OPPORTUNITIES FOR WOOD FUEL HARVESTING IN FORESTS OF UKRAINE

UABio Position Paper N 19

Georgii Geletukha, Tetiana Zheliezna, Anna Pastukh, Semeon Drahniev

31 January 2018

The publication is available at: www.uabio.org/activity/uabio-analytics
Responses and comments: geletukha@uabio.org

Contents

Introduction

Position Paper N 19 by the Bioenergy Association of Ukraine (UABio) is related to the analysis of opportunities for increasing the volume of wood fuel harvesting in Ukraine's forests in accordance with key indicators of strategic national documents. Barriers to such activities are considered and possible ways to overcome them are proposed. A scenario for increasing the volume of wood fuel harvesting, consistent with the key objectives of the Energy Strategy of Ukraine for the period up to 2035, is developed.

Problems of Biofuel Market in Ukraine

Bioenergy is a dynamically developing renewable energy sector in Ukraine, and today biomass replaces about 3.5 billion m^3 of natural gas per year. The steady increase in demand for biofuels raises a number of issues including ensuring reliable supplies at the required levels, ensuring the proper quality of biofuels and fair prices, transparency of purchase/sale mechanisms, and others. Particularly these problems relate to wood fuel that is currently used the most.

The current state of the bioenergy sector development in Ukraine and, in particular, the planned future goals require the creation and proper functioning of a biofuel market. Today, the market is developed very poorly, which leads to problems of finding reliable suppliers, instability of prices, and quality of biofuels.

Among the **barriers** that hinder the creation of the biofuel market in the country wood fuel harvesting issues are particularly important, namely:

- **complicated access** of private companies to logging residues, which are an important potential source of feedstock for the production of wood fuel (wood chips);
- **the absence of record keeping** for the logging residues;
- **there are no plans for the permanent forest users** for solid wood fuel harvesting agreed with the National Renewable Energy Action Plan until 2020 and the Energy Strategy of Ukraine until 2035.

Let us consider these barriers and possible ways to overcome them, taking into account the current characteristics of Ukraine's forests and the dynamics of their changes.

Current state and existing forest management trends in Ukraine

The wood growing-stock in Ukraine is estimated at about 2102 million m^3 and has a steady upward trend (**Fig. 1**). Average wood growing-stock per hectare in the forests of the State Forest Resources Agency of Ukraine is also increasing and equals about 241 m^3/ha according to the data of the state forest inventory for 2011 (**Table 1**) that corresponds to the 7th place in Europe (for comparison, in Poland the figure is 219 m^3/ha, in Belarus 183 m^3/ha, in Sweden 119 m^3/ha). The average annual change in the wood growing-stock (wood growth) per hectare in the forests of the State Forest Resources Agency of Ukraine is 4 m^3/ha and ranges from 5 m^3/ha in the Carpathians to 2.5 m^3/ha in the Steppe zone[1, 2].

[1] The data of the State Forest Resources Agency of Ukraine.
http://dklg.kmu.gov.ua/forest/control/uk/publish/article?art_id=62921&cat_id=32867
http://dklg.kmu.gov.ua/forest/control/uk/publish/article?art_id=101934&cat_id=32876
[2] http://dklg.kmu.gov.ua/forest/control/uk/publish/article?art_id=182224&cat_id=166243

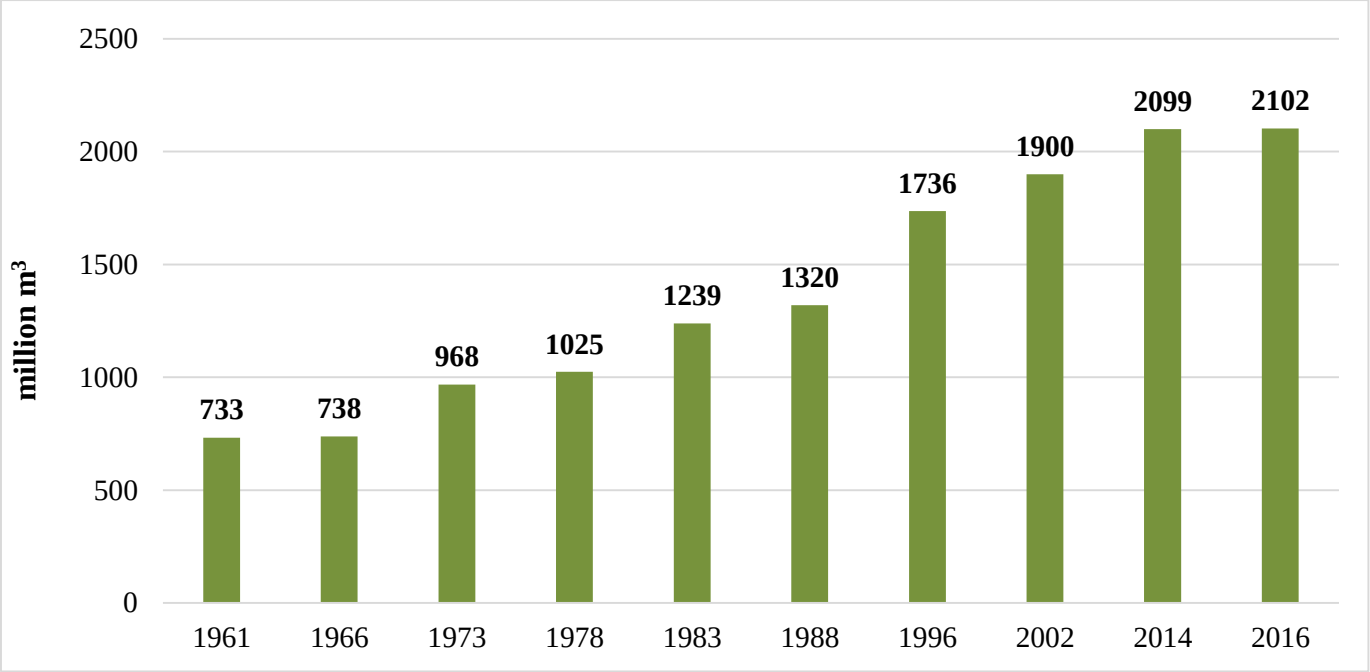


Fig. 1. Dynamics of the wood growing-stock changes in the forests of Ukraine[1].

Table 1. The average wood growing-stock per one hectare in the forests of the State Forest Resources Agency of Ukraine, m^3 [1]

Forests	Years of state inventory of forests				
	1983	**1988**	**1996**	**2002**	**2011**
Middle-aged	208	216	240	257	267
Middle mature	266	267	282	301	312
Mature	276	264	262	258	258
Total	**167**	**171**	**211**	**231**	**241**

According to the statistics of 2016, the harvesting of merchantable wood in Ukraine amounted to 19.6 million m^3 including **6.92** million m^3 of firewood for heating[3]. Since 2000, there has been a tendency for a gradual increase in the volume of harvesting of merchantable wood in general and firewood for heating in particular (**Fig. 2**).

Harvesting of merchantable wood is carried out according to systems and types of felling, which include *major felling, forming and sanitary felling* of forests and other measures related to forest management (hereinafter forming/sanitary felling), as well as measures not related with the management of forestry.

According to the data of 2016, almost all merchantable wood (99.6% of the total volume) is originated from major felling and forming/sanitary felling of forests – 43% and 56.6%, respectively. At the same time, the areas of these types of cuttings differ a lot: the area of the major

[3] Statistical Yearbook of Ukraine for 2016. State Statistics Service of Ukraine, Kyiv, 2017.

felling is 34.7 th. ha (9.0% of the total area where the harvesting of merchantable wood was carried out), and the area of forming/sanitary felling of forests is 350.0 th. ha (90.6%) (**Table 2**). Thus, the output of merchantable wood from 1 hectare in 2016 amounted to **243 m^3** for major felling and 32 m^3 for forming/sanitary felling of forests.

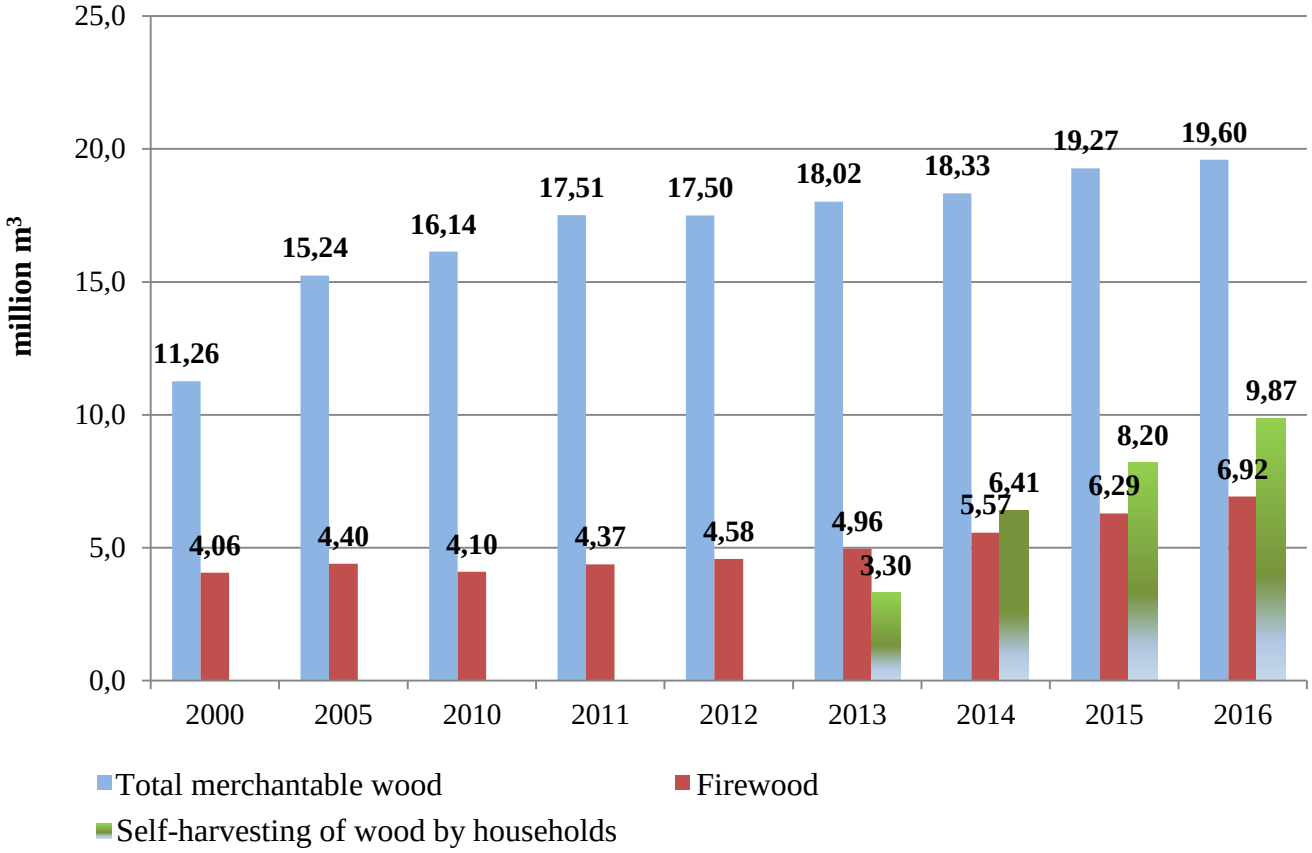


Fig. 2. Merchantable wood harvesting and self-harvesting of wood by households in Ukraine[4],[5].

Today, the share of felling of the annual wood growth in Ukraine is **50.5%** (estimation was made by UABio for statistical data of 2016) (**Fig. 3**). This indicator is much lower than the annual wood growth rate in many European countries (**Fig. 4**)[6]. In particular, it is in Austria – 94%, Sweden, Lithuania – 80%, Slovakia – 79%, the Czech Republic – 78%, Belgium – 73%, the Netherlands – 69%, France, Portugal – 68% without environmental damage because the EU countries pay great attention to the issue of the sustainable development in general and sustainable forest management in particular.

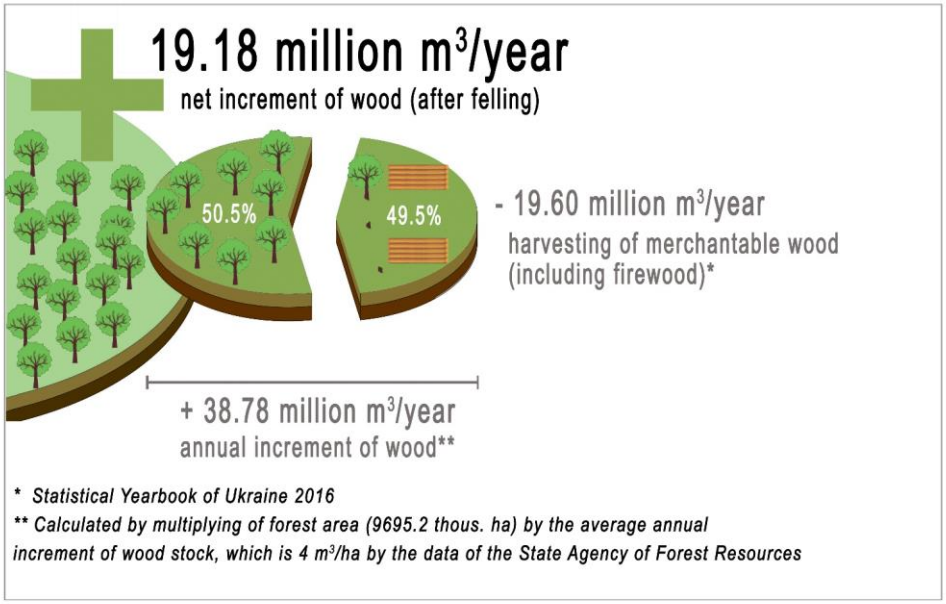
[4] Data of the State Statistics Service of Ukraine http://www.ukrstat.gov.ua/

[5] According to the State Statistics Service of Ukraine, the self-harvesting includes harvesting of firewood, logs, brushwood. The data is obtained through a *random* poll of household owners in different oblasts of Ukraine followed by the *extrapolation* to the entire country. In this regard, it appears that the *reliability* of the data is not 100%. Thus, according to the State Statistics Service of Ukraine, the volume of self- harvesting in 2015 amounted to **8.20** million m^3, while according to estimates of the UABio's experts, based on the analysis of the Energy Balance of Ukraine for 2015 and a number of statistical data, it amounted to **4.38** million m^3.

[6] AEBIOM Statistical Report 2017 http://www.aebiom.org/statistical-report-2017/statistical-report-2017-17-10-17/

Table 2. Merchantable wood harvesting by systems and types of felling[7]

	Area where the harvesting of wood was carried out		Volume of harvested merchantable wood	
	ha	in % to the total area where the harvesting of merchantable wood was carried out	th. m^3	in % to the volume of harvested merchantable wood
Total by systems and types of felling, including:	**386382**	**100.0**	**19605.7**	**100.0**
• Major felling	34694	9.0	8425.0	43.0
• Forming and sanitation felling of forests and other maintenance felling:	350034	90.6	11103.7	56.6
cleaning	24113	6.2	4.9	0.0
clearing	24293	6.3	27.8	0.1
thinning	21018	5.4	309.0	1.6
advance thinning	28087	7.3	789.2	4.0
selective sanitary	182096	47.1	3361.8	17.2
continues sanitary	29535	7.7	5914.3	30.2
renewal	1599	0.4	260.2	1.3
conversion	195	0.1	20.4	0.1
reconstructive	176	0.0	2.5	0.0
landscape	212	0.1	6.7	0.0
other measures related to the forestry management	38710	10.0	406.9	2.1
• Other measures not related to the forestry management	1654	0.4	77.0	0.4



Increment of wood and wood felling in Ukraine in 2016

Only 50.5% of the annual increment of wood is used

[7] Forestry activities in 2016. Express-issue by the State Statistics Service of Ukraine № 109/0/06.4вн-17 of 12.04.2017.

Fig. 3. Evaluation of annual wood increment and share of its felling in forests of Ukraine.

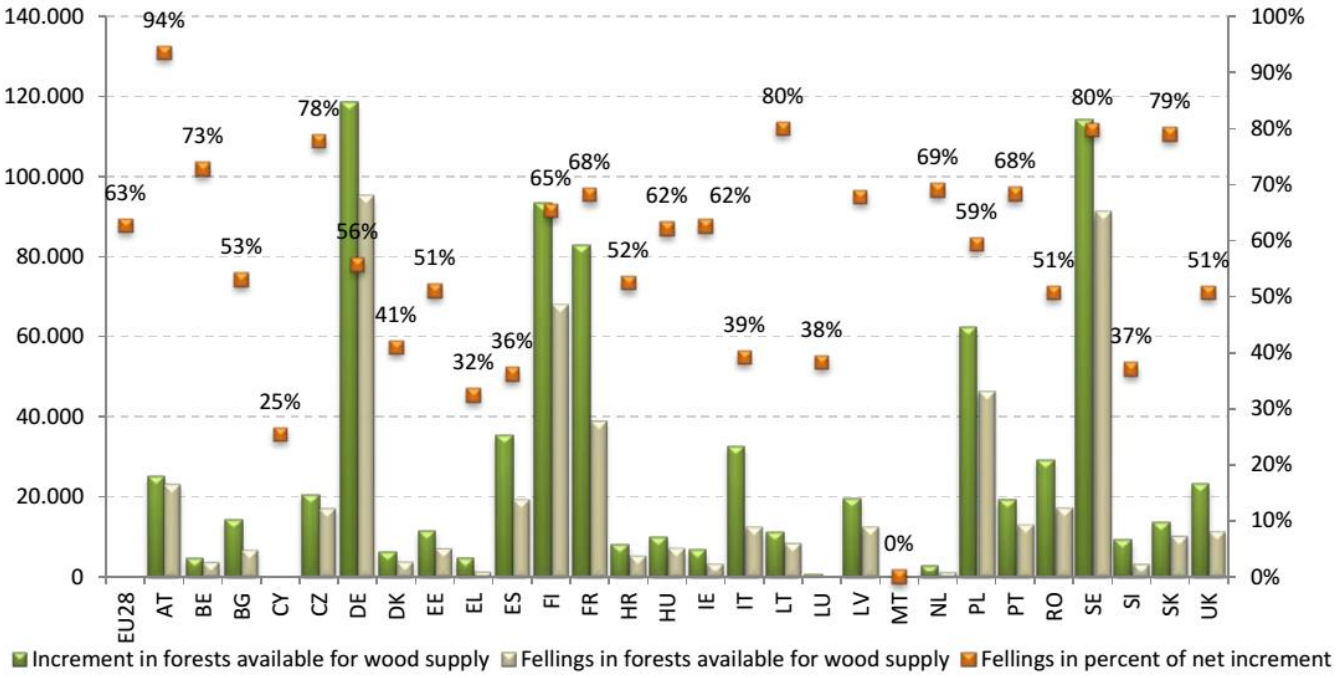


Fig. 4. Annual wood increment and its use in the EU countries[6].

The growth trend of the volumes of *the wood self-harvesting by households* in Ukraine causes concern. Since 2014, according to the State Statistics Service of Ukraine[8], the volume of self-harvesting has exceeded the volume of the firewood harvesting for heating by permanent forest users (see **Fig. 2**). We believe that this issue needs to be regulated and decided at the level of forest management of Ukraine. The population should be supplied with wood fuel, which is bought and sold on a legal and transparent biofuel market.

On November 15th, 2017, the CMU approved the ***Strategy of Forestry Reform of Ukraine until 2022***[9]. In this Strategy the following characteristics of the forests of Ukraine and views on the further use of forest resources, which ***confirm the possibility of increasing the volume of wood fuel harvesting*** can be found *(quotes)*[10]:

> *The wood growing-stock in the forests is estimated at **2.1** billion m^3*
>
> *There is a gradual **increase in the wood growing-stock** that confirms the significant economic and environmental potential of our forests.*
>
> *The potential **wood growing-stock and opportunities** of Ukrainian forests are **big** and, according to local and international experts, **are not fully used**. The use of annual increment of wood is about **60%**, but in European countries it is **70-80%**. In Ukraine, only 0.9% of the wood growing-stock is*

[8] As noted previously, the method used by the State Statistics Service of Ukraine for obtaining data on self-harvesting of firewood by households does not guarantee 100% reliability. Therefore, the data provided by the State Statistics Service of Ukraine is only **indicative**.

[9] http://ua.interfax.com.ua/news/economic/462100.html

[10] The official text of the Strategy of Forestry Reform of Ukraine until 2022 is not available. The data is from the text published in the mass media http://www.lisportal.org.ua/87278/

*cut down per year, while in Switzerland the annual felling is 1.9%, Czech Republic – **2.4%**, Finland – **2.8%**, Great Britain and Belgium – **3%** and **3.1%**, respectively.*

Taking into account the increase in the area of mature and over-mature trees in the forests of Ukraine, in the coming years the increase of wood harvesting rates will be objective.

The **draft** Strategy for Sustainable Development and Institutional Reforms of the Forestry and Hunting Sector of Ukraine for the period up to 2022 (published on the website of the State Forest Resources Agency of Ukraine of 11.08.2017) says (quotes)[2]:

*Forests of Ukraine are **not exhausted**. In the forests of the State Forest Resources Agency of Ukraine, the wood growing-stock per 1 hectare is about 240 m^3 (7^{th} place in Europe, in Poland – 219 m^3, in Belarus – 183 m^3, in Sweden – 119 m^3).*

*Support and ensuring sustainable forest management through ... development of regional and local programs aimed at providing population, enterprises, institutions and organizations, business with **fuel wood** ... (item 6 of the section "Priority ways to achieve strategic objectives").*

The views of a number of domestic experts in the forestry sector coincide with the UABio's position regarding the possibility of increasing the felling volumes in the forests of Ukraine to provide the necessary volume of wood fuel production. In particular, the presentation of **Prystaia O.D.** (Deputy Director General of "Lisproekt" of the State Forest Resources Agency of Ukraine) contains the following statements[11]:

- *In Ukraine, it is possible to reach a level of the use of about **12** million m^3 of wood biomass for energy purposes and to reach substitution of 3.0 billion m^3 of natural gas annually by wood by 2020.*
- *Up to **4.0** million m^3 of wood fuel can **increase the use of annual increment of wood** in Ukraine to the level of the EU countries.*
- ***Sanitary felling of dying forests** is an important source of wood biomass for energy.*
- *In the forests of Ukraine there are about 280 million m^3 of wood on ground at different degrees of **decay**. Each year, about 12.0 million m^3 of wood are lost (fell on the ground) due to natural factors.*

The position of the authors of the article "Change of the age of maturity of the forest-stand as the way of optimizing the age structure of forests and the rate of the forest use"[12] is also interesting for the bioenergy sector. Among others, the article contains the following views (*quotes*):

- *The **age range** adopted in Ukraine, within which one or another forest-stand is mature, is **very narrow** – one age class, which is usually ten years. This circumstance significantly **limits the possibility of flexibility** when planning forest management because due to the regulatory requirements **it is permitted to cut down only mature forest** and ripening forest only in exceptional cases in the forests of the second group with the permission of the Cabinet of Ministers (Article 52 of the current Forest Code of Ukraine). However, such a system **does not meet** the requirements of Article 34 of the Forest Code of Ukraine on **non-exhaustive, continuous and rational use of forests**[13].*

[11] Prystaia O.D. Resources, logistics and the use of the forest energy biomass in Ukraine. Presentation at the 9th International Conference "Energy from Biomass", September 24-25, 2013, Kyiv.
[12] Poliakov L.V., Kyryliuk S.L., Storozhuk V.F., Popkov M.Y., Savushchyk N.P., Siryk A.A. Change of the age of maturity of the forest-stand – the way of optimizing the age structure of forests and the rate of the forest use. *Forestry and agroforestry*, issue 101, 2002. https://www.lisportal.org.ua/75/
[13] References to legislation are relevant for 2002 (the year of publication of the article inquestion).

- *We see a way out of the existing situation in **an increase in the age range** within which the forest-stand felling is possible.*
- *Is it necessary **to keep protective and social purpose forests on the stem before their decay** and keep harvesting in them "for firewood", as it is accepted now? **We reckon that it is not.** After all, nobody has shown that the protective functions of the forest-stands increase with their age. Moreover, there is a lot of evidence that proves the opposite point of view.*
- *The first step towards improving the current situation is recognizing that **forest felling is not only possible but also necessary on a large area of forests that are now excluded from exploitation**. And it should be planned.*
- ***Ukraine has significant resources for increasing of the forest use**, however, predominantly, due to the low-quality forest-stand felling, the timber of which has limited demand. Along with this, high-quality hardwood forests are exploited today intensively and it is not reasonably to talk about increasing their use in the future. That is why, before planning an increase in forest use, the issue of sales of low-value forest should be solved *.*

*****Comment of UABio: at present, the problem of sales of low-quality wood does not exist as **it can be used for the production of wood fuel.**

An analysis of the current characteristics of Ukrainian forests and the dynamics of their changes gives grounds for concluding that ***the use of annual increment of wood to the European level can be increased***.

Logging residues as a source for wood fuel production

Logging residues are an important potential source of wood fuel (wood chips) production in Ukraine. Assuming that on average their volume amounts to about **14%**[14,15,16] of the total volume of the merchantable wood harvesting, according the data of 2016, it can be estimated at **2.74** million m^3 for Ukraine. Assuming that at least **20%**[16,17] of logging waste should be left in a forest to conserve biodiversity, the available amount for the production of wood chips was 2.20 million m^3 in 2016.

In the European practice of the forest management and wood fuel harvesting, there are three main options for the production of wood chips from logging residues: production just at the site where these residues were generated, production at the site near a road, and production at a bioenergy unit's site.

[14] Leen Kuiper. The harvest of forest residues in Europe, 2006
http://www.probos.nl/biomassa-upstream/pdf/reportBUSD15a.pdf
[15] Handbook of Bioenergy Crop Plants, 2012
https://books.google.com.ua/books?id=T6mm5-qAvpcC&pg=PA123&lpg=PA123&dq=20%25+of+the+logging+residues+should+be+left+in+forest&source=bl&ots=PBp7l6RZXI&sig=b4UzGgOJ8c4wUg7HaFrQ5LIZnp4&hl=ru&sa=X&ved=0ahUKEwjGqs33yYnYAhXqIpoKHQbuCPw4ChDoAQgtMAE#v=onepage&q=20%25%20of%20the%20logging%20residues%20should%20be%20left%20in%20forest&f=false
[16] Primary Forest Biomass. In the Report by Global CCS Institute
https://hub.globalccsinstitute.com/publications/us-billion-ton-update-biomass-supply-bioenergy-and-bioproducts-industry/31-primary-forest-biomass
[17] Bengt Nilsson. Extraction of logging residues for bioenergy. Linnaeus University Dissertations N 270/2016
https://www.diva-portal.org/smash/get/diva2:1049815/FULLTEXT01.pdf

Today, the most common option, especially in the Scandinavian countries (Finland and Sweden), is the production of wood chips from logging waste **at the site near a road**. In this case, the logging residues are collected and delivered to the road by a forwarder, where they are laid out in bulk for storing during a certain period of time for drying. Wood chips are produced by a mobile chipper aggregated with an agricultural tractor and transported from the forest by trucks. Another option is the production and transportation of wood chips by a combined machine – a wood chip truck equipped with a chipper (**Fig. 5, 6**)[17, 18, 19].

In Ukraine, logging waste is practically not used for the biofuel production. The rules for the handling of logging residues (methods for cleaning felling sites) include the harvesting of logging residues in piles and bulks to decay, spreading over the felling site, laying on skid roads and in the places where the aggregate forest machines run, as well as partial combustion (Section VI Cleaning of felling sites of "*Regulation of Felling*"[20])[21]. Harvesting of logging residues and the production of wood fuel from them are not provided by the current legislation. In addition, there are no requirements for permanent forest users to keep records of the entire amount of logging residues (at present, records are only kept for brushwood and twigs).

Taking into account the above mentioned, we consider it necessary:

- To oblige permanent forest users to ***transport logging residues to the nearest roads*** for the production of solid biofuels (for **80%** of the logging residues weight).
- Impose a ***ban on the entire and partial combustion*** of the logging residues.

This can be achieved by amending the **Forest Code of Ukraine**[22] (Code No. 3852-XII of January 21, 1994, as amended, *has the status of the law*) and providing a new method of clearing the felling sites, and prohibiting any combustion of logging residues. The relevant paragraphs of the comparison table of the proposed draft law of Ukraine are given in **Annex 1**[23].

Introduction of ***the accounting of logging residues*** is proposed by taking into account their mass in felling permits. The relevant draft Resolution of the Cabinet of Ministers of Ukraine is given in **Appendix 2.** By this Resolution, the State Forest Resources Agency of Ukraine is charged with the developing of a procedure for the accounting of logging residues.

[18] http://www.eubia.org/cms/wiki-biomass/biomass-procurement/recovery-of-forest-residues/
[19] Developing technology for large-scale production of forest chips. TEKES, Finland, Final Report, 2004 https://www.tekes.fi/globalassets/julkaisut/wood_energy_final.pdf
[20] Approved by the Order of the State Forestry Committee of Ukraine of 23.12.2009 N 364 http://zakon3.rada.gov.ua/laws/show/z0085-10
[21] The current state and problems of forestry of Ukraine is described more detailed in the UABio Position Paper N 18 "Creation of the Competitive Biofuel Market in Ukraine" http://uabio.org/img/files/docs/position-paper-uabio-18-en.pdf
[22] http://zakon5.rada.gov.ua/laws/show/3852-12
[23] In addition to amending the FCU, the draft law contains a number of provisions on the introduction and functioning of the electronic trading system for biofuels in Ukraine.

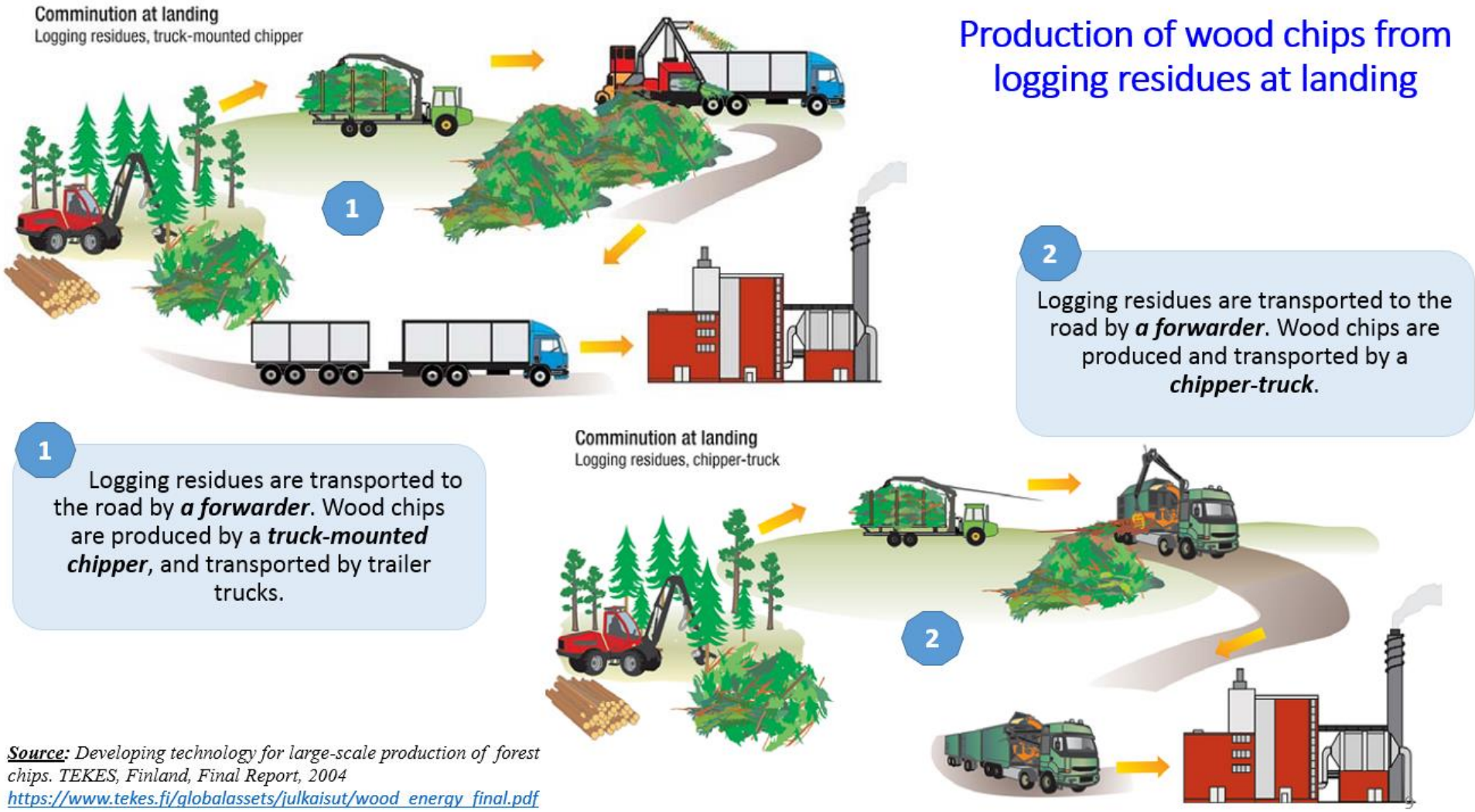


Fig. 5. Wood chips production from logging residues on the site near a road[19]

Stacking of logging residues by a forwarder

Haulage of logging residues by a forwarder

Comminution of logging residues by a truck-mounted chipper

Comminution of logging residues by a chipper-truck

Fig. 6. Examples of operations with logging residues and machines used[17].

Estimation of the cost of transportation of logging residues to a road in Ukraine

Based on the existing level of the forestry mechanization in Ukraine, estimation of the cost of the logging residues transportation from the forest to the road is based on the use of the following equipment: tractor MTZ-82.1 equipped with a manipulator, and tractor trailer 2PTS-4. The calculation includes such operations for the harvesting of the logging residues (10 m^3/h productivity) and transportation to the road at a distance of 5 km (26 m^3/h productivity). It is assumed that 1 tractor driver and 2 loaders are involved in the operations.

According to the results of the estimation, the cost of the logging residues transportation from the forest to the road is **279** UAH/t (taking into account technical maintenance and equipment repair). The list of accepted assumptions and details of the calculation are given in **Annex 3**.

In order to provide permanent forest users (state forest enterprises) with financial means for harvesting and transportation of logging residues to the road, we consider it necessary to reduce the income deduction rate of such enterprises to the state budget from 75% (corresponding to the

requirements of the current legislation[24]) to **40%**. At the same time, the state forestry enterprises *have to use* **35%** of the net profit (income) from their activities for the modernization and procurement of specialized equipment for the harvesting and transportation of the logging residues to nearest roads, production and transportation of solid biofuels. The relevant draft resolution of the CMU is given in **Annex 4**.

Assessment of the required amount of wood fuel to be harvested by permanent forest users in Ukraine until 2035

Forecasted estimation of the required volumes of ***wood fuel*** such as firewood and chips to be harvested by permanent forest users during the period of 2018-2035 is based on key indicators of the Energy Strategy of Ukraine until 2035 "Safety, Energy Efficiency, Competitiveness"[25] (hereinafter - the Energy Strategy) as well as existing statistics and a number of expert assessments and assumptions.

According to the Energy Strategy, the projected volume of biomass, biofuels and waste in the total primary energy supply will be 4 Mtoe in 2020, 6 Mtoe in 2025, 8 Mtoe in 2030, **11** Mtoe in 2035; that means the growth by **5.2** times over the period of 2015-2035 (**Table 3**). The volume of solid biofuels can be estimated as 90% of this total volume: 3.6 Mtoe in 2020, 5.4 Mtoe in 2025, 7.2 Mtoe in 2030, **9.9** Mtoe in 2035.

Table 3. Structure of the total primary energy supply in Ukraine according to the Energy Strategy of Ukraine until 2035[26]

Energy sources	**2015 (actual)**	**2020 (forecast)**	**2025 (forecast)**	**2030 (forecast)**	**2035 (forecast)**
Coal	27.3	18	14	13	12
Natural gas	26.1	24.3	27	28	29
Oil products	10.5	9.5	8	7.5	7
Nuclear energy	23	24	28	27	24
Biomass, biofuels and waste	**2.1**	**4**	**6**	**8**	**11**
Solar and wind energy	0.1	1	2	5	10
HPP	0.5	1	1	1	1
Thermal energy	0.5	0.5	1	1.5	2
TOTAL, Mtoe	**90.1**	**82.3**	**87**	**91**	**96**

It is assumed that *the structure* of solid biofuels will include wood fuel (pellets, briquettes, firewood, and chips), biofuels of agricultural origin (bales, pellets, and briquettes), sunflower husk (loose husk, pellets, and briquettes), and energy crops (pellets, chips).

When *quantifying* the amount of solid biofuels, the following is taken into account:

[24] Order for partial allocating the net income of the state unitary enterprises and their associations into the state budget. Approved by CMU Resolution № 138 of 23.02.2011 (with amendments)
http://zakon2.rada.gov.ua/laws/show/138-2011-%D0%BF
[25] Approved by CMU Resolution № 605-p of 18.08.2017
http://www.kmu.gov.ua/control/uk/cardnpd?docid=250250456
[26] http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art_id=245234085&cat_id=35109

- Features of the structure of the biomass energy potential in Ukraine are: (a) relatively limited amount of wood resources (about 2.6 Mtoe/yr with the total potential of biomass of 21.2 Mtoe/yr according to 2016 data); (b) a large volume of biomass of agricultural origin (primary and secondary residues and by-products, in total of about 9.0 Mtoe/yr according to 2016 data); (c) potentially a big amount of energy crops (about 7.5 Mtoe/yr according to 2016 data).
- A part of firewood for heating is harvested by *households themselves*. The volume of "self-harvested" firewood in 2015 is estimated by BAU's experts at 4.38 million m^3 [5]; it is assumed that it will decrease to 2.20 million m^3 in 2035 due to the development of a civilized biofuel market. When estimating the required volumes of wood fuel to be harvested by permanent forest users, the volume of "self-harvested" firewood is deducted from the total amount of consumption of wood fuel.
- The share of felling of the annual wood increment in Ukraine can be increased from the current 50.5% (data of 2016) to about 70% in 2035 (in line with the best European practices).

Under the above approach and assumptions, ***the share of wood fuel*** in the structure of solid fuels will be:

taking into account firewood "self-harvested" by households: 2.35 Mtoe (or 12.36 million m^3) in 2018 increasing to 2.85 Mtoe (or 15.00 million m^3) in 2035 (**Fig. 7, Table 4**);

not taking into account firewood "self-harvested" by households: 1.76 Mtoe (or 8.16 million m^3) in 2018 increasing to **2.54** Mtoe (or **12.80** million m^3) in 2035 (see **Table 4**).

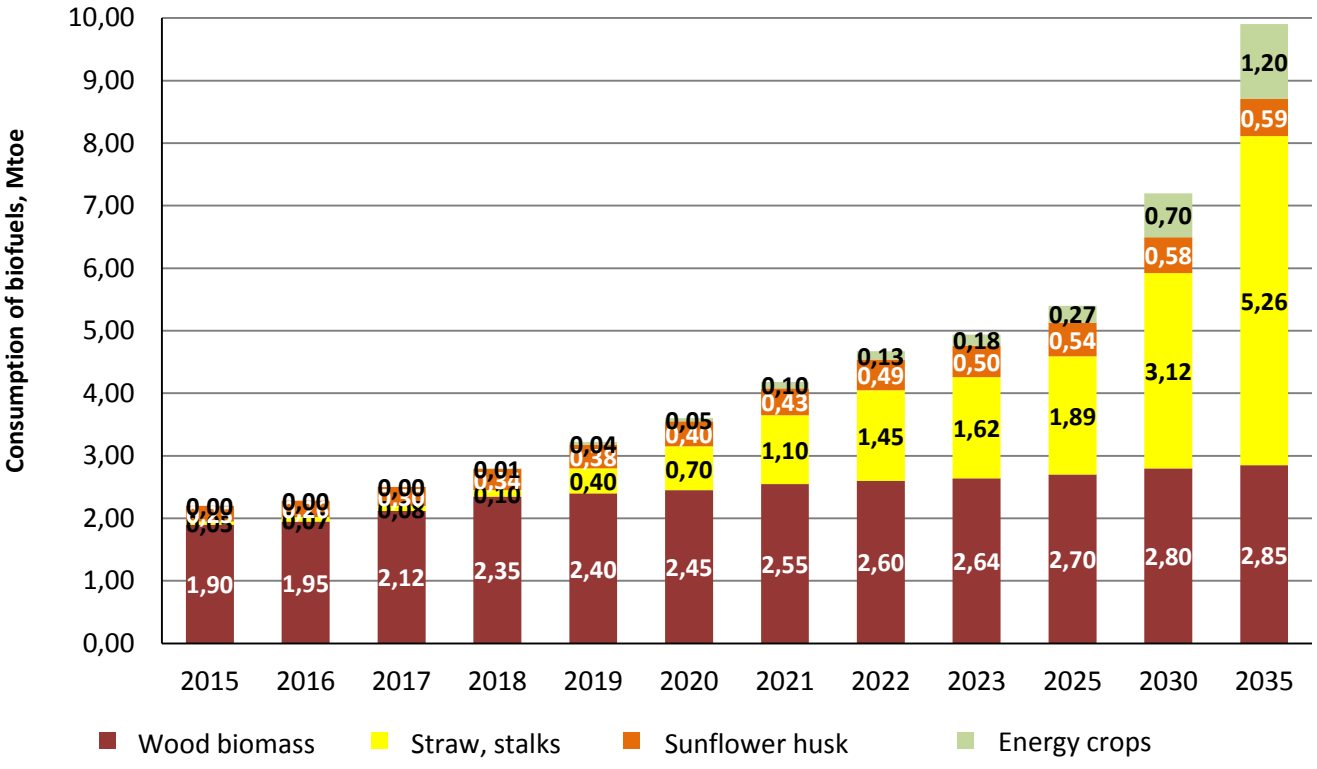


Fig. 7. Assessment of biofuels consumption until 2035 by types.

To ensure the consumption of the above amount of solid wood fuel (*not taking into account firewood "self-harvested" by households*), its volume to be harvested by permanent forest users must be at least 8.30 million m^3 in 2018 (including firewood and chips at least 7.2 million m^3 and 1.1 million m^3 respectively) increasing to at least **13.0** million m^3 in 2035 (including firewood and chips at least 9.5 million m^3 and 3.5 million m^3 respectively (see **Table 4**).

Table 4. Assessment of the required volumes of wood fuel for energy to be harvested in Ukraine.

WOOD FUEL	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**
Total consumption:											
Mtoe	1.90	1.95	2.12	2.35	2.40	2.45	2.55	2.60	2.70	2.80	2.85
million m³	10.0	10.26	11.15	**12.36**	**12.63**	**12.89**	**13.41**	**13.68**	**14.20**	**14.73**	**15.00**
Firewood "self-harvested" by households:											
Mtoe	0.62	0.62	0.61	0.59	0.56	0.54	0.49	0.45	0.40	0.35	0.31
million m³	4.38	4.38	4.30	4.20	4.00	3.80	3.50	3.20	2.85	2.50	2.20
Total consumption not taking into account firewood "self-harvested" by households:											
Mtoe	1.28	1.33	1.51	1.76	1.84	1.91	2.06	2.15	2.30	2.45	2.54
million m³	5.62	5.88	6.85	**8.16**	**8.63**	**9.09**	**9.91**	**10.48**	**11.35**	**12.23**	**12.80**
The volume to be harvested by permanent forest users:											
- firewood, million m³	6.29*	6.92*	7.10	**7.20**	**7.40**	**7.60**	**8.00**	**8.30**	**8.60**	**9.20**	**9.50**
- wood chips, million m³	n.d.	n.d.	n.d.	**1.10**	**1.40**	**1.70**	**2.10**	**2.60**	**3.10**	**3.30**	**3.50**
TOTAL, million m³				**8.30**	**8.80**	**9.30**	**10.10**	**10.90**	**11.70**	**12.50**	**13.00**

** Actual amount (statistical data); n.d. – no data.*

We suggest that ***the obligation for the permanent forest users*** to harvest the determined amount of wood fuel during the period of 2018-2035 should be ***legally imposed by a CMU Resolution***[27]. The draft Resolution is presented in **Annex 2**.

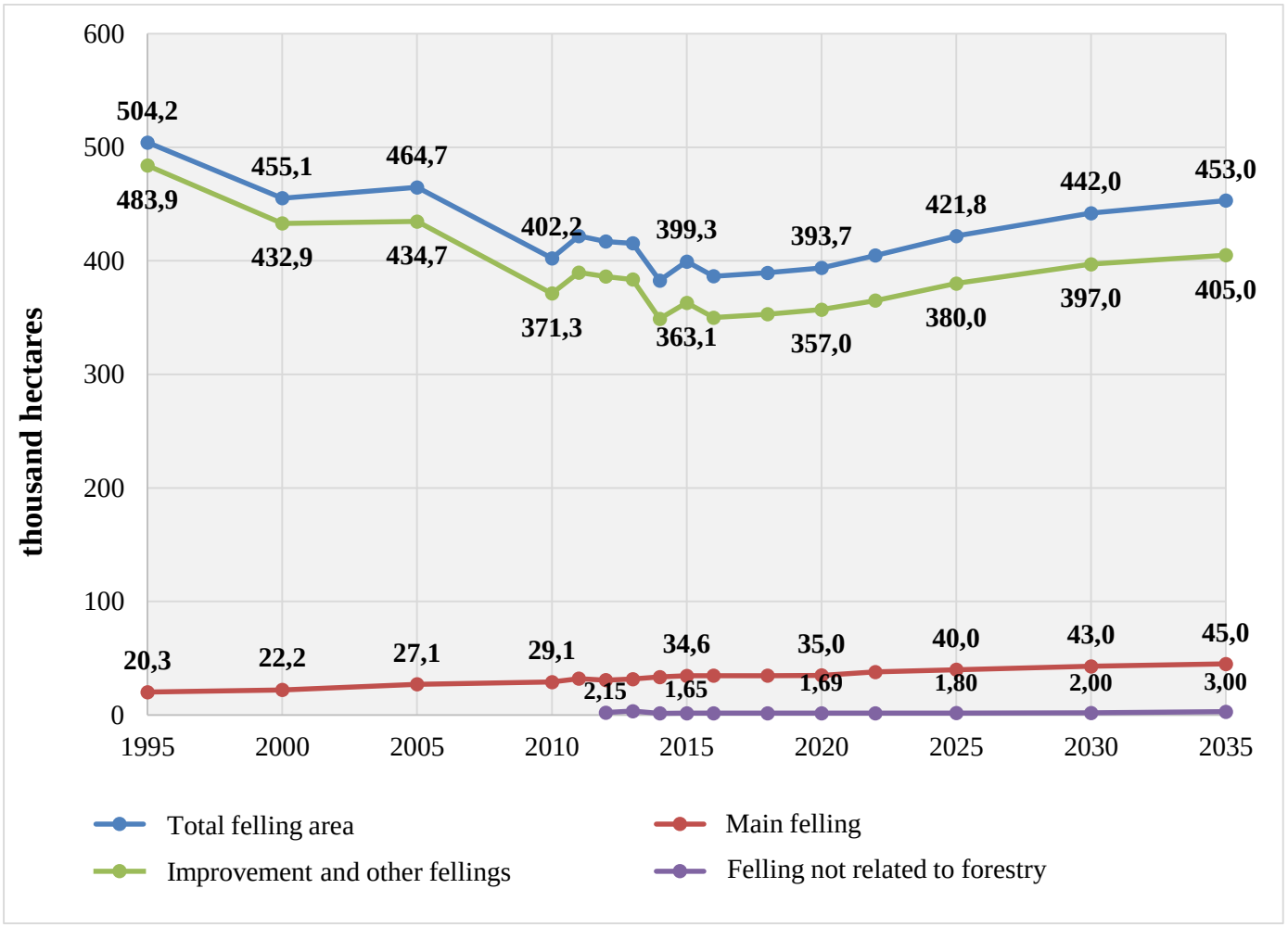
Suggested scenario to ensure harvesting of the required volume of wood fuel until 2035

The volume of harvested wood fuel that meets Ukraine's needs in accordance with key figures of the Energy Strategy of Ukraine until 2035 can be achieved by ***increasing the main felling area as well as the improvement felling area***.

[27] A **draft Action plan for the Energy Strategy of Ukraine until 2035** is now under development. **Item 143 of the draft Plan includes** "Development and adoption of legal acts as for introducing **compulsory plans for the permanent users to harvest firewood and produce wood chips;** accounting of felling residues and the use of felling residues for energy production" (the period of execution is 2018).

Statistical data show that the total felling area in Ukraine in 1995 was **504.2** th. ha decreasing to **386.4** th. ha in 2016 at the expense of the improvement felling area. At that, the main felling area increased from **20.3** th. ha to **34.7** th. ha during this period of time (**Fig. 8**).

We suggest that the improvement felling area should be increased to **405.0** th. ha by 2035 (that is much less than the area in 1995), and the main felling area should be increased to **45.0** th. ha in 2035 (that continues stable trend existing since 1995). Then the total area for wood harvesting will be **453.0** th. ha in 2035, which is also much less than the area in 1995 (see **Fig. 8**).



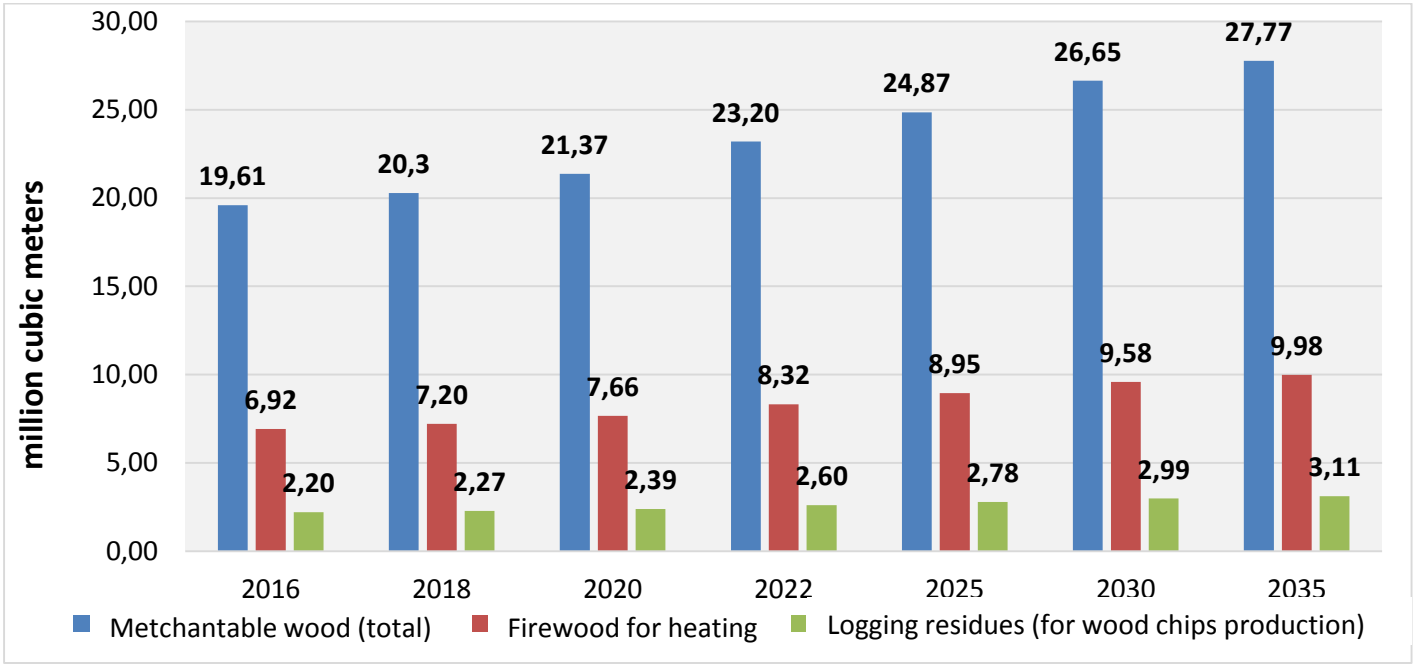
Figures for 1995-2016 are statistical data, figures for 2017-2035 are forecast

Fig. 8. Area for wood harvesting in Ukraine.

Under the suggested scenario for increasing felling area and gradual increase of merchantable wood yield per hectare during improvement felling by 30% from the current level, the harvested merchantable wood may reach **27.77** million m^3 in 2035 including **9.98** million m^3 of firewood for heating. At that, the volume of logging residues available for energy is estimated as **3.11** million m^3 in 2035[28] (**Fig. 9**).

[28] The volume of logging residues is estimated as 14% of the volume of harvested merchantable wood. It is assumed that 80% of the total volume of logging residues can be used for energy.

According to the scenario, the share of the annual wood increment felling will be **71.6%** in 2035 (**Fig. 10**), and the share of felling of growing-stock in the forests will be **1.3%**, which is in line with the best European practice.



Figures for 2016 are statistical data (harvesting of merchantable wood including firewood)

Fig. 9. Forecast for the harvesting of merchantable wood and generation of logging residues in Ukraine.

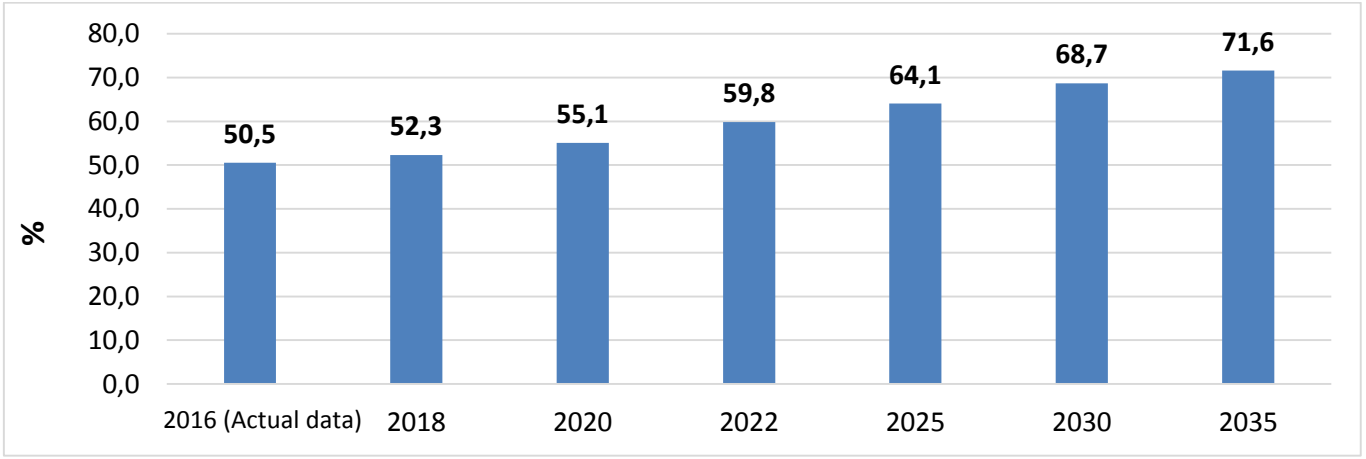


Fig. 10. Forecast for the felling of the annual wood increment in Ukraine.

Thus, the suggested scenario for increasing harvesting of merchantable wood until 2035 ***provides the required volumes of harvested wood fuel*** (firewood and wood chips), which are determined in accordance with key figures of the Energy Strategy of Ukraine until 2035 (**Table 5**) and fixed in the draft CMU Resolution (see **Annex 2**).

Table 5. Comparison of the required volumes of harvested wood fuel and the developed scenario for wood harvesting until 2035.

Required volume of harvested wood fuel (the draft CMU Resolution)								
million cubic meters	2018	2019	2020	2021	2022	2025	2030	2035
Firewood	7.20	7.40	7.60	8.00	8.30	8.60	9.20	9.50
Wood chips	1.10	1.40	1.70	2.10	2.60	3.10	3.30	3.50
Total	**8.30**	**8.80**	**9.30**	**10.10**	**10.90**	**11.70**	**12.50**	**13.00**
Scenario for wood harvesting until 2035 (forecast)								
million cubic meters	2018	2019	2020	2021	2022	2025	2030	2035
Firewood*	7.20	7.48	7.66	8.03	8.32	8.95	9.58	9.98
Logging residues (for wood chips production)**	2.27	2.35	2.39	2.51	2.60	2.78	2.99	3.11
Total	**9.48**	**9.83**	**10.06**	**10.54**	**10.92**	**11.73**	**12.57**	**13.09**

** Firewood can be partly comminuted into chips.*

*** Volume available for energy (80% of the total amount).*

Conclusions

Bioenergy is a dynamically developing renewable energy sector in Ukraine, and today biomass replaces about **3.5** billion m^3 of natural gas per year. The steady increase in demand for biofuels raises a number of issues including ensuring reliable supplies at the required levels, ensuring the proper quality of biofuels and fair prices, transparency of purchase/sale mechanisms, and others. Among the ***barriers*** that hamper the creation of the biofuel market in the country, ones, related to the ***wood fuel harvesting***, are significant.

Logging residues are an important potential source of the wood fuel (wood chips) production in Ukraine. The current rules for the logging residues handling do not include their harvesting and wood fuel production. In addition, there are no requirements for permanent forest users to keep records of the entire amount of logging residues (at present, records are only kept for brushwood and twigs).

Taking into account the above mentioned, we consider it necessary:

- To oblige permanent forest users to ***transport logging residues to the nearest roads*** for the production of solid biofuels (for **80%** of the logging residues weight).
- Impose a ***ban on the entire and partial combustion*** of the logging residues.

This can be achieved by amending the **Forest Code of Ukraine** and providing a new method of clearing the felling sites, and prohibiting any combustion of the logging residues. Introduction of ***the accounting of logging residues*** is proposed by taking into account their mass in the felling permits.

According to estimates of the UABio's experts, the full cost of the logging residues transportation from the forest to the road is **279** UAH/t. In order to provide permanent forest users (state forest

enterprises) with financial means for harvesting and transportation of logging residues to the road, we consider it necessary ***to reduce the income deduction rate*** of such enterprises to the state budget from 75% (corresponding to the requirements of the current legislation) to **40%**. At the same time, the state forestry enterprises *have to use* **35%** of the net profit (income) from their activities for the modernization and procurement of specialized equipment for the harvesting and transportation of the logging residues to nearest roads, production and transportation of solid biofuels.

According to the key indicators of the Energy Strategy of Ukraine for the period up to 2035, ***the share of wood fuel*** in the structure of solid fuels can be estimated as 1.76 Mtoe (or 8.16 million m^3) in 2018 increasing to **2.54** Mtoe (or **12.80** million m^3) in 2035 (*not taking into account firewood "self-harvested" by households)*.

To ensure the consumption of above mentioned amount of solid wood fuel, its volume to be harvested by permanent forest users must be at least 8.30 million m^3 in 2018 (including firewood and chips at least 7.2 million m^3 and 1.1 million m^3 respectively) increasing to at least 13.0 million m^3 in 2035 (including firewood and chips at least 9.5 million m^3 and 3.5 million m^3 respectively). The obligation for the permanent forest users to harvest the determined amount of wood fuel during the period of 2018-2035 should be legally imposed by a *CMU Resolution.*

The volume of harvested wood fuel that meets Ukraine's needs in accordance with the key figures of the Energy Strategy of Ukraine until 2035 can be achieved by ***increasing the main felling area*** as well as the forming/sanitary felling area.

We suggest that the forming/sanitary felling area should be increased to **405.0** th. ha by 2035 (that is much less than the area in 1995), and the main felling area should be increased to **45.0** th. ha in 2035 (that continues stable trend existing since 1995). Then the total area for wood harvesting will be **453.0** th. ha in 2035, which is also much less than the area in 1995.

Under the suggested scenario for increasing felling area and gradual increase of merchantable wood yield per hectare during forming/sanitary felling by 30% from the current level, the harvested merchantable wood may reach **27.77** million m^3 in 2035 including **9.98** million m^3 of firewood for heating. At that, the volume of logging residues available for energy is estimated as **3.11** million m^3 in 2035.

According to the scenario, the share of the annual wood increment felling will be **71.6%** in 2035, and the share of felling of growing-stock in the forests will be **1.3%**, which is in line with the best European practice.

Thus, the suggested scenario for increasing harvesting of merchantable wood until 2035 ***provides the required volumes of harvested wood fuel*** (firewood and wood chips), which are determined in accordance with key figures of the Energy Strategy of Ukraine until 2035 and fixed in the draft CMU Resolution.

Annex 1. Comparison table for the draft Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine on the Development of Trade by Biological Types of Fuels"

***Note**: Below, the Comparison Table provides only those points that concern the introduction of changes to the FCU and the introduction of responsibility for the combustion of logging residues*[23].

COMPARISON TABLE
for the draft Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine on the Development of Trade by Biological Types of Fuels"

Essence of the provisions of the current legislation	Essence of the appropriate provisions of the draft
Code of Ukraine on Administrative Offenses	
Absent	**Article 77-2. Partial or entire combustion of logging residues** **Partial or entire combustion of logging residues during wood harvesting, -** **result in the imposition of a fine** on officials in the amount of one hundred to two hundred tax-free minimum incomes of citizens.
…	…
Forest Code of Ukraine	
Article 71. Limit of wood harvesting in the procedure of major felling. The limit for wood harvesting in the procedure of major felling is approved in the approved in accordance with the established procedure calculated felling site. Wood harvesting in the procedure of major felling in sizes exceeding the calculated felling site is prohibited.	**Article 71. Limit of wood harvesting in the procedure of major felling.** The limit for wood harvesting in the procedure of major felling is approved in the approved in accordance with the established procedure calculated felling site. Wood harvesting in the procedure of major felling in sizes exceeding the calculated felling site is prohibited.
—	**Article 71-1. Clearing of felling sites during felling** **During the harvesting of wood, forest owners and permanent forest users must clear felling sites.** **Depending on the forest conditions and the requirements of reforestation, the following ways of clearing the felling sites are used:**

	1) hauling of logging residues to the nearest roads for the production of solid biofuels; **2) collection of logging residues in piles and windrows for rotting;** **3) even spreading of logging residues, which are cut to pieces of up to 1 m, over felling sites. On erosion-hazardous areas, clearing is carried out only in this way;** **4) stacking of logging residues on logway in the hollows and compressing them during wood skidding;** **5) laying of logging residues in the places of going of aggregate forest machines.** **Forest owners and permanent forest users are obliged to use the method of clearing the felling sites provided for in paragraph 1 of part two of this article for 80% of the logging residues mass, with 20% of the logging residues mass being treated by ways of clearing the felling sites provided for in paragraphs 2-5 of part two of this article.** **Entire and partial combustion of logging residues is prohibited.**
…	…

Annex 2. Draft resolution of CMU "Some issues of solid wood fuel harvesting by permanent forest users"

DRAFT

CABINET OF MINISTERS OF UKRAINE
RESOLUTION

___ _____ 2018 № _____
Kyiv

Some issues of solid wood fuel harvesting by permanent forest users

In order to implement the National Renewable Energy Action Plan until 2020 and the Energy Strategy of Ukraine until 2035, the Cabinet of Ministers of Ukraine **decrees:**

1. The State Forest Resources Agency, the Ministry of Defence of Ukraine, the Ministry of Ecology and Natural Resources, the Ministry of Infrastructure, the State Service of Ukraine for Emergencies and other forest owners shall **provide the harvesting of solid wood fuel in the following volume**:

million m^3	2018	2019	2020	2021	2022	2025	2030	2035
Firewood	7.20	7.40	7.60	8.00	8.30	8.60	9.20	9.50
Wood chips	1.10	1.40	1.70	2.10	2.60	3.10	3.30	3.50
Total	**8.30**	**8.80**	**9.30**	**10.10**	**10.90**	**11.70**	**12.50**	**13.00**

2. The State Forest Resources Agency, the Ministry of Defence of Ukraine, the Ministry of Ecology and Natural Resources, the Ministry of Infrastructure, the State Service of Ukraine for Emergencies and other forest owners shall bring the determined volume of solid wood fuel harvesting to permanent forest users and control fulfilment of the plan.

3. The State Forest Resources Agency shall provide the accounting of logging residues.

4. To add changes to Annex 1 to the Procedure for issuing special permits for the use of forest resources approved by the Resolution of the Cabinet of Ministers of Ukraine No. 761 of May 23, 2007 (Official Bulletin of Ukraine, 2007, No. 39, Article 31).

5. Central bodies of executive power shall, within a month, bring their own acts into compliance with this resolution.

Prime-minister of Ukraine **V. GROISMAN**

APPROVED
By the decision of the Cabinet of Ministers of Ukraine
___ _____ 2018 № _____

CHANGES
that are introduced in Annex 1 to the Procedure for issuing special permits for the use of forest resources

1. Sub-column “brushwood and twigs” of the column “Wood mass, cubic meters” shall be renamed into: “all logging residues”.

2. Sub-column "brushwood and twigs" of the column “Normative cost, hryvnia” shall be renamed into: “all logging residues”.

Annex 3. Estimation of the cost of harvesting and transportation of logging residues to the road for the wood chips production

Initial data and assumptions	
The forest enterprise is located in the Zhytomyr region. Major felling. Wood stock is 240 m^3/ha. Volume of the formed logging residues from merchantable wood – 14%; 80% of the total volume is taken for processing into wood chips.	
Transportation distance to the road, km	**5**
Logging residues output, solid m^3/ha	**27**
The price of diesel fuel, UAH/l excl. VAT	**25.83**
Logging area, ha	**10**
Weight of 1 stacked m^3 of twigs, kg/m^3	**151**
Solid m^3, kg/m^3	**700**
Amortization rate, years	**8**
Deductions for maintenance and repair, %	**5**
Number of logging residues piles, pieces/ha	**10**
Volume of logging residues in 1 pile, solid m^3	**2.7**
Weight of logging residues in 1 pile, kg	**1890**
Volume of logging residues in 1 pile, m^3	**13**
Volume of logging residues for a trailer, m^3	**26**

Characteristics and indicative cost of equipment

Equipment	Number, units	Price of a unit, thousand UAH	Price, thousand UAH
Tractor MTZ-82.1	1	540	540
Manipulator with a grip	1	100	100
Tractor trailer 2PTS-4	1	150	150
Total			**790**

Work duration, hours	Estimated specific annual load, h/year	Deductions for maintenance and repair, %	Maintenance and repair costs, UAH	Amortization, UAH/t	Specific costs for maintenance and repair, UAH/t	Specific costs for amortization, UAH/t
173	1600	**5**	4278	10696	23	57

Duration of stages on harvesting and logistics of logging residues

Stage and equipment	Transportation distance, km	Productivity, m^3/h	Total volume of work	Working day duration, h	Total duration, days	Selected duration, days	Adjusted load, h
1. Logging residues harvesting			**189 t**				
MTZ-82.1 + manipulator + trailer		10	125 h				
2. Transportation of logging residues to the road	**5**		189 t				
MTZ-82.1 + manipulator + trailer		26	48 h				
TOTAL:			173 h	8	22	22	176

Calculation of labour cost under the annual volume of harvested logging residues of 189 t

Position	Number, persons	Tariff, UAH/h	Rate of wages, UAH/month	Deductions from wages fund	Sum with deductions, UAH	Specific costs, UAH/t
Tractor driver	1	40	6718	2553	9271	49
Loaders	2	34	5705	2168	7873	42
Total with deductions					17144	**91**

Fuel costs at annual volumes of harvesting

Equipment	Fuel consumption, l/h	Number of working hours	Volume of fuel, l	Total fuel price, UAH	Fuel specific cost, UAH/t
Tractor MTZ-82, harvesting	7	125	876	18859	100
Tractor MTZ-82, transportation	12	48	578	12435	66
Total				31294	**166**

The price of diesel fuel is 21.52 UAH/l excl. VAT

Results of calculations

TOTAL for hauling of 1 t of logging residues without amortization, maintenance and repair	256 UAH/t
TOTAL for hauling of 1 t of logging residues with amortization, maintenance and repair	**279 UAH/t**

Annex 4. Draft resolution of CMU "On amending paragraph 1 of the Procedure for assigning a part of the net profit (income) from the state unitary enterprises and their associations to the state budget"

DRAFT

CABINET OF MINISTERS OF UKRAINE
RESOLUTION

___ _____ 2018 № _____
Kyiv

On amending paragraph 1 of the Procedure for assigning a part of the net profit (income) from the state unitary enterprises and their associations to the state budget

The Cabinet of Ministers of Ukraine **decrees:**

1. To partially amend the first paragraph of item 1 of the Procedure for assigning a part of the net profit (income) from the state unitary enterprises and their associations into the state budget, approved by the Resolution of the Cabinet of Ministers of Ukraine dated February 23, 2011 No. 138 (Official Bulletin of Ukraine, 2011, No. 14, Article 576; 2012, No. 87, Article 3533; 2015, No. 1, Article 9; 2016, No. 84, Article 2756, No. 100, Article 3251; 2017, No. 54, Article 1625), to establish that a part of the net profit (income) assigned by the forestry enterprises belonging to the sphere of management of the State Agency of Forest Resources, the Ministry of Defence of Ukraine, the Ministry of Ecology and Natural Resources, the Ministry of Infrastructure, the State Service of Ukraine for Emergencies and other central executive authorities to the state budget for the relevant period, is determined at **40 percent**, provided that they allocate **35 percent** of their net profit (income) from their activities to modernization and purchase of specialized machines for the collection and haulage of logging residues to the nearest roads, production and transportation of solid biofuels. The use of 35 percent of the net profit (income) is subject to a quarterly state financial audit.

2. This resolution comes into force on the day of its publication and is valid until December 31, 2020.

Prime-minister of Ukraine **V. GROISMAN**

Abbreviations

BAU – Bioenergy Association of Ukraine

CMU – Cabinet of Ministers of Ukraine

EU – European Union

FCU – Forest Code of Ukraine

toe – tons of oil equivalent

UABio – Bioenergy Association of Ukraine

Previous publications by UABio

http://www.uabio.org/en/activity/uabio-analytics

1. *Position Paper N 1* (2012) "Position of bioenergy in the draft updated energy strategy of Ukraine till 2030".
2. *Position Paper N 2* (2013) "Analysis of the Law of Ukraine "On amending the Law of Ukraine "On Electricity" No5485-VI of 20.11.2012".
3. *Position Paper N 3* (2013) "Barriers to the development of bioenergy in Ukraine".
4. *Position Paper N 4* (2013) "Prospects of biogas production and use in Ukraine".
5. *Position Paper N 5* (2013) "Prospects for the electricity generation from biomass in Ukraine"
6. *Position Paper N 6* (2013) "Prospects for heat production from biomass in Ukraine"
7. *Position Paper N 7* (2014) "Prospects for the use of agricultural residues for energy production in Ukraine".
8. *Position Paper N 8* (2014) "Energy and environmental analysis of bioenergy technologies"
9. *Position paper N 9* (2014) "State of the art and prospects for bioenergy development in Ukraine"
10. *Position paper N 10* (2014) "Prospects for the growing and use of energy crops in Ukraine"
11. *Position paper N 11* (2014) "Prospects of biomethane production and use in Ukraine"
12. *Position paper N 12* (2015) "Prospects for the development of bioenergy as an instrument for natural gas replacement in Ukraine"
13. *Position paper N 13* (2015) "Analysis of energy strategies of the EU and world countries and the role of renewables in their energy systems".
14. *Position paper N 14* (2016) "Analysis of tariff setting in the district heating sector of EU countries".
15. *Position paper N 15* (2016) "Analysis of additional sources of wood fuel in Ukraine".
16. *Position paper N 16* (2016) "Opportunities for harvesting by-products of grain corn for energy production in Ukraine".
17. *Position paper N 17* (2016) "Analysis of criteria for the sustainable development of bioenergy".
18. *Position paper N 18* (2017) "Creation of the competitive biofuel market in Ukraine".

Civic union "Bioenergy Association of Ukraine" (UABio) was established to create a common platform for cooperation on bioenergy market in Ukraine, as well as to provide the most favorable business environment, accelerated and sustainable development of bioenergy. General constituent assembly of UABio was held on September, 25, 2012 in Kyiv. The Association was officially registered on 8 April 2013. Among UABio members there are over 10 leading companies and over 20 recognized experts working in the field of bioenergy.
http://uabio.org/en/

Bioenergy Association of Ukraine