the national overall target set for 2020 (figures from Part A of Annex I to Directive 2009/28/EC) – are shown in Table 2 in Annex 1.

3.2 Sectoral targets and development trajectories

The national renewables target for 2020 and the estimated development trajectory in heating and cooling, electricity generation and transport are shown in Table 3 in Annex 1.

Estimates of the share of renewables in final energy consumption in each sector are shown in Table 4a in Annex 1.

Estimates of the share of renewables in transport are shown in Table 4b in Annex 1.

4. MEASURES TO ATTAIN THE TARGETS

4.1 Overview of all policies and measures to promote the use of renewables

Table 5

Overview of policies and measures (buildings only)

Name of measure & reference	Type of measure (*)	Anticipated outcome (**)	Target group and/or target activity (***)	In progress or planned	Start and end dates of measure
2012 regulations	Regulatory		Public administration, planners, architects	Preparation in progress	Energy requirements for new buildings should enter into force in 1/2012
Support schemes: household offset, energy assistance etc.	Financial		Final consumers	In progress	Ongoing activity
Provision of information by Motiva	Information guidance ('soft')		Investors, final consumers, public admin., planners, architects, fitters, general public, etc.	In progress	Ongoing activity
Fitters' certification scheme	Regulatory		Fitters	Planning in progress	Trial training scheme 9/2010, finalised training scheme 2012, ongoing activity in future
ERA 17 project	Information guidance		Investors, final consumers, public admin., planners, architects, fitters, general public, etc.	In progress	Drafting of action programme in 2010
Synergy house	Information guidance		Planners, architects	In progress	2009-2013

4.2.3 Buildings (Article 13(3) of Directive 2009/28/EC)

The estimated share of renewables in the buildings sector is shown in Table 6 in Annex 1.

4.6.1 Availability of biomass: both domestic capacity and imports

The availability of biomass in 2006 is shown in Table 7 in Annex 1.

The estimated domestic supply of biomass in 2015 and 2020 is shown in Table 7a in Annex 1.

The use of farmland to produce energy crops in 2006 is shown in Table 8 in Annex 1.

4.7.4 Estimated demand for energy from renewables to be met by means other than domestic production

The estimated volume exceeding and/or falling short of the normative development trajectory for energy production from renewables which could be transferred from Finland to other Member States or vice versa is shown in Table 9 in Annex 1.

5. ESTIMATES

5.1 Anticipated total contribution of the respective renewable energy technologies to attainment of the compulsory targets and normative development trajectory in 2020, as regards the shares of renewables in electricity generation, heating and cooling, and transport

An estimate of the anticipated total contribution of the respective renewable energy technologies (installed capacity, total electricity generation) to attainment of the compulsory targets and normative development trajectory in Finland in 2020, as regards the share of renewables in electricity generation in 2010-2014 is shown in Table 10a in Annex 1.

An estimate of the anticipated total contribution of the respective renewable energy technologies (installed capacity, total electricity generation) to attainment of the compulsory targets and normative development trajectory in Finland in 2020, as regards the share of renewables in electricity generation in 2015-2020 is shown in Table 10b in Annex 1.

An estimate of the anticipated total contribution of the respective renewable energy technologies (final energy consumption) to attainment of the compulsory targets and normative development trajectory in Finland in 2020, as regards the share of renewables in heating and cooling in 2010-2020 is shown in Table 11 in Annex 1.

An estimate of the anticipated total contribution of the respective renewable energy technologies to attainment of the compulsory targets and normative development trajectory in Finland in 2020, as regards the share of renewables in transport in 2010-2020 is shown in Table 12 in Annex 1.

Table 1

Finland's expected gross final energy consumption in heating and cooling, electricity and transport up to 2020 taking into account the effects of energy efficiency and energy saving measures 2010-2020 (ktoe)

	2005 Base year	2010 Additional energy efficiency	2011 Additional energy efficiency	2012 Additional energy efficiency	2013 Additional energy efficiency	2014 Additional energy efficiency	2015 Additional energy efficiency	2016 Additional energy efficiency	2017 Additional energy efficiency	2018 Additional energy efficiency	2019 Additional energy efficiency	2020 Additional energy efficiency
1) Heating and cooling	13970	14010	14380	14540	14670	14830	15000	15080	15120	15170	15260	15300
2) Electricity	7530	7550	7770	7880	7990	8100	8210	8310	8400	8500	8640	8740
3) Transport as in Article 3(4)(a)	4220	4030	4060	4060	4080	4090	4100	4110	4150	4150	4120	4080
4) Gross final energy consumption	26260	25730	26330	26610	26860	27140	27420	27600	27770	27910	28080	28170

Table 2

National overall target for the share of energy from renewable sources in gross final consumption of energy in 2005 and 2020 (figures to be transcribed from Annex I, part A of Directive 2009/28/EC):

A) Share of energy from renewable sources in gross final consumption of energy in 2005 (S2005) (%)	28.5%
B) Target of energy from renewable sources in gross final consumption of energy in 2020 (S2020) (%)	38%
C) Expected total adjusted energy consumption in 2020 (from Table 1, last cell) (ktoe)	28170
D) Expected amount of energy from renewable sources corresponding to the 2020 target (calculated as B x C) (ktoe)	10700

Table 3

National 2020 target and estimated trajectory of energy from renewable sources in heating and cooling, electricity and transport

Renewable energy %

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Heating and cooling	40%	37%	39%	40%	41%	42%	42%	43%	44%	45%	46%	47%
Electricity	27%	26%	26%	26%	27%	27%	27%	28%	29%	30%	32%	33%
Transport	0%	6%	7%	8%	10%	11%	12%	14%	15%	17%	18%	20%
Overall share	28.8%	28.7%	30.1%	31.0%	31.6%	32.2%	32.6%	33.6%	34.7%	35.7%	36.8%	38.0%
<i>Of which from cooperation mechanism (%)</i>	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<i>Surplus for cooperation mechanism</i>	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

As part B of Annex I of the Directive	2011-2012	2013-2014	2015-2016	2017-2018	2020
	S 2005 + 20% (S 2020-S 2005)	S 2005 + 30% (S 2020-S 2005)	S 2005 + 45% (S 2020-S 2005)	S 2005 + 65% (S 2020-S 2005)	S 2020
RES minimum trajectory	30.4%	31.4%	32.8%	34.7%	38.0%
RES minimum trajectory (ktoe)	8050	8460	9020	9650	10700

Table 4a

Calculation table for the renewable energy contribution of each sector to final energy consumption (ktoe)

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
A) Expected gross final consumption of RES for heating and cooling	5530	5210	5630	5870	6040	6190	6340	6510	6680	6860	7070	7270
B) Expected gross final consumption of electricity from RES	2030	1950	2040	2080	2120	2160	2200	2330	2460	2590	2730	2870
C) Expected RES consumption in transport*	0	220	260	300	340	380	410	450	480	510	540	560
D) Expected total RES consumption	7560	7380	7930	8250	8500	8730	8950	9280	9620	9970	10330	10700
E) Expected transfer of RES to other Member States	0	0	0	0	0	0	0	0	0	0	0	0
F) Expected transfer of RES from other Member States and 3rd countries	0	0	0	0	0	0	0	0	0	0	0	0
G) Expected RES consumption adjusted for target (D)-(E)+(F)	7560	7380	7930	8250	8500	8730	8950	9280	9620	9970	10330	10700

* Renewable electricity for transport is included under B) (Electricity).

Table 4b

Calculation table for the renewable energy in transport share (ktoe)

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
C) Expected RES consumption in transport	20	230	280	320	360	400	440	470	510	540	570	600
H) Expected RES electricity in road transport	0	0	0	0	0	0	0	0	10	10	10	10
I) Expected consumption of biofuels from wastes, residues, non-food cellulosic and lignocellulosic material in transport	0	0	10	20	30	50	70	90	110	140	160	180
J) Expected RES contribution to transport for the RES-T target: (C)+(2.5-1)x(H)+(2-1)x(I)	20	230	290	340	390	450	510	570	630	690	750	800

Table 6

Estimated share of renewable energy in the building sector (%)

	2005	2010	2015	2020
Residential	39%	46%	58%	68%
Services sector - total	15%	18%	26%	38%
Industrial	n/a	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a

Table 7
Biomass supply in 2006

Sector of origin	Amount of domestic resource ²⁶⁾ Biomass as a source of energy	Imported		Exported	Net amount	Primary energy production (ktoe)
		EU	Non-EU	EU/Non-EU		
A) Biomass from forestry ²⁷⁾	<i>Of which:</i>					
	1. Direct supply of wood biomass from forests and other wooded land for energy generation					
	<i>Optional - if information is available you can further detail the amount of feedstock belonging to this category:</i>					
	a) fellings	0				
	b) residues from fellings (tops, branches, bark, stumps)					
	b1) tops, branches	1.7 million m ³				287 ktoe
	b2) stumps and rhizomes	0.5 million m ³				96 ktoe
	c) landscape management residues (woody biomass from parks, gardens, tree rows, bushes)	0				
	d) other (please define)					
	d1) management of newly planted saplings, thinnings (small-sized wood)	0.7 million m ³				119 ktoe
	d2) firewood for one-family houses	5.2 million m ³				908 ktoe
	d3) large trunks	0.2 million m ³				36 ktoe
	2. Indirect supply of wood biomass for energy generation					
	<i>Optional - if information is available you can further detail:</i>					
	a) residues from sawmilling, woodworking, furniture industry (bark, sawdust)	11.7 million m ³				1 839 ktoe
	b) by-products of the pulp and paper industry (black liquor, tall oil)					3 821 ktoe
	c) processed wood-fuel	259 000 t	0	0	193 000 t	
d) post-consumer recycled wood (recycled wood for energy generation, household waste wood)						
d2) recycled wood burned in households	1.0 million m ³				167 ktoe	
e) other (please define)						

B) Biomass from agriculture and fisheries:	Of which:					
	1. Agricultural crops and fishery products directly provided for energy generation					
	<i>Optional - if information is available you can further detail:</i>					
	a) arable crops (cereals, oilseeds, sugar beet, silage maize)	oats 233 ha spring turnip rape 521 ha				0.00113 ktOE 0.00074 ktOE
	b) plantations					
	c) short rotation trees					
	d) other energy crops (grasses)					
	e) algae					
	f) other (please define)	reed canary grass 13 500 ha				31.5 ktOE
	2. Agricultural by-products / processed residues and fishery by-products for energy generation					
	a) straw					
	b) manure					
	c) animal fat	8.35 million kg. In addition, the fat from processed carcasses recovered in fur animal processing plants at a rate of 20-28% totals around 6.8 million kg.				total 13.38 ktOE
	d) meat and bone meal	22 million kg. In addition, the pulp (not meat and bone meal but rather moist matter) from processed carcasses recovered in fur animal processing plants at a rate of 65-80% totals around 21 million kg.				9.46 ktOE; 9.02 ktOE (pulp)
e) cake by-products (incl. oil seed and olive oil cake for energy)						
f) fruit biomass (including shell, kernel)						
g) fishery by-products						
h) clippings from vines, olive trees, fruit trees						
i) other (please define)						
C) Biomass from waste:	Of which:					
	1. Biodegradable fraction of municipal solid waste including biowaste (biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants) and landfill gas					
	2. Biodegradable fraction of industrial waste (including paper, cardboard, pallets)					
	3. Sewage sludge					

²⁶⁾ Amount of the resource in m³ (if possible, otherwise in appropriate alternative units) for category A and its subcategories and in tonnes for categories B and C and their subcategories.

²⁷⁾ Biomass from forestry should also include biomass from forest-based industries. Under the category of biomass from forestry processed solid fuels, such as chips, pellets and briquettes should be included in the corresponding subcategories of origin.

- *¹) Other fuel includes recycled wood, wood pellets and briquettes and other solid fuels.
- *²) Other fuel includes recycled wood, wood pellets and briquettes and other solid fuels.
- *³) Other forestry by-products include pine and birch oil, soap, methanol, biosludge and paper.

Table 9

Estimated excess and/or deficit production of renewable energy compared to the indicative trajectory which could be transferred to/from other Member States in Finland (ktoe)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Estimated excess in forecast document	0	0	0	0	0	0	0	0	0	0	0
Estimated excess in NREAP	0	0	0	0	0	0	0	0	0	0	0
Estimated deficit in forecast document	0	0	0	0	0	0	0	0	0	0	0
Estimated deficit in NREAP	0	0	0	0	0	0	0	0	0	0	0

Tables 10a and 10b

Estimation of total contribution expected from each renewable energy technology in Finland to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in electricity

Installed capacity (MW)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	3040	3050	3050	3050	3050	3050	3050	3060	3070	3080	3090	3100
<1 MW	30	30	30	30	30	30	30	30	30	30	30	30
1 -10 MW	280	280	280	280	280	280	280	280	280	280	280	280
>10MW	2730	2750	2750	2750	2750	2750	2750	2750	2760	2770	2780	2790
Of which pumping	0	0	0	0	0	0	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0	0	0	0	0	0	0
Solar	0	0	0	0	0	0	0	0	0	10	10	10
photovoltaic	0	0	0	0	0	0	0	0	0	10	10	10
concentrated solar power	0	0	0	0	0	0	0	0	0	0	0	0
Tide, wave, ocean	0	0	0	0	0	0	10	10	10	10	10	10
Wind	80	170	280	380	480	580	670	1060	1440	1800	2160	2500
onshore	80	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
offshore	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Biomass	2140	1790	1980	2040	2090	2150	2200	2320	2450	2600	2740	2920
solid	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
biogas	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
bioliquids	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total	5260	5010	5310	5480	5640	5790	5940	6450	6970	7490	8000	8540
of which in CHP	2030	1690	1870	1930	1980	2030	2080	2190	2320	2460	2590	2760
Gross electricity generation (GWh)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	13910	14210	14210	14210	14210	14210	14210	14250	14290	14330	14370	14410
<1 MW	140	150	150	150	150	150	150	150	150	150	150	150
1 -10 MW	1260	1290	1290	1290	1290	1290	1290	1290	1290	1300	1300	1310
>10MW	12510	12780	12780	12780	12780	12780	12780	12810	12850	12890	12920	12960
Of which pumping	0	0	0	0	0	0	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0	0	0	0	0	0	0
Solar	0	0	0	0	0	0	0	0	0	0	0	0
photovoltaic	0	0	0	0	0	0	0	0	0	0	0	0
concentrated solar power	0	0	0	0	0	0	0	0	0	0	0	0
Tide, wave, ocean	0	0	0	0	0	0	0	0	0	0	0	0
Wind	150	360	590	820	1060	1290	1520	2440	3350	4260	5180	6090
onshore	150	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
offshore	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Biomass	9660	8090	8910	9200	9420	9650	9880	10370	10930	11550	12150	12910
solid	9640	3930	4520	4760	4940	5120	5300	5730	6240	6810	7350	7860
biogas	20	40	40	40	50	50	50	60	60	70	70	270
bioliquids	included in solid biomass	4120	4350	4390	4440	4480	4530	4580	4630	4680	4730	4780
Total	23730	22660	23710	24230	24690	25150	25620	27060	28580	30150	31710	33420
of which in CHP	8480	7980	8480	8750	8980	9210	9430	9900	10440	11040	11620	12340

Table 11

Estimation of total contribution (final energy consumption) expected from each renewable energy technology in Finland to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in heating and cooling 2010-2020 (ktoe)

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Geothermal	0	0	0	0	0	0	0	0	0	0	0	0
Solar	0	0	0	0	0	0	0	0	0	0	0	0
Biomass	5490	4990	5310	5470	5580	5700	5810	5950	6100	6250	6440	6610
solid	5450	2710	2910	3040	3130	3220	3300	3410	3540	3660	3820	3940
biogas	40	30	30	30	30	30	30	30	30	30	30	60
bioliquids	included in solid biomass	2240	2370	2400	2420	2450	2470	2500	2530	2560	2580	2610
Heat pumps	40	230	320	400	450	490	530	560	590	610	630	660
Total	5530	5210	5630	5870	6040	6190	6340	6510	6680	6860	7070	7270
Of which DH	830	510	610	660	710	750	800	870	960	1050	1140	1260
Of which biomass in households	1110	1010	1030	1050	1060	1070	1080	1090	1090	1090	1100	1100

Table 12

Estimation of total contribution expected from each renewable energy technology in Finland to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in the transport sector 2010-2020 (ktoe)

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Bioethanol	0	70	80	90	100	110	120	120	120	130	130	130
Of which biofuels Article 21(2)	0	0	0	10	10	10	20	20	30	30	40	40
Of which imported	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Biodiesel	0	150	180	210	240	270	300	330	360	390	410	430
Of which biofuels Article 21(2)	0	0	10	10	20	40	50	60	80	100	120	140
Of which imported	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hydrogen from renewables	0	0	0	0	0	0	0	0	0	0	0	0
Renewable electricity	20	20	20	20	20	20	20	20	30	30	30	40
Of which road transport	0	0	0	0	0	0	0	0	10	10	10	10
Of which non-road transport	20	20	20	20	20	20	20	20	20	20	20	20
Others (such as biogas, vegetable oils, etc.)	0	0	0	0	0	0	0	0	0	0	0	0
Of which biofuels Article 21(2)	0	0	0	0	0	0	0	0	0	0	0	0
Total	20	230	280	320	360	400	440	470	510	540	570	600