

APPROVED
by the Cabinet of Ministers of Ukraine
Executive Order
No. 902-p of 1 October 2014

NATIONAL RENEWABLE ENERGY
ACTION PLAN
UP TO 2020

Ukraine is an energy-scarce country, importing about 70 percent of its own natural gas consumption. At the same time, energy intensity of its domestic economy is 3-4 times higher than the relevant figure of economically developed countries, which renders Ukraine extremely sensitive to the natural gas importation conditions and makes it impossible to guarantee normal conditions of the vital activity of people and budget-funded institutions.

Utilisation of renewable energy sources is one of the most crucial areas in Ukraine's energy policy aimed at saving conventional fuel and energy resources and improving environmental conditions. Increasing the use of renewable energy sources in Ukraine's energy balance will allow raising the degree of energy carrier sources diversification, thereby promoting the country's stronger energy independence.

At present, the annual technically achievable energy potential of renewable energy sources in Ukraine, as calculated by the Institute of Renewable Energy of the National Academy of Sciences, reaches 68.6 m t of oil equivalent, that being about 50 percent of overall energy consumption in Ukraine. Key areas of renewable energy sources use in Ukraine are as follows: wind energy, solar energy, river energy, biomass energy, geothermal energy, and environmental energy using heat pumps.

As of the end of the first half of 2014, overall electrical capacity of renewable energy facilities working under the feed-in tariff in Ukraine was 1,419 MW, including wind – 497 MW, solar – 819 MW, small hydro – 77 MW, biomass and biogas – 26 MW. Installed capacity of the facilities producing heat from renewable energy sources is greater than 1,070 MW.

The year of 2013 became generally emblematic for the domestic renewable energy that not only maintained but also substantially accelerated its development rates. For example, it was 2013 when installed capacity of renewable energy facilities almost doubled to exceed 1 GW whereas annual production of electricity from renewable sources exceeded 1 billion kWh already in September. The first contract for delivery of Ukrainian-made wind generators to Kazakhstan was signed.

The rapid and positive development dynamics of the renewable energy sector has resulted from a consistent and prudent state policy aimed at developing the use of renewable energy sources, which ensures greater environmental and energy security, development of industry and diversification of energy sources.

To encourage development of renewable energy and use of renewable energy sources and alternative fuels in Ukraine, the Tax and Customs Codes of Ukraine contain provisions that envisage:

land tax reduction for renewable energy enterprises;

tax exemption of:

- operating profits of the energy companies producing electricity from renewable sources;

- biofuel producers' profits earned from biofuel sales;

- company profits earned from combined electricity and heat production and/or production of heat using biological fuel types;

- profits of producers of machines, equipment and devices for the manufacture and reconstruction of technical and transport means consuming biological fuel types;

value-added tax exemption for the transactions related to importation to Ukraine's customs territory of equipment working on renewable energy sources, equipment and materials for production of alternative fuels or for production of energy from renewable sources, as well as import duty exemption for the above-mentioned equipment and materials.

Besides, the Law of Ukraine on Electric Power Engineering envisages setting a feed-in tariff at which electricity produced by electric power facilities from alternative energy sources is purchased (except blast-furnace and coke-oven gas; and with the use of hydro energy – produced only by micro-, mini- and small hydropower plants).

The Cabinet of Ministers of Ukraine Executive Order No. 1071 of 24 July 2013 approved the updated Energy Strategy of Ukraine up to 2030.

The Energy Strategy of Ukraine up to 2030 specifies that adoption of renewable energy sources is an important factor for raising the energy security level and for reducing the energy sector's environmental anthropogenic impact. Large-scale utilisation of the renewable energy sources' potential in Ukraine is not only of domestic but also of great international importance as a weighty factor for counteraction to global climate change in general and for improvement of the overall energy security of Europe. According to the basic scenario in the Strategy, electricity demand in Ukraine in 2030 will be 50 percent higher than the 2010 level. It will be mainly caused by greater electricity consumption in industry (+55 percent) and in services (+100 percent). Such a forecast of electricity consumption was developed with account of effects ensuing from implementation of energy saving measures. The Strategy provides for increasing the share of renewable energy sources in the total balance of installed capacities up to about 20 percent by 2020, which under the basic scenario is 12.1 GW (including large hydro) whereas electricity production is 25 TWh. The basic electricity demand scenario envisages about 40 percent decrease in the gross domestic product's electric intensity.

According to the basic scenario, total heat consumption in 2030 is to increase to 271 m Gcal. In the basic scenario of the transport fleet development, aggregate domestic demand for main light oil products in 2030 will be about 17.4 m t (including 6.3 m t of petrol, 10.1 m t of diesel fuel, and 1 m t of kerosene) whereas electricity consumption in transport will reach 14 bn kWh. To achieve such indicators, fuel consumption efficiency needs to be raised by 25-30 percent.

The indicators suggested in the Strategy and energy efficiency measures envisaged therein were used in this National Action Plan for calculations of various scenarios of energy consumption in Ukraine up to 2020 (Annex 1).

In September 2010, the Protocol concerning the Accession of Ukraine to the Treaty Establishing the Energy Community was signed; later it was ratified by the Law of Ukraine on the Ratification of the Protocol concerning the Accession of Ukraine to the Treaty Establishing the Energy Community (15 December 2010). According to the Law, Ukraine became a full member of the Energy Community since 1 February 2011.

In October 2012, the Ministerial Council of the Energy Community approved Decision D/2012/04/MC-EnC on the implementation of Directive 2009/28/EC and amending Article 20 of the Energy Community Treaty, pursuant to which each Contracting Party shall bring into force the laws, regulations and administrative provisions necessary to comply with Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

The above-mentioned Directive 2009/28/EC sets mandatory national targets for renewable energy, first of all to provide certain guarantees to investors and encourage development of novel technologies and innovations in this field. Therewith, it contains rather strict requirements to the criteria of sustainable production of biofuels and reduction of greenhouse gas emissions. Pursuant to Decision D/2012/04/MC-EnC, Ukraine undertook to achieve by 2020 the 11 percent share of energy from renewable sources in its gross final consumption of energy, which will provide a powerful stimulus for further development of the use of renewable energy sources in Ukraine.

Ukraine's national targets in renewable energy are presented in Annex 2, and the estimated trajectory for the growing share of energy from renewable sources in gross final consumption is provided in Annex 3.

Membership in the Energy Community provides Ukraine opportunities for implementation in its domestic market of greater competition, European technical standards and transparent regulation rules, and a better investment climate. It also means deeper integration of the Ukrainian energy sector in the Member State markets, and stronger energy security of Ukraine itself. The membership also provides a benefit of additional opportunities for the Member States to engage international credits and technical assistance.

Considering the commitments assumed by Ukraine in joining the Energy Community, the Government-approved policy documents on energy (in particular, the State Target Economic Programme on Energy Efficiency and Development of Production of Energy Carriers from Renewable Energy Sources and Alternative Fuels for 2010-2015, and the Energy Strategy of Ukraine up to 2030), and renewable energy development dynamics in the country, achievement of mandatory targets is expected in the following areas.

Hydro energy

The current capacity of small hydro energy facilities is about 75 MW. Because of its minor share in the overall energy balance, small hydro energy cannot substantially impact the country's energy supply structure now. However, natural potential of their development has not been realised in full yet. Ukraine possesses considerable potential for using small river resources, particularly in its western regions.

If the hydro potential of small Ukrainian rivers is used, then a considerable saving of fuel and energy resources can be achieved, and development of small hydro energy will promote decentralisation of the overall energy system, thereby allowing a number of problems to be addressed in energy supply to remote and hard-to-reach rural areas.

Micro-, mini- and small hydropower plants can become a strong foundation for energy provision to all regions of the western Ukraine, and a source of full energy provision to some districts in Zakarpattia and Chernivtsi oblasts.

To address the small hydro energy development issues, Ukraine possesses a sufficient scientific and technological potential and considerable experience in the field of design and development of hydro turbine equipment structures. Domestic enterprises have necessary production facilities to supply such hydropower plants with Ukrainian-made equipment.

If existing capacities are upgraded, formerly active small hydropower plants are restored, and new hydro energy generating capacities are commissioned, the following production of electricity can be ensured in Ukraine:

micro- and mini-hydropower plants – up to 75 GWh in 2015 (total capacity 33 MW) and up to 130 GWh in 2020 (total capacity 55 MW);

small hydropower plants – up to 140 GWh in 2015 (total capacity 65 MW) and up to 210 GWh in 2020 (total capacity 95 MW);

large hydropower plants – up to 12,000 GWh in 2015 (total capacity 4,800 MW) and up to 13000 GWh in 2020 (total capacity 5,200 MW).

Solar energy

Average annual quantity of solar radiation energy arriving at the territory of Ukraine varies between 1,070 kWh/m² in its northern part to 1,400 kWh/m² and more in its southern part and in the Autonomous Republic of Crimea.

Photovoltaic equipment can be efficiently operated throughout the year, however the highest operation efficiency is achieved during seven months per year (from April to October) in the southern regions and during five months per year (from May to September) in the northern regions. Findings of various studies show that the reasonable installed capacity of solar energy in Ukraine is about 4 GW.

Conversion of solar energy into electricity in the Ukrainian conditions should be done first of all with the use of photovoltaic devices. Availability of considerable resource stocks, an industrial and scientific and technological base for production of photovoltaic devices can fully satisfy not only the domestic consumers' needs but also provide more than two-thirds of the products for export deliveries.

Considering experience of implementation of solar power plants in European countries with a similar solar radiation level, as well as in view of world tendencies of

continuous decrease in the costs of construction of solar power plants due to technology development, production of electricity in Ukraine can be increased by means of improving technologies and commissioning new capacities up to 1,050 GWh in 2015 (total capacity 1,000 MW) and up to 2,420 GWh in 2020 (total capacity 2,300 MW).

Wind energy

Ukraine has a considerable potential for wind energy development. Most promising for wind energy development are the country's southern and southeastern regions where the average wind velocity at the height of the rotor axis of modern wind power plants reaches 7 mps and higher. However, this potential is almost not utilised today. As of early 2014, wind power plants with total installed capacity of about 340 MW are operating in Ukraine.

At the same time, a potential economically reasonable installed capacity of the wind energy sector in Ukraine reaches 15 GW. However, construction of wind power plants with such capacity requires more than 200 bn hryvnias of investments.

Based on the experience of most European countries in implementation of wind power plants, production of electricity in Ukraine can be increased by means of using more powerful wind generators and commissioning new capacities up to 2,400 GWh in 2015 (total capacity 1,000 MW) and up to 5,900 GWh in 2020 (total capacity 2,280 MW).

Bioenergy

The bioenergy segment in Ukraine has almost the greatest development potential. This is caused by climate specificities, agricultural potential and availability of necessary manpower. The largest energy potential in Ukraine is represented by such types of biomass as agricultural crops, wooden residues, liquid fuels from biomass, a biological component of solid municipal waste, and biogas. According to various estimates, a potential installed capacity in the bioenergy segment is 15 GW.

However, realisation of the available bioenergy potential is complicated by the fact that the infrastructure and the raw material base are not developed while they are necessary to ensure smooth deliveries of raw materials; by a low level of development of industries supplying equipment; and by a small amount of each individual facility's generation. Therefore, biomass-based electricity production dynamics lags behind electricity generation from other renewable sources. However, the use of biomass can become an important component in the heat production balance. Therewith, an important part must be played by the implementation of stimulating tariff setting for heat generation from renewable sources and by the development of an energy biomass market in Ukraine.

Based on the experience of European countries with a similar bioenergy potential in implementation of bioenergy plants, as well as in view of decrease in the costs of construction of bioenergy plants due to technology improvement, production of electricity from biomass in Ukraine can be increased by means of building and commissioning new biogeneration capacities up to 1,100 GWh in 2015 (total capacity 250 MW) and up to 4,220 GWh in 2020 (total capacity 950 MW).

Geothermal energy

Ukraine has a certain potential for development of geothermal energy. This is due to the country's thermogeological features of relief and specificities of its geothermal resources. However, currently in Ukraine scientific, geological prospecting and practical works focus only on geothermal resources represented by thermal waters. According to various estimates, the economically reasonable energy resource of thermal waters in Ukraine is up to 8.4 m t of oil equivalent per year.

Ukraine has enough geothermal deposits with a high temperature potential (120—180°C), enabling the use of geothermal heat for electricity production.

Practical development of thermal waters in Ukraine is carried out in the Autonomous Republic of Crimea where 11 geothermal circulation systems have been built, compliant with modern technologies of extraction of geothermal heat of the earth. All the geothermal installations are in an experimental industrial phase.

Large thermal water deposits were found in Chernihiv, Poltava, Kharkiv, Luhansk and Sumy oblasts. Hundreds of wells with thermal water, now suspended, can be renewed for further operation as geothermal heat extraction systems.

When calculating the possible consumption amounts of low-temperature geothermal resources in geoclimatic conditions of various regions of Ukraine, one should consider that their intense operation can lead to decrease in the soil mass temperature and to their fast depletion. It is necessary to maintain a rate of geothermal energy use that would allow operating a source of energy resources without any harm to environment. For each region of Ukraine, there exists a certain maximum intensity of geothermal energy extraction that can be maintained for a long period of time.

Based on the experience of European countries in implementation of geothermal power plants, production of electricity by geothermal units in Ukraine can be ensured by means of commissioning new capacities in the amount of 44 GWh in 2015 (total capacity 8 MW) and 120 GWh in 2020 (total capacity 20 MW).

Using the energy carriers from renewable sources in transport

In the transport sector, no tendency can be seen so far towards any considerable increase in the use of energy carriers from renewable sources. At present, there is no industry-scale production of biodiesel in Ukraine. According to various data, production of biodiesel fuel is about 20,000 t per year (mainly by farmers at low-capacity equipment and for their own needs).

In 2012, the Law of Ukraine on Amending Some Laws of Ukraine Concerning Production and Use of Motor Fuels Containing Biocomponents was adopted, according to which a mandatory bioethanol content in motor petrols produced and/or sold in Ukraine was introduced. To comply with the Law, about 250 thousand t of bioethanol must be produced. However, its current production is about 50 thousand t per year.

The estimated share of renewable energy in transport up to 2020 is presented in Annex 4.

The renewable energy contributions of electricity, heating and cooling, and transport to final energy consumption are shown in Annex 5.

Given active development of generation based on renewable energy sources (Annex 6), mechanisms should be envisaged to ensure increase of maneuvering capacities. Therewith, installed capacity of renewable energy sources should be enlarged within the limits technologically admissible for maintenance of reliable work of Ukraine's energy system. When increasing production of electricity based on renewable sources, grids should be upgraded to so-called smart grids. In case production of electricity from renewable sources is increased, the system operator of Ukraine's Unified Energy System must ensure fulfilment of the daily load curve with account of the most efficient and safest use of all types of generation. An effective mechanism for regulation of RES capacities (particularly wind and solar plants) can be provided by the use of regulator consumers based on heat pumps, heat accumulators, or similar technology.

To solve the problem of shortage of maneuvering and regulating capacities, construction of hydro and pump storage capacities. Priority projects are as follows:

- completion of the first stage of Dniester PSPP and the first stage of Tashlyk PSPP by 2015;

- construction of the second stage of Tashlyk PSPP and the second stage of Dniester PSPP by 2020;

- continuation of construction of 1,000 MW Kaniv PSPP, and start-up of its first hydro unit in 2015;

- completion of designing of 270 MW Kakhovka HPP by 2014, and its enlargement by 2020;

- reconstruction and enlargement of Tereble-Rikska HPP with 30 MW capacity increase by 2020.

Separate attention should be paid to the necessity of developing and implementing effective mechanisms for people's investment involvement in a wider use of renewable energy sources.

Key indicators of the National Renewable Energy Action Plan up to 2020 are provided in Annexes 1-8.

Considering that the share of energy from renewable sources in gross final energy consumption in 2009 was 3.8 percent, this National Action Plan envisages achievement of the following national overall targets:

- target of energy from renewable sources in gross final consumption of energy in 2020 – 11 percent;

- expected total adjusted energy consumption in 2020 – 78,080 thousand toe;

- expected amount of energy from renewable sources corresponding to the 2020 target – 8,590 thousand toe.

Besides, this National Action Plan sets sectoral targets and provides calculation of their achievement trajectories (Annex 1).

Expected final consumption of energy was calculated according to the Energy Strategy of Ukraine up to 2030. For the 2015-2020 level, indicative figures of the basic electricity development scenario were used; for interim values of heating and cooling,

transport and energy efficiency, forecasted data of the basic scenario up to 2030 were used.

Full-scale realisation of provisions of this National Action Plan will allow:

enhancing the level of Ukraine's energy independence;

increasing the share of energy carriers from renewable sources in the structure of Ukraine's total final energy consumption in 2020 to at least 11 percent;

optimising the structure of Ukraine's fuel and energy balance, particularly ensuring reduction of the use of conventional energy carriers by 35 m toe by 2020;

improving the mechanism of public management and regulation in the field of renewable energy sources;

ensuring wider involvement of intellectual property entities in the process of development of renewable energy sources;

raising competitiveness of the national economy;

improving the ecological situation in the country by reducing atmospheric emissions of harmful substances created in combustion of organic fuel;

raising the development level of production of energy carriers from renewable sources up to the European Union requirements and the Energy Charter provisions;

ensuring renovation of fixed assets in Ukraine's energy sector;

creating jobs in the energy sector and other industries.

EXPECTED GROSS FINAL ENERGY CONSUMPTION
up to 2020 under reference and additional energy efficiency scenarios

(ktoe)

Energy consumption sector	2009	2014		2015		2016		2017		2018		2019		2020	
	base year	reference scenario	additional energy efficiency												
Heating and cooling	43 640	47 790	45 570	48 620	45 910	49 510	46 280	50 460	46 680	51 460	46 800	52 520	46 950	53 780	47100
Electricity	13 791	17 390	16 780	17 890	17 110	18 400	17 440	18 930	17 770	19 470	18 100	20 030	18 930	20 710	20300
Transport	8 943	9 620	9 260	9 950	9 480	10 290	9 700	10 650	9 930	11 030	10 170	11 440	10 420	11 910	10 680
Gross final energy consumption	66 374	74 800	71 610	76 460	72 500	78 200	73 420	80 040	74 380	81 960	75 070	83 990	76 300	86 400	78 080

- Notes:
1. The additional energy efficiency scenario means the energy consumption scenario considering impact of energy efficiency and energy saving measures.
 2. The final energy consumption in heating and cooling includes consumption of heat for own use at electricity and heat plants and heat losses in network.
 3. The gross electricity consumption comprises total electricity production, including autoproduction, and electricity imports (minus electricity exports and electricity use in transport).
 4. The gross final energy consumption comprises final energy consumption, network losses, own use of energy at electricity and heat plants (except consumption of electricity by pumped hydro storage plants for transformation in electrical boilers or heat pumps at district heating plants, as defined in Article 2(f) of Directive 2009/28/EC).

Annex 2
to the National Action Plan

NATIONAL TARGET
for the share of energy from renewable sources in gross final consumption of energy
up to 2020 in heating and cooling, electricity and transport

Uses of energy from renewable sources	2009	2014	2015	2016	2017	2018	2019	2020
Renewable energy sources in heating and cooling ¹	3.4	5.7	6.7	7.7	8.9	10.0	11.2	12.4
Renewable energy sources in electricity ²	7.1	7.6	8.3	8.8	9.7	10.4	10.9	11
Renewable energy sources in transport ³	1.5	4.1	5	6.5	7.5	8.2	9	10
Overall share of renewable energy sources ⁴ , of which:	3.8	5.9	6.7	7.4	8.3	9.1	10.1	11
from cooperation mechanism								
surplus for cooperation mechanism								

¹ Share of renewable energy in heating and cooling: gross final consumption of energy from renewable sources for heating and cooling (as defined in Articles 5(1)b and 5(4) of Directive 2009/28/EC) divided by gross final consumption of energy for heating and cooling.

² Share of renewable energy in electricity: gross final consumption of electricity from renewable sources for electricity (as defined in Articles 5(1)a) and 5(3) of Directive 2009/28/EC) divided by total gross final consumption of electricity.

³ Share of renewable energy in transport: final energy from renewable sources consumed in transport (as defined in Article 5(1)c) and 5(5) of Directive 2009/28/EC) divided by the consumption of petrol, diesel, biofuels used in road and rail transport, and electricity in land transport.

⁴ Share of renewable energy in gross final energy consumption.

ESTIMATED TRAJECTORY
for the growing share of energy from renewable sources in gross final consumption
of energy in heating and cooling, electricity and transport

Indicator of the growing share of energy from renewable sources	2011—2012	2013—2014	2015—2016	2017—2018	2020
RES minimum trajectory (%)	5,3	6	7	8,5	11
RES minimum trajectory (ktoe)	3 630	4 240	5 110	6 360	8 590

Annex 4
to the National Action Plan

ESTIMATED SHARE
of renewable energy in transport

Expected energy consumption	(ktoe)							
	2009	2014	2015	2016	2017	2018	2019	2020
Expected RES consumption in transport	52	174	221	298	351	395	445	505
Expected consumption of electricity from RES in transport	52	64	71	78	86	95	105	115
Expected consumption of biofuels from wastes, residues, non-food cellulosic and lignocellulosic material in transport		110	150	220	265	300	340	390
Expected RES contribution to transport for the RES-T target	130	380	477	635	745	837	942	1 068

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- Notes:
1. Consumption of energy from renewable sources in transport comprises electricity, hydrogen, gas and biofuels that comply with the sustainability criteria (as per Article 5(1), last subparagraph, of Directive 2009/28/EC).
 2. This annex provides actual values of renewable energy consumption calculated without using the multiplication factors.
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Annex 5
to the National Action Plan

CALCULATION TABLE
for the renewable energy contribution of each sector to final energy consumption

	(ktoe)							
Expected consumption of energy from renewable sources	2009	2014	2015	2016	2017	2018	2019	2020
Expected gross final consumption of RES for heating and cooling	1473	2955	3277	3690	4095	4575	5140	5850
Expected gross final consumption of electricity from RES	980	1275	1427	1540	1720	1890	2060	2235
Expected final consumption of energy from RES in transport	52	174	221	298	351	395	445	505
Expected total RES consumption *	2505	4404	4925	5528	6166	6860	7645	8590
Expected transfer of RES to other Energy Community Member States								
Expected transfer of RES from other Energy Community Member States and third countries								
Expected RES consumption adjusted for target	2505	4404	4925	5528	6166	6860	7645	8590

* Electricity, hydrogen and gas from renewable energy sources are only considered once (as defined in Article 5(1) of Directive 2009/28/EC).

Annex 6
to the National Action Plan

ESTIMATION

of total contribution (installed capacity, gross electricity generation) expected from each renewable energy technology in Ukraine to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable sources in electricity, 2014-2020

Electricity by source	2009		2014		2015		2016		2017		2018		2019		2020	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
Hydro:	4 549	11 430	4788	12045	4898	12215	4987	12440	5077	12660	5167	12885	5258	13110	5 350	13340
< 1 MW	19	12	28	65	33	75	37	85	42	95	47	110	52	120	55	130
1 MW – 10 MW	30	18	60	130	65	140	70	155	75	165	80	175	86	190	95	210
> 10 MW	4 500	11 400	4700	11850	4800	12000	4880	12200	4960	12400	5040	12600	5120	12800	5200	13000
Geothermal			6	30	8	44	10	56	12	73	14	84	17	105	20	120
Solar			860	900	1000	1050	1250	1310	1450	1520	1700	1780	2000	2100	2300	2420
Wind onshore	76	41	700	1680	1000	2400	1350	3240	1650	4125	1900	4845	2100	5460	2280	5900
Biomass:			40	150	250	1100	380	1680	520	2300	650	2870	780	3450	950	4220
solid			28	105	175	770	260	1180	360	1600	455	2000	540	2415	660	2950
biogas			12	45	75	330	120	500	160	700	195	870	240	1035	290	1270
Total	4 625	11 471	6394	14805	7156	16809	7977	18726	8709	20678	9431	22464	10155	24225	10900	26000
of which in CHP			40	150	250	1100	380	1680	520	2300	650	2870	780	3450	950	4220

Annex 7
to the National Action Plan

ESTIMATION

of total contribution (final energy consumption)* expected from each renewable energy technology in Ukraine to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable sources in heating and cooling, 2014-2020

(ktoe)

Heating by source	2009	2014	2015	2016	2017	2018	2019	2020
Geothermal (excluding low temperature geothermal heat in heat pump applications)		30	33	36	39	42	46	50
Solar		140	150	160	170	180	190	200
Biomass:	1433	2280	2700	3100	3580	4050	4525	5000
solid	1433	2260	2660	3040	3500	3950	4400	4850
biogas		20	40	60	80	100	125	150
Renewable energy from heat pumps:	40	130	200	280	350	420	500	600
aerothermal	27	90	140	195	245	290	360	420
geothermal	9	26	39	55	70	85	90	120
hydrothermal	4	14	21	30	35	45	50	60
Total	1473	2580	3083	3576	4139	4692	5261	5850
of which:								
district heating	552	1720	2130	2560	3050	3550	4080	4650
in households	921	860	953	1016	1089	1142	1181	1200

* Calculated both for direct use of energy resources and for use through district heating (as defined in Article 5(4) of Directive 2009/28/EC).

Annex 8
to the National Action Plan

ESTIMATION

of total contribution expected from each renewable energy technology to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable sources in transport, 2014-2020 (including biofuels compliant with the sustainability criteria)

(ktoe)

Energy sources for the use in transport	2009	2014	2015	2016	2017	2018	2019	2020
Bioethanol / bio-ETBE		110	150	200	225	250	280	320
of which biofuels*		110	150	200	225	250	280	320
Biodiesel				20	40	50	60	70
of which biofuels*				20	40	50	60	70
Renewable electricity	52	64	71	78	86	95	105	115
Total	52	174	221	298	351	395	445	505

* Biofuel consumption is calculated as per Article 21(2) of Directive 2009/28/EC.

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IMPLEMENTATION PLAN
for the National Renewable Energy Action Plan up to 2020

Activity	Implementing entities	Timeframe	Sources of financing	Installed capacity as of 31 December 2020, MW	Production in 2020, GWh, Gcal, kt	Estimated financing*, 1,000 UAH	Energy from renewable sources in gross final consumption in 2020, ktoe
Goal 1. Development of electricity							
Development of electricity generating capacities:		2014 — 2020	Other sources**	10 900	26 000	156 733 000	2 235
based on wind energy use	SAEE, MERT, MECI			2 280	5 900	40 407 000	507
based on solar energy use				2 300	2 420	28 768 000	208
based on hydro energy use, of which:				5 350	13 340	52 914 000	1 147
large hydro	MECI			5 200	13 000	50 000 000	1 117
micro-, mini- and small hydro	SAEE, MERT, MECI			150	340	2 914 000	30
based on geothermal energy use	SAEE, MERT, MECI			20	120	1 140 000	10

Activity	Implementing entities	Timeframe	Sources of financing	Installed capacity as of 31 December 2020, MW	Production in 2020, GWh, Gcal, kt	Estimated financing*, 1,000 UAH	Energy from renewable sources in gross final consumption in 2020, ktoe
based on biomass use	—“—			950	4 220	33 504 000	363
Goal 2. Development of heating and cooling							
Development of heat generating capacities:	SAEE, MERT, Minregion, AR Crimea Council of Ministers, oblast state administrations, Kyiv and Sevastopol city state administrations	2014 — 2020	Other sources**	14 940	58 500	126 868 000	5 850
based on solar energy use				1 190	2 000	7 703 000	200
based on biomass use				11 875	50 000	97 929 000	5 000
based on environmental energy use with heat pumps				1 732	6 000	17 918 000	600
based on geothermal sources use				430	500	3 318 000	50

Goal 3. Increasing the use of energy carriers from renewable sources in transport

Activity	Implementing entities	Timeframe	Sources of financing	Installed capacity as of 31 December 2020, MW	Production in 2020, GWh, Gcal, kt	Estimated financing*, 1,000 UAH	Energy from renewable sources in gross final consumption in 2020, ktoe
Use of energy carriers from renewable sources in transport, including:	MI, MAPF, MECI, MERT, SAEE	2014 — 2020	Other sources **			10 940 941	505
using electricity				625	1 340	7 637 501	115
developing the use of bioethanol				500	500	2 334 792	320
developing the use of biodiesel				80	80	518 648	70
Goal 4. Regulatory legal support for the renewable energy development							
Developing and approving state building regulations, state standards and guidelines for local authorities on planning, designing, building and renovating residential and industrial buildings with the use of RES-based equipment and systems	Minregion, SAEE, National Academy of Sciences	December 2016					

Activity	Implementing entities	Timeframe	Sources of financing	Installed capacity as of 31 December 2020, MW	Production in 2020, GWh, Gcal, kt	Estimated financing*, 1,000 UAH	Energy from renewable sources in gross final consumption in 2020, ktoe
Improving the system of statistical indicators of the use of renewable sources in electricity, heating and cooling, and transport	State Statistics Service, National Academy of Sciences, SAEE	July 2015					
Providing the training and methodological support for qualification and certification centres for RES-based equipment installers	MES, National Academy of Sciences, SAEE	—“—					
Developing technical regulations and standards on the use of renewable energy sources and alternative fuels	SAEE, MERT, MECI, MAPF, MENR	December 2018					
Drafting a regulatory legal act on setting requirements to non-constant generators of energy from renewable sources for connecting them to external electric networks to ensure energy system reliability and increase the allowable share of renewable sources in the energy system	MECI, MERT, NCSEPUR, SAEE	June 2016					

Activity	Implementing entities	Timeframe	Sources of financing	Installed capacity as of 31 December 2020, MW	Production in 2020, GWh, Gcal, kt	Estimated financing*, 1,000 UAH	Energy from renewable sources in gross final consumption in 2020, ktoe
Developing and adopting regulatory legal acts to support production of motor biofuels and components thereof	MECI, MAPF, MI, MERT, SAEE	May 2016					
Implementing a system to monitor the development of production of energy carriers from renewable sources and alternative fuels	SAEE, MECI, NCSEPUR	December 2015					
Providing favourable conditions to raise investments in production of energy carriers from renewable sources and alternative fuels	SAINP, MERT, MECI, SAEE	on a continuous basis					
Expanding international cooperation in production of energy carriers from renewable sources and alternative fuels	MFA, SAEE, MECI	—“—					
Popularising development prospects of production of energy carriers from renewable sources and alternative fuels in Ukraine, particularly by including relevant aspects in curricula of	SAEE, MES	—“—					

Activity	Implementing entities	Timeframe	Sources of financing	Installed capacity as of 31 December 2020, MW	Production in 2020, GWh, Gcal, kt	Estimated financing*, 1,000 UAH	Energy from renewable sources in gross final consumption in 2020, ktoe
educational institutions of all levels							

* Estimated financing does not include funds invested in already implemented projects.
Calculated as per UAH/USD 12.95 exchange rate.

** Other sources mean investors' funds or mobilised credit resources.

Translator's note:

- SAEE - *State Agency on Energy Efficiency and Energy Saving*
MERT - *Ministry of Economic Development and Trade*
MECI - *Ministry of Energy and Coal Industry*
Minregion - *Ministry of Regional Development, Construction and Housing and Public Utilities*
MI - *Ministry of Infrastructure*
MAPF - *Ministry of Agrarian Policy and Food*
MES - *Ministry of Education and Science*
MENR - *Ministry of Ecology and Natural Resources*
NCSEPUR - *National Commission for State Energy and Public Utilities Regulation*
SAINP - *State Agency for Investment and National Projects*
MFA - *Ministry of Foreign Affairs*