



Bioenergy Development in Ukraine

Georgiy Geletukha, PhD

Head of the Board, Bioenergy Association of Ukraine (UABio)

We are greening the energy!

UABio Members



Scientific-Engineering Centre
"Biomass"



LLC «Salix Energy»



NGO "Renewable Energy Agency"



LLC "SynEnergy Consulting"



LLC "Volyn Kalvis"



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LLC "ENERSTENA Ukraine"



"Agro-Wild Ukraine"



LLC «ACCORD-LTD»



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PE "Briquetting Technologies"



LLC "Smilaenergopromtrans"



Еко Енерджи

PJSC "MHP Eko Energy"



LLC "Boiler factory "Kriger"



LLC «Kyiv Green Energy»



Ukrainian heat generating
company "Ukrteplo"



Energy-Industrial Group
«Yugenergopromtrans»



DP «Siemens Ukraine»



LLC "Metropoliya Science and
Technology Company"

МЕТРОПОЛІЯ



Private Enterprise «Kramar»



Institute of Engineering
Thermophysics of NAS of Ukraine



LLC "NLM-GROUP"



LLC "Atis Energy"



LLC "Gals Agro"



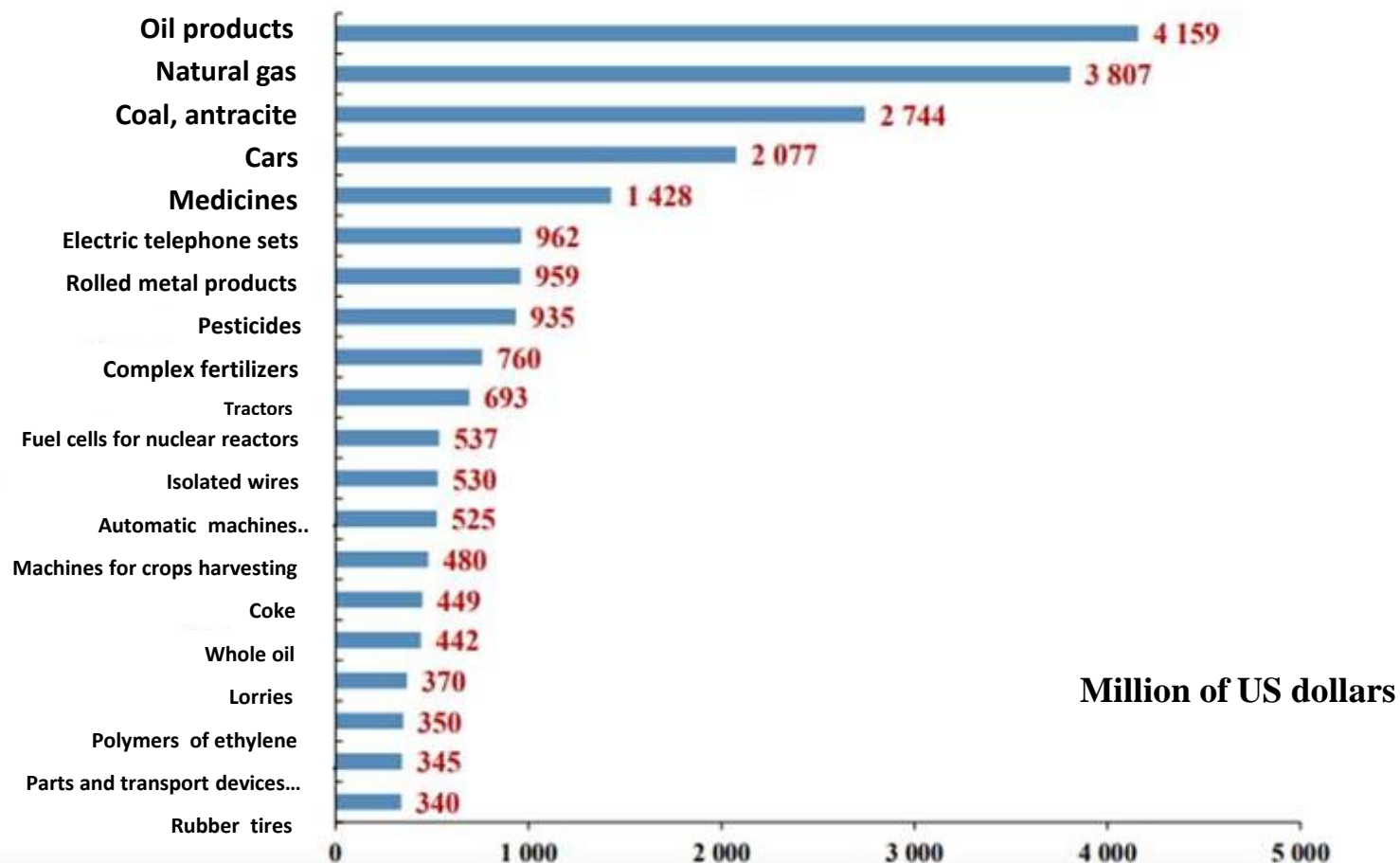
LLC "Khmelnyska biofuel power plant"

Maraykin R., Petrov Ya., Grais O., Bereznytska M., Epshtein Yu., Galchyńska Yu. Moroz O.

Teush S., Stupak S., Romanyuk O., Kotsar O., Hritsyshyna M., Sysoiev M., Kharchyna E., Semyanchuk R.

Ukraine imports of energy carriers on **10,7 bill \$/ year** – **46% of total import (2017)**

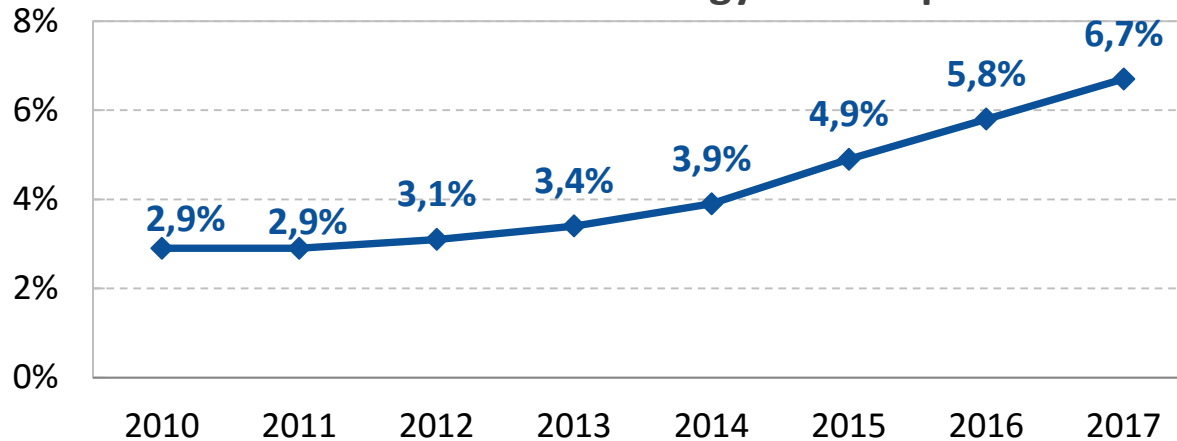
The structure of Ukraine import in 2017. Principal items



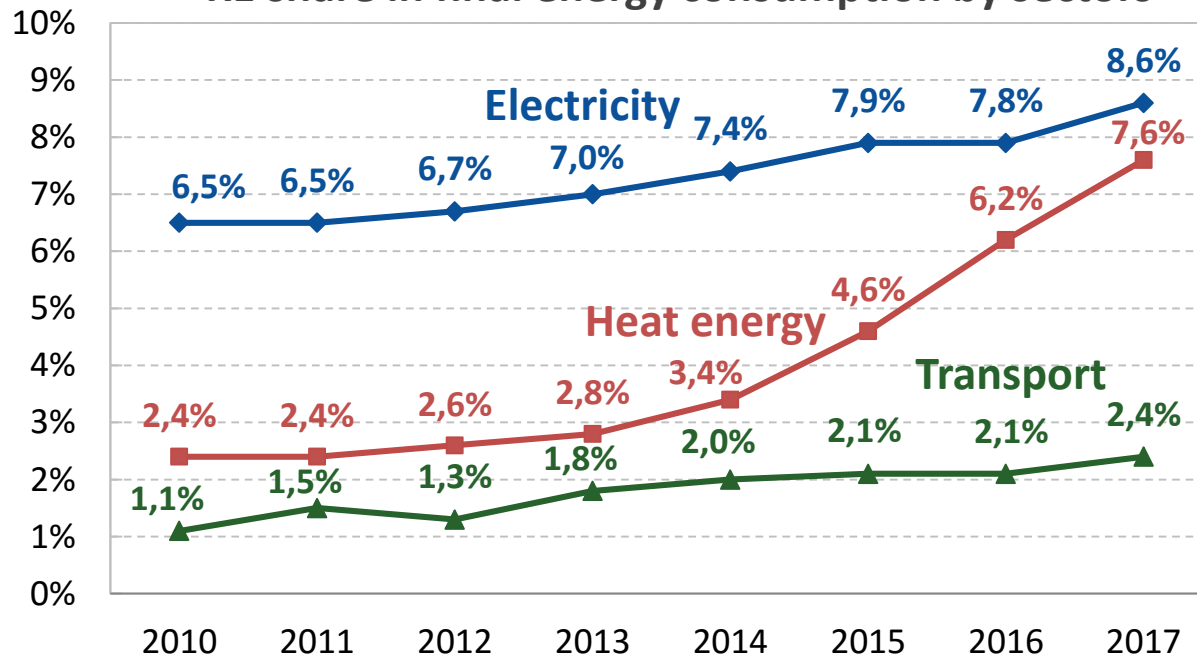
Bioenergy is a Key Sector of Renewable Energy in Ukraine, 2010-2017



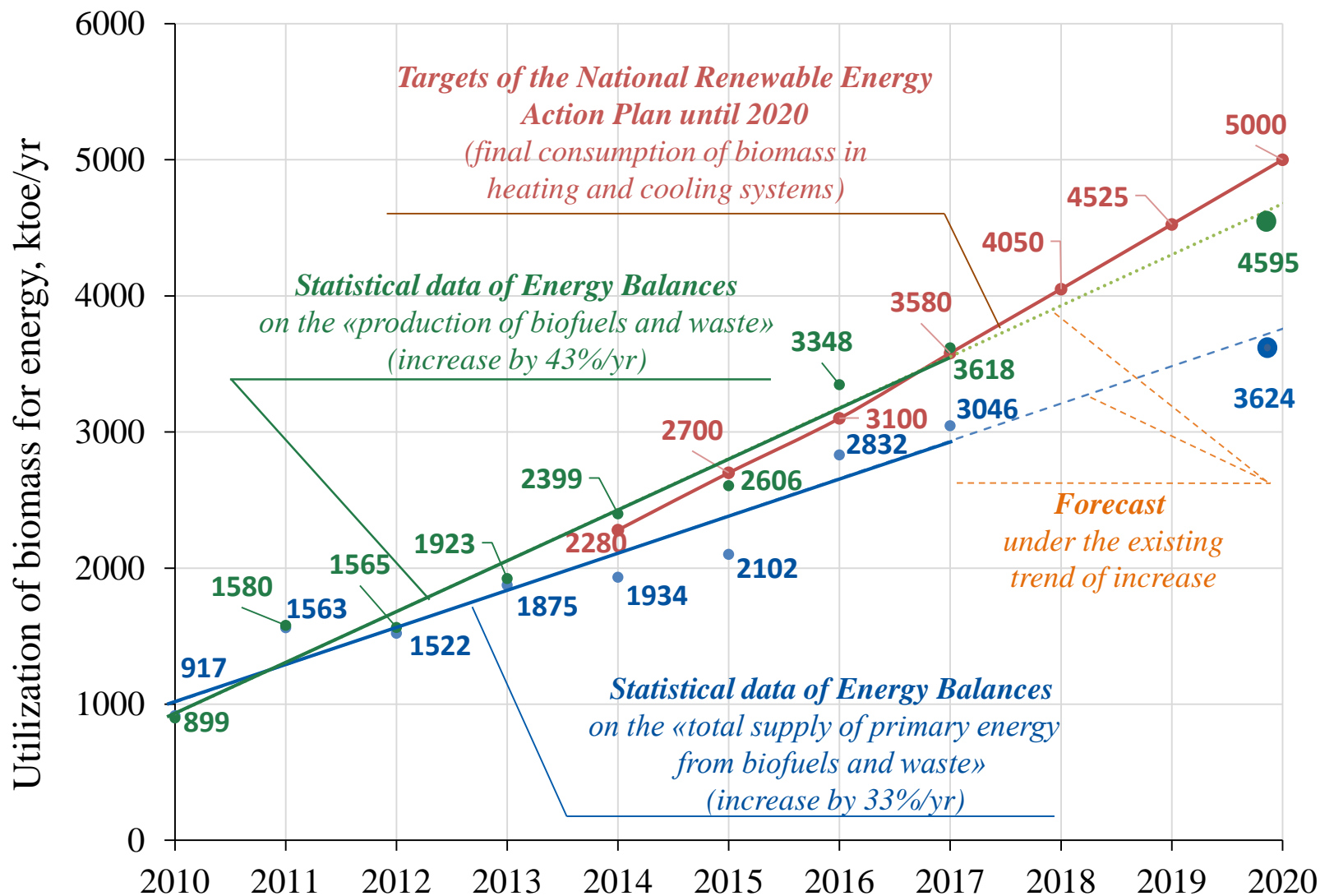
RES share in total final energy consumption



RE share in final energy consumption by sectors



Growth of bioenergy in Ukraine - 33%/year (2010-2017)



Forecast of Bioenergy Development in Ukraine – Growth in more than 5 times (2015 – 2035)

Type of energy source	2015 (fact)	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 Wastes	2,1	4	6	8	11
Solar and Wind Energy	0,1	1	2	5	10
Hydro Energy	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

Source: http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art_id=245234085&cat_id=35109

Energy Potential of Biomass in Ukraine exceeds 25 bill m3 of natural gas/ year (2017)

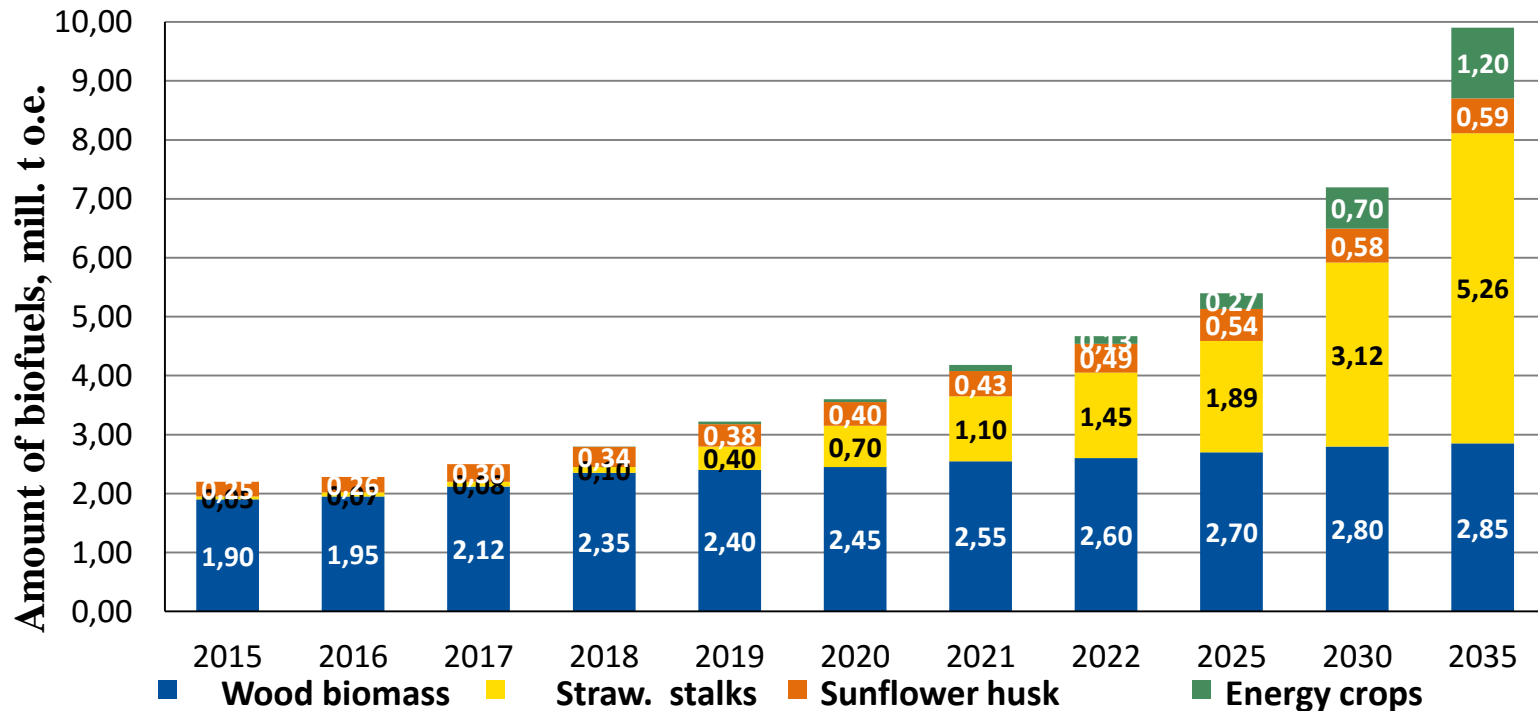
Type of biomass	Theoretical potential, Mt	Potential available for energy	
		Share of theoretical potential, %	Mtoe
Straw of grain crops	35.6	30	3.65
Straw of rape	3.9	40	0.54
By-products of grain corn production (stalks, cobs)	32.1	40	2.45
By-products of sunflower production (stalks, heads)	23.2	40	1.33
Secondary agricultural residues (sunflower husk)	2.4	100	0.99
Wood biomass (firewood, felling residues, wood processing waste)	6.6	94	1.54
Wood biomass (dead wood, wood from shelterbelt forests, pruning)	8.8	44	1.01
Biodiesel (rapeseed)	-	-	0.31
Bioethanol (corn and sugar beet)	-	-	0.59
Biogas from waste and by-products of agricultural sector	1.6 bln m ³ CH ₄	50	0.68
Landfill gas	0.6 bln m ³ CH ₄	34	0.18
Sewage gas (industrial and municipal wastewater)	1.0 bln m ³ CH ₄	23	0.19
Energy crops:			
- willow, poplar, miscanthus (1 mln ha*)	11.5	100	4.88
- corn for biogas (1 mln ha*)	3.0 bln m ³ CH ₄	100	2.58
TOTAL <i>*In case of growing on 1 mln ha of unused agricultural land.</i>	-	-	<u>20.92</u>

43%

36%

Agrobiomass is a Future of Bioenergy in Ukraine

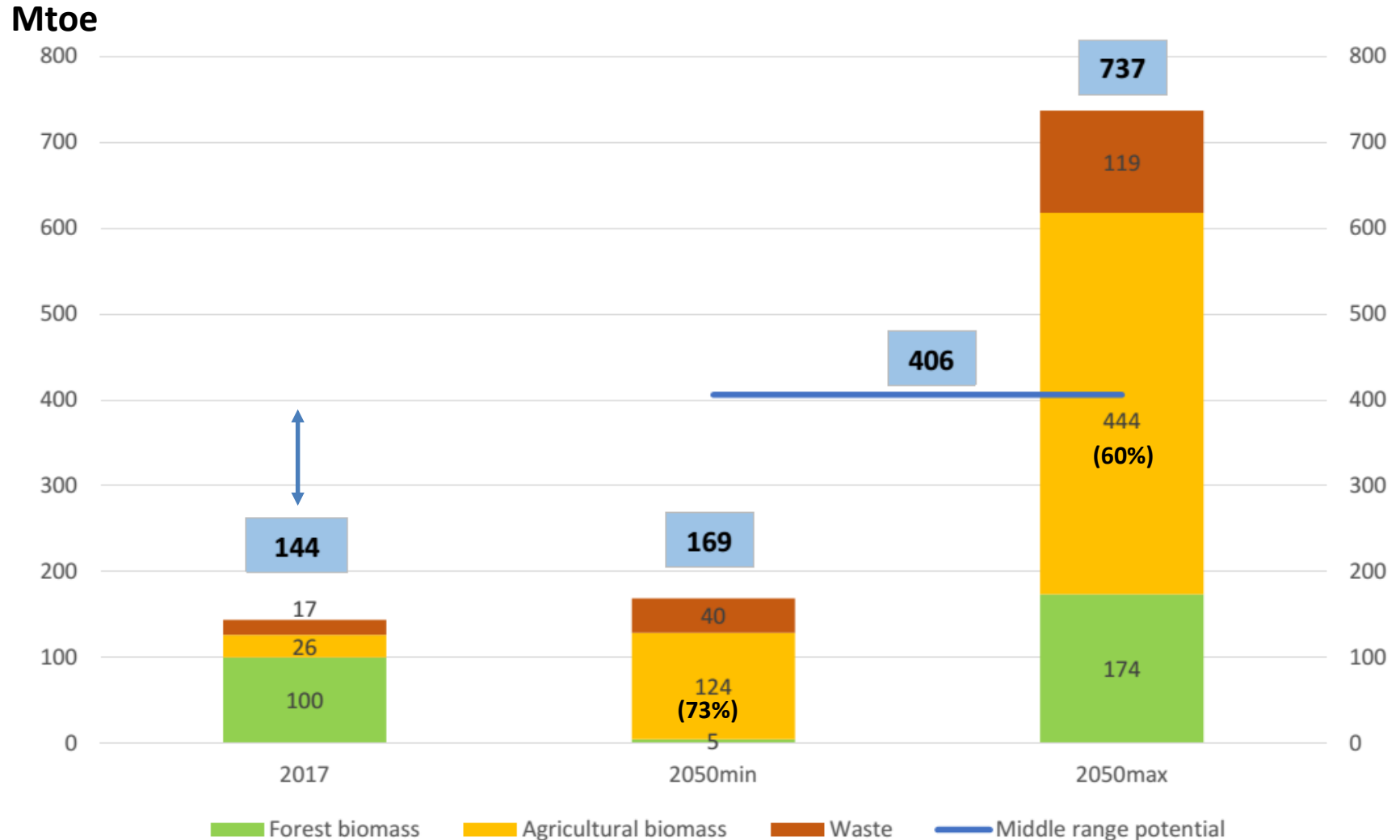
Forecast of total amount of consumption and structure of solid biofuels in Ukraine (2015 – 2035)



Type of biomass	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
Wood fuels	1,90	1,95	2,12	2,35	2,40	2,45	2,55	2,60	2,70	2,80	2,85
Straw, stalks	0,05	0,07	0,08	0,10	0,40	0,70	1,10	1,45	1,89	3,12	5,26
Sunflower husk	0,25	0,26	0,30	0,34	0,38	0,40	0,43	0,49	0,54	0,58	0,59
Energy crops	0,00	0,00	0,00	0,01	0,04	0,05	0,10	0,13	0,27	0,70	1,20
TOTAL, Mtoe	2,20	2,28	2,50	2,80	3,22	3,60	4,18	4,67	5,40	7,20	9,90

Agrobiomass is a Future of Bioenergy in Ukraine

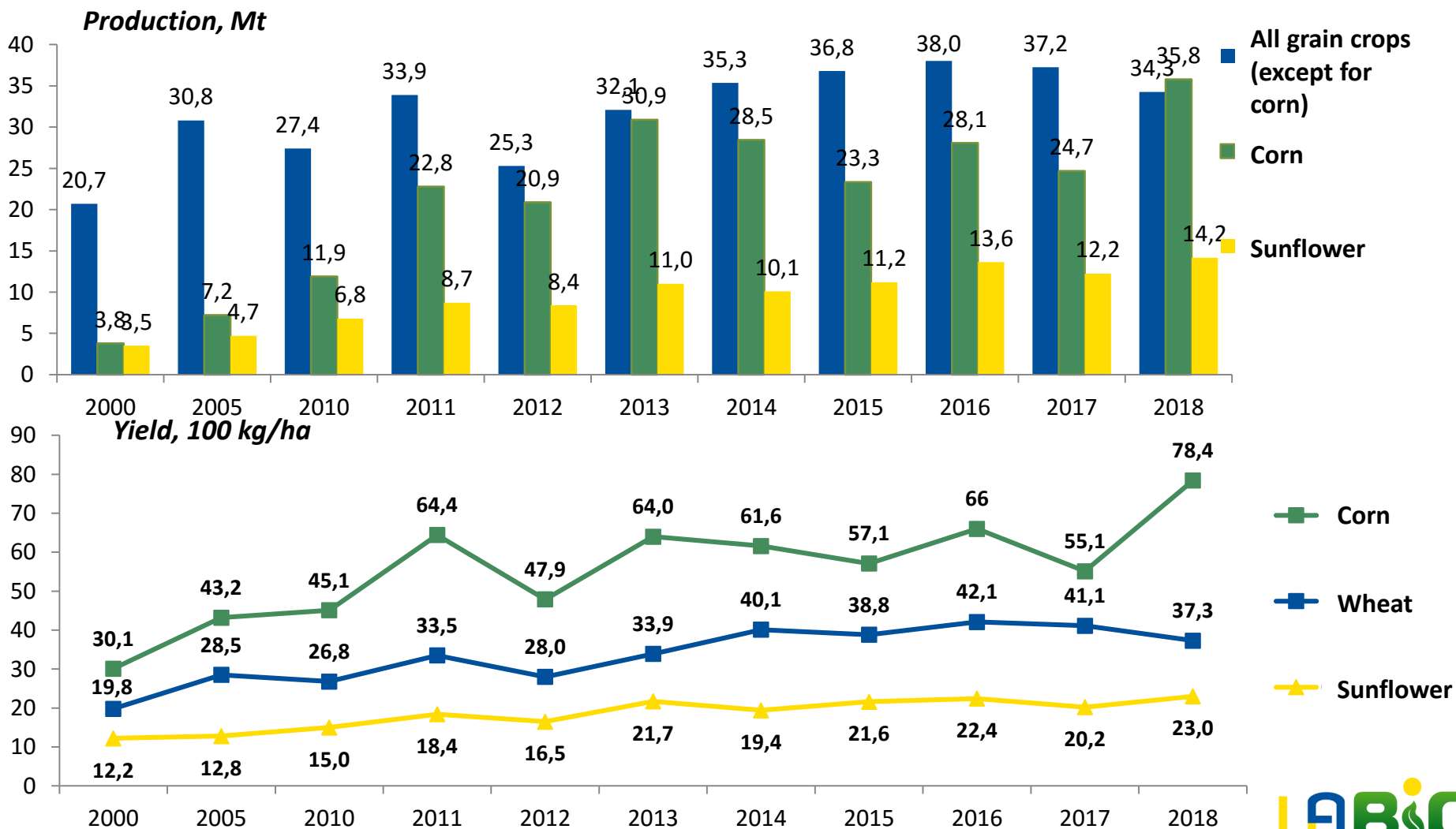
Gross inland energy consumption of biomass in 2017 and potential in 2050 for the EU-28



Source: Statistical Report. Biomass supply, Bioenergy Europe, 2019
<https://bioenergyeurope.org/statistical-report-2019/>

Corn is a bioenergy perspective for Ukraine

Dynamics of production of main agricultural crops in Ukraine



Corn is a bioenergy perspective for Ukraine

Chemical composition and properties of different types of biomass

Parameters	Yellow straw	Grey straw	Straw of winter wheat	Corn stalks*	Sunflower stalks*	Wood chips
Moisture, %	10-20	10-20	11.2	45-60 (after harvesting) 15-18 (air dried)	60-70% (after harvesting) ~20 (air dried)	40
Lower heating value, MJ/kg	14.4	15	14.96	16.7 (c.p.) 5-8 (W 45-60%) 15-17 (W 15-18%)	16 (W<16%)	10.4
Volatile components, %	>70	>70	80.2	67	73	>70
Ash, %	4	3	6.59	6-9	10-12	0.6-1.5
Elementary composition, %:						
carbon	42	43	45.64	45.5	44,1	50
hydrogen	5	5.2	5.97	5.5	5.0	6
oxygen	37	38	41.36	41.5	39.4	43
chlorine	0.75	0.2	0.392	0.2	0.7-0.8	0.02
potassium (alkali metal)	1.18	0.22	–	cobs: 6.1 mg/kg d.m.	5.0	0.13-0.35
nitrogen	0.35	0.41	0.37	0.69; 0.3	0.7	0.3
sulphur	0.16	0.13	0.08	0.04	0.1	0.05
Ash melting temperature, °C	800-1000	950-1100	1150	1050-1200	800-1270	1000-1400

d.m. – dry matter; *W* – moisture.

* Volatile components, ash, and elementary composition are given as *d.m.* mass %.

**Potential of energy crops is equivalent to
8.9 billion m³ of natural gas per year (for 2 million ha)**

Type of biomass	Theoretical potential, Mt	Potential available for energy, Mtoe
Willow, poplar, miscanthus (for 1 Mha)	11.5	4.88
Corn for biogas (for 1 Mha)	3.0 billion m ³ CH ₄	2.58
TOTAL		7.46

Economic indexes for energy crop production

Name	Unit	Poplar		Willow		Miscanthus	
		No subsidy	Subsidy: 20 000 UAH (649 EUR)	No subsidy	Subsidy: 21 000 UAH (681 EUR)	No subsidy	Subsidy: 24 000 UAH (778 EUR)
Capital costs	EUR/ha	1192	541	1282	599	4021	3240
Subsidy as a share of capital costs	%		55		53		19
Operating costs	EUR/ha	176	176	45	45	45	45
Profit	EUR/ha	396	396	310	310	854	854
Credit share (8 years; 8%/yr)	%	60	60	60	60	60	60
NPV	EUR	557	1085	715	1250	3684	4334
IRR	%	11.3	21.7	11.9	21.4	17.0	21.5
Simple payback period	EUR	8.4	5.0	8.2	5.3	6.0	4.7

Bioenergy potential from shelterbelt forests, other protective forest belts and possibility of using this potential

Source of wood fuel	Area, 1000 ha	Total resources, million m ³ *	Period for reconstruction of protective forest belts (use of biomass)	Economic potential of wood fuel
				ktoe/yr
Shelterbelt forests	422.2	63.3	20	446.3
Forest belts alongside of motor roads	44.9	6.8	10	23.7
Forest belts alongside of railways	19.8	3.0	10	15.7
TOTAL	486.9	73.1		485.7

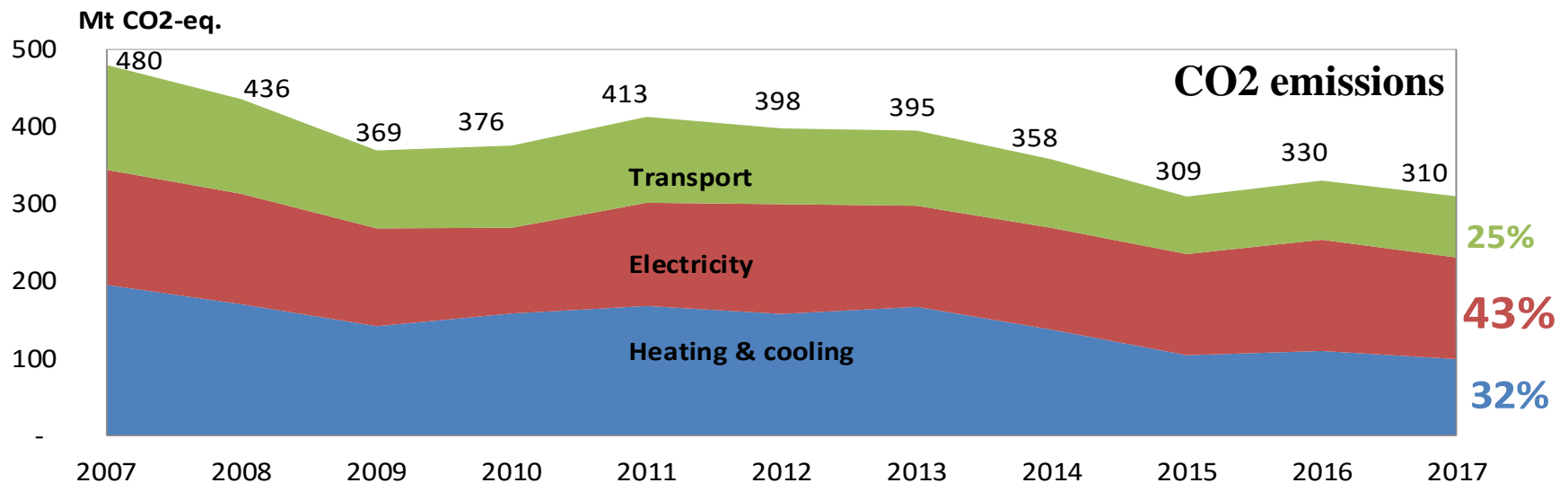
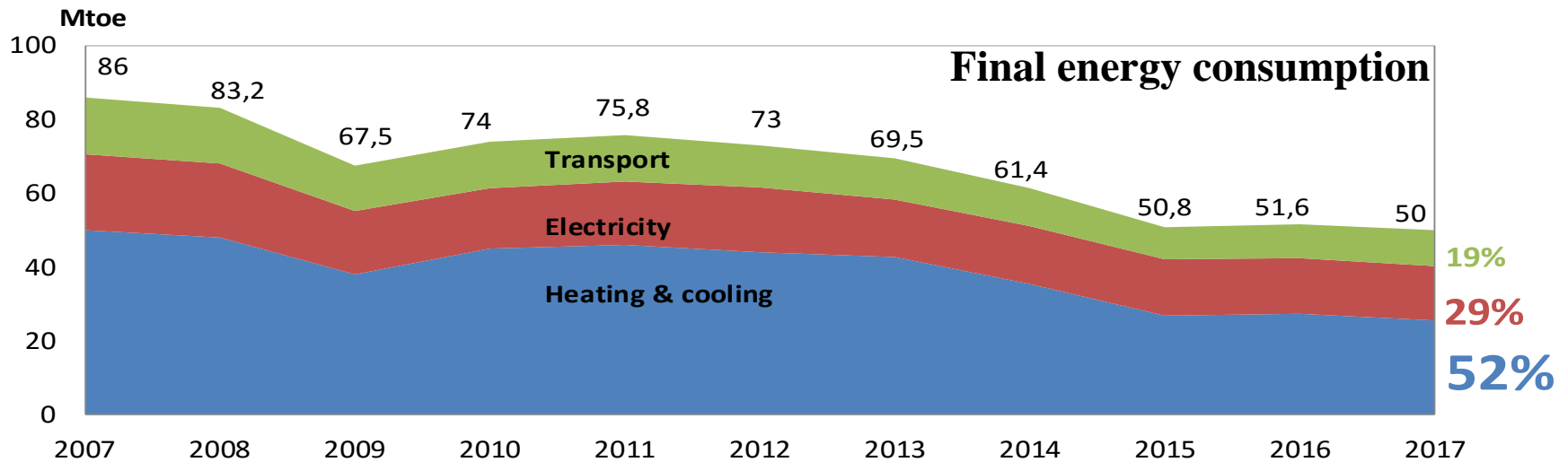
* Assessment based on the yield of fuel (not merchantable) wood – 150 m³/ha.

- ✓ Land under shelterbelt forests was transferred to the ownership of Amalgamated Territorial Communities.
- ✓ Shelterbelt forests and other protective forest belts urgently require reconstruction and renewal!
- ✓ We consider it necessary to develop and adopt **State Program** for the reconstruction and renewal of shelterbelt forests in Ukraine (for example based on the current Concept for the development of agricultural afforestation in Ukraine)



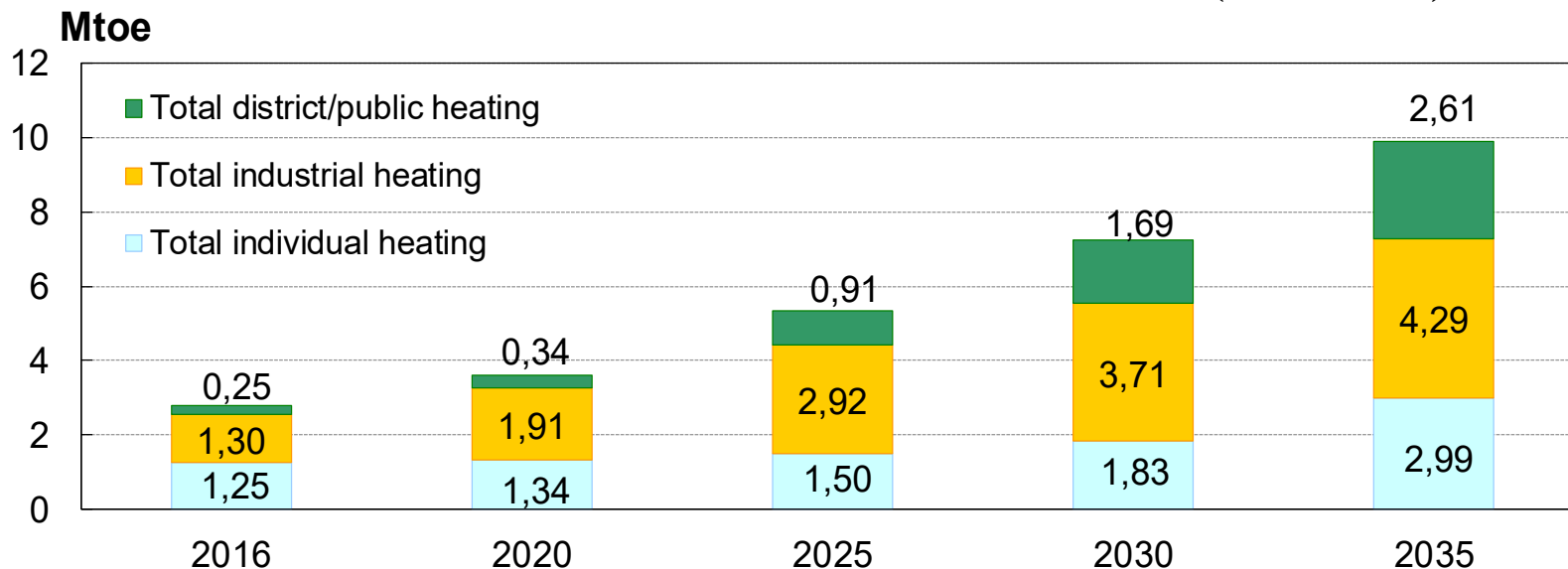
«Energy» is not equal «Electric Energy»

Structure of final energy consumption of Ukraine and CO2 emissions, 2007-2017

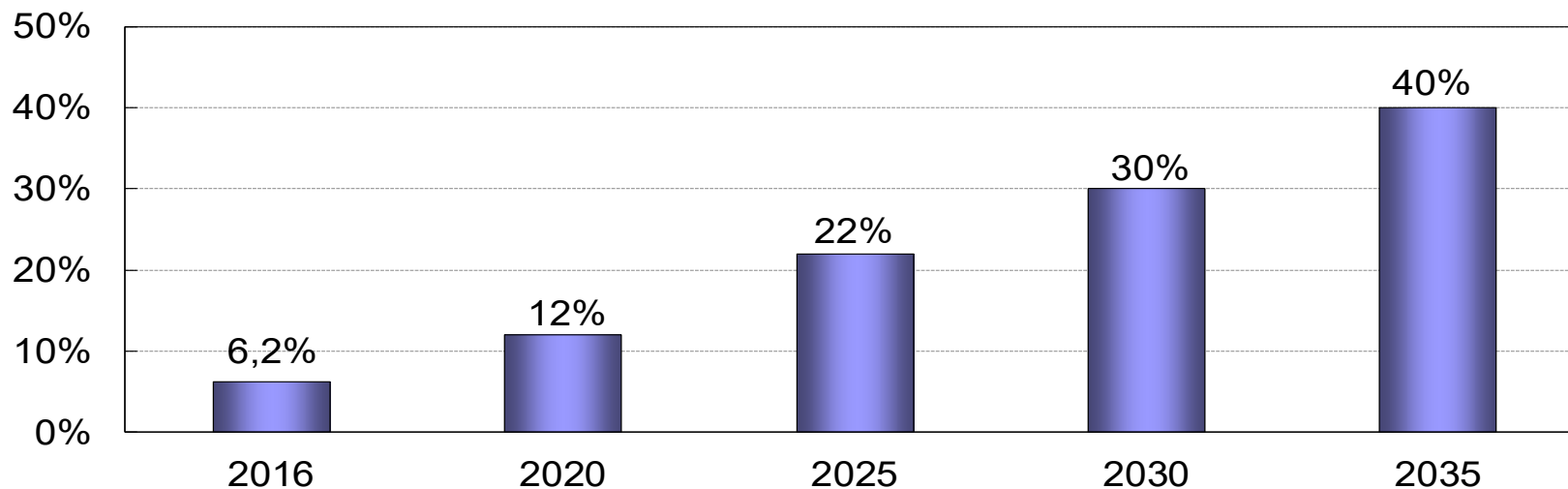


Moving to 40% of Renewable Heat in Ukraine

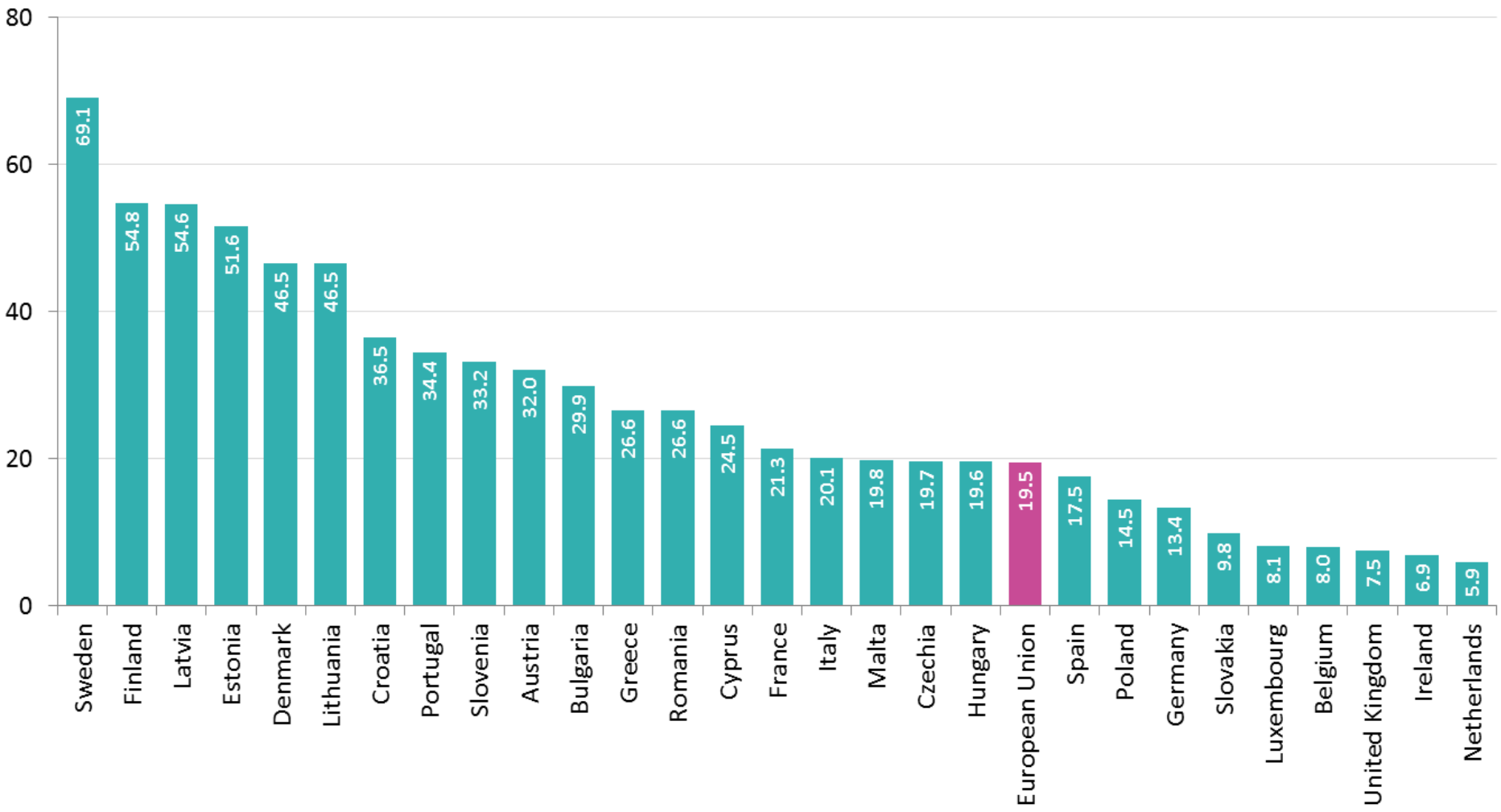
Forecast of Renewable Heat Production in Ukraine (2016-2035)



Forecast of RES share in heat production (2016-2035), %



Share of Total Energy Used for Heating and Cooling from Renewable Sources in EU, 2017 (in %).



Source: ec.europa.eu/eurostat

Forecast of Renewable Heat Production in Ukraine (2016 – 2035)

Year	MW, heat	MW _e	Mtoe	NG replacement, billion m ³	Share of RES	CO ₂ reduction, MtCO ₂ /yr	Total investments, million Euro	Total new jobs
2016	5000	45	2,8	3,5	6,2%	6,2	1 000	13 000
2020*	7 000	250	3,6	4,4	12%	8,6	1 800	22 000
2025	11 250	800	5,3	6,6	22%	12,9	3 800	42 000
2030	16 200	1260	7,2	8,9	30%	17,5	5 700	64 000
2035* *	24 000	1780	9,9	12,2	40%	24,0	8 000	97 000

* according Renewable Energy Action Plan till 2020.

** according Energy Strategy of Ukraine till 2035.

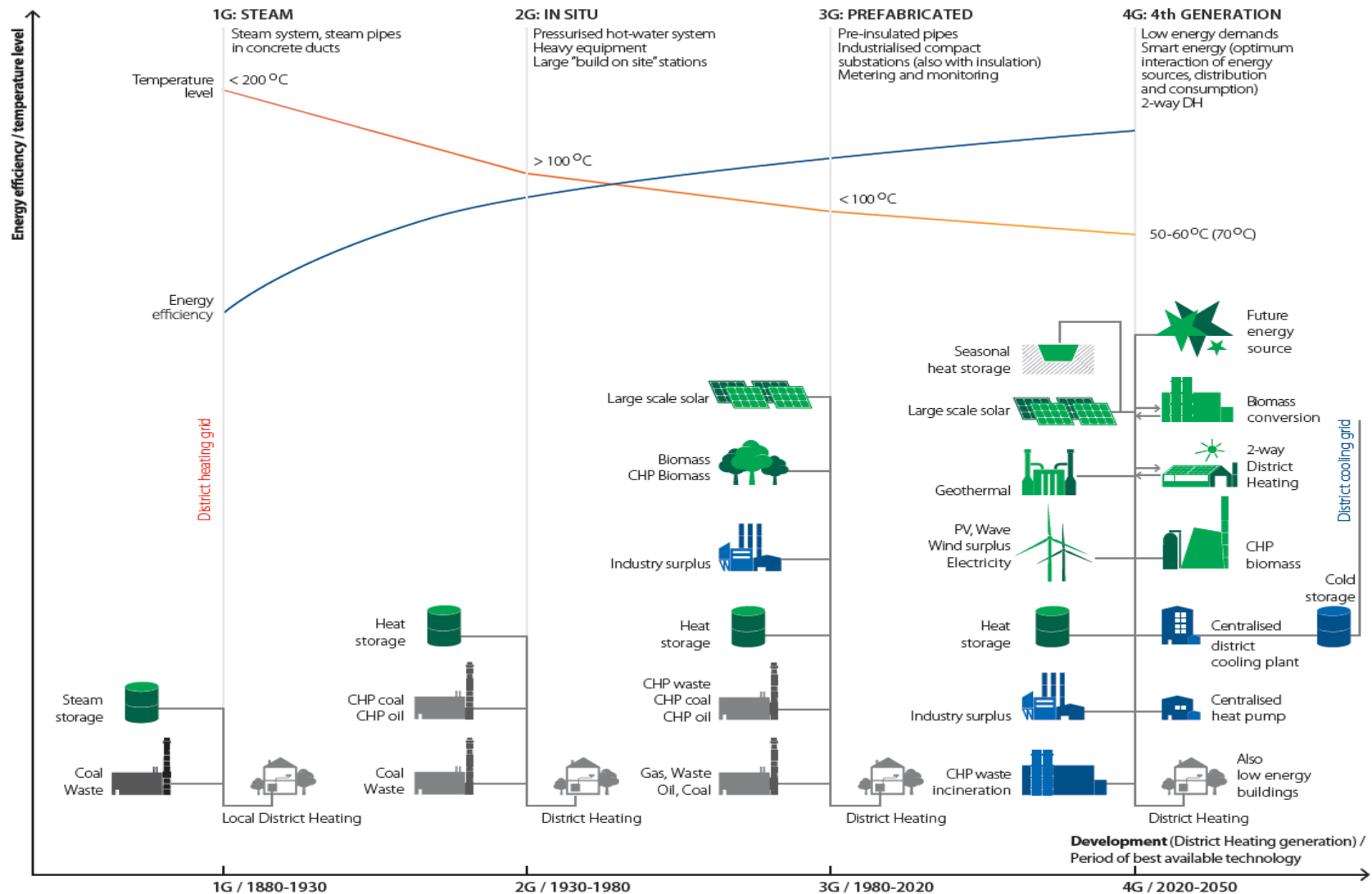
Road Map to improve DH systems efficiency *

Strategic / Legislative level:

Governmental decision	The Heat Supply Strategy of Ukraine until 2035 and the Action Plan for its implementation.
Law of Ukraine "On Heat supply"	<ol style="list-style-type: none">1. Priority for DH systems.2. The term "Efficient district heating system" introduction (according to Directive 2012/27/EC) and increasing the share of them in the DH of Ukraine. <i>"efficient district heating and cooling" means a district heating or cooling system using at least 50% renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat.</i>3. Heat supply development plans introduction.4. Responsibility for the lack of heat supply schemes.5. Non-discriminatory access to heat networks for heat energy producers.6. Zoning principle introduction.
Law of Ukraine dated "On cogeneration ..."	incentive measures and/or administrative obligations for the development of high-efficiency cogeneration in Ukraine.

* According draft report of USAID Municipal Energy Reform project

Development Diagram for District Heating

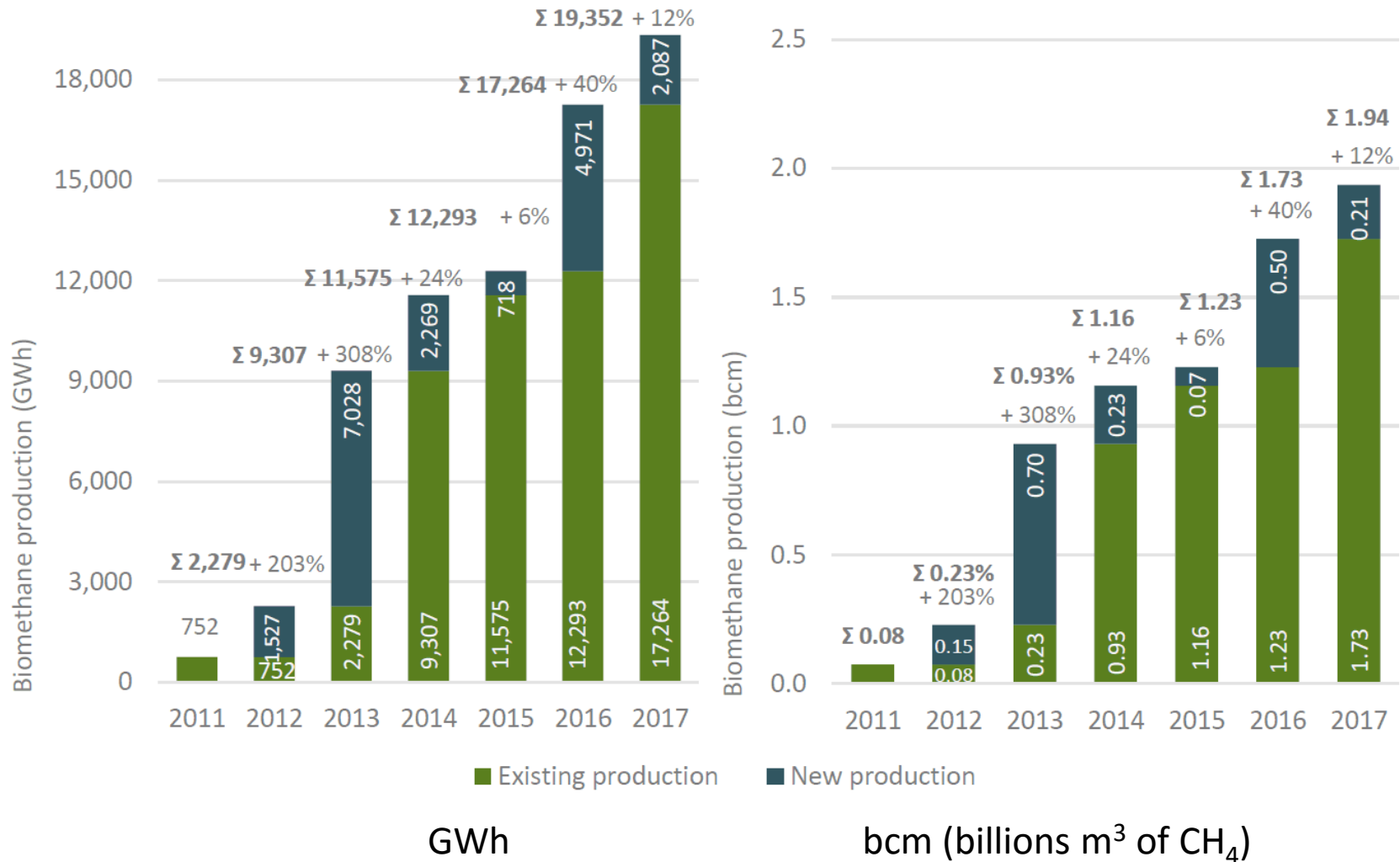


Source: Henrik Lund, ... 4th Generation District Heating (4GDH), 2014:

<https://doi.org/10.1016/j.energy.2014.02.089>

Biomethane – Future of Biogas

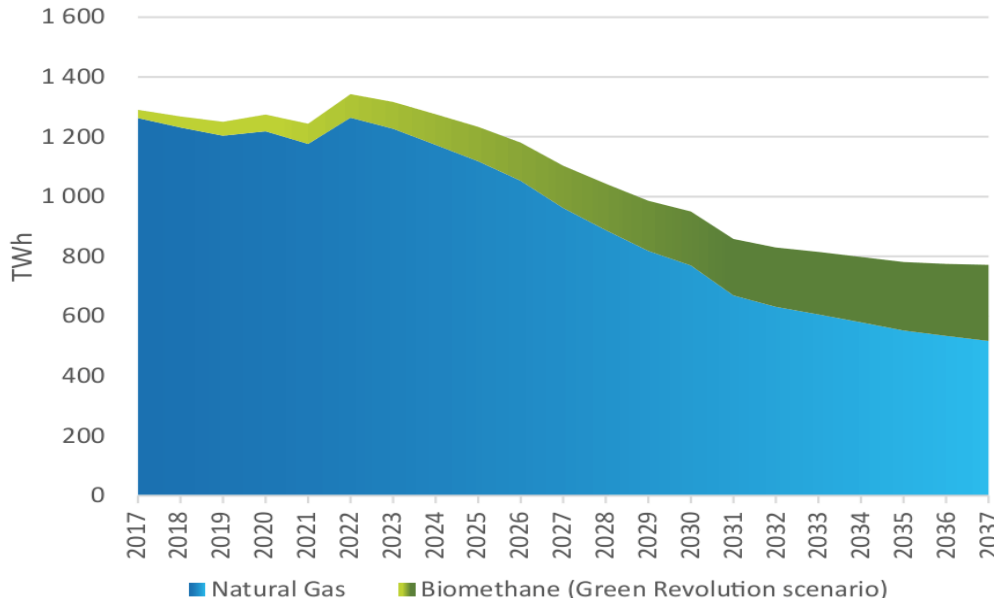
Biomethane production in European countries (2011-2017)



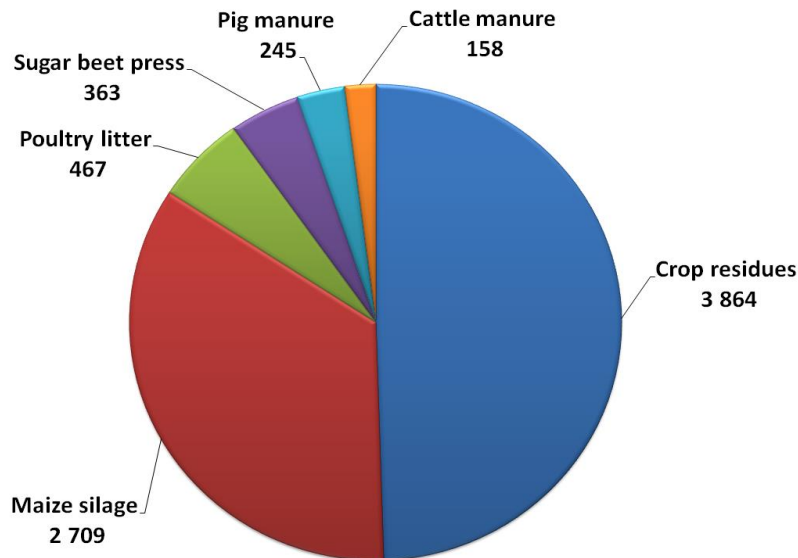
Source: EBA Statistical Report 2018

Biomethane – Future of Biogas

Natural gas and biomethane productions in Europe by 2037



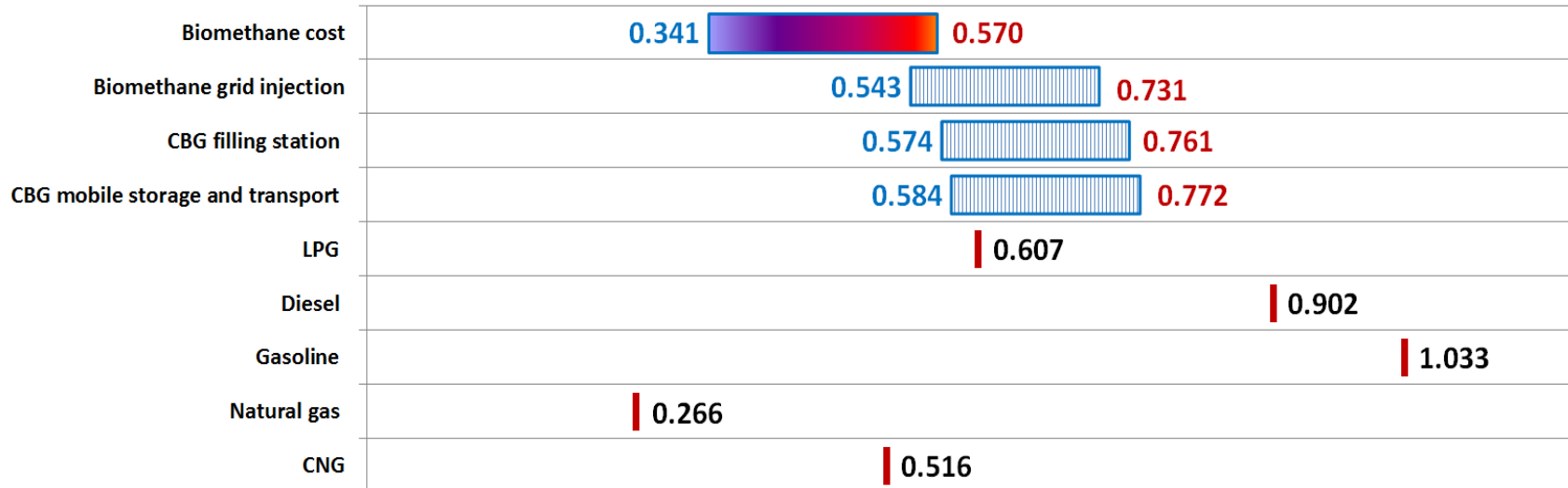
Source: European Network of Transmission System Operators for Gas: Ten-Year Network Development Plan 2017 (TYNDP 20p17 – ENTSOG)



Biomethane potential in Ukraine in 1000 Nm^3 - 7.8 bln m^3 CH_4 or 25% of NG consumption (2018)

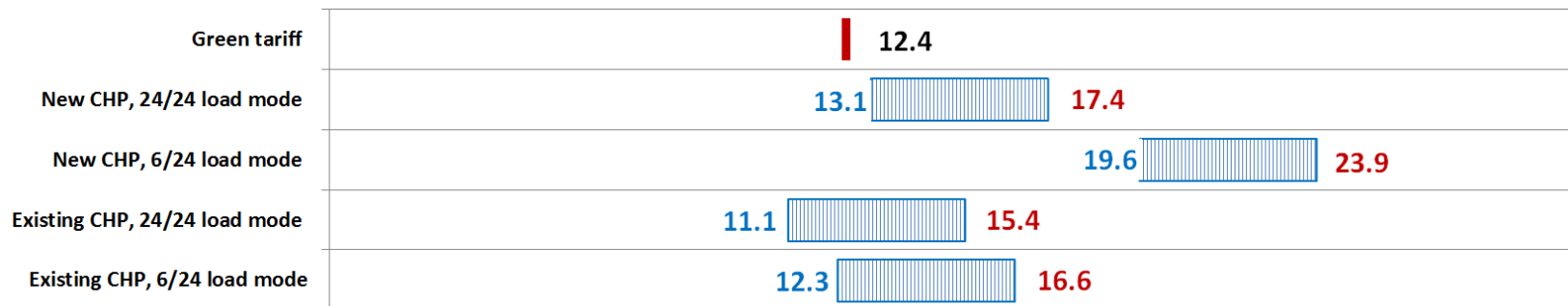
Biomethane cost in comparison with fossil fuels alternatives

Biomethane as fuel



€/m³ biomethane equivalent

Biomethane for power/heat production



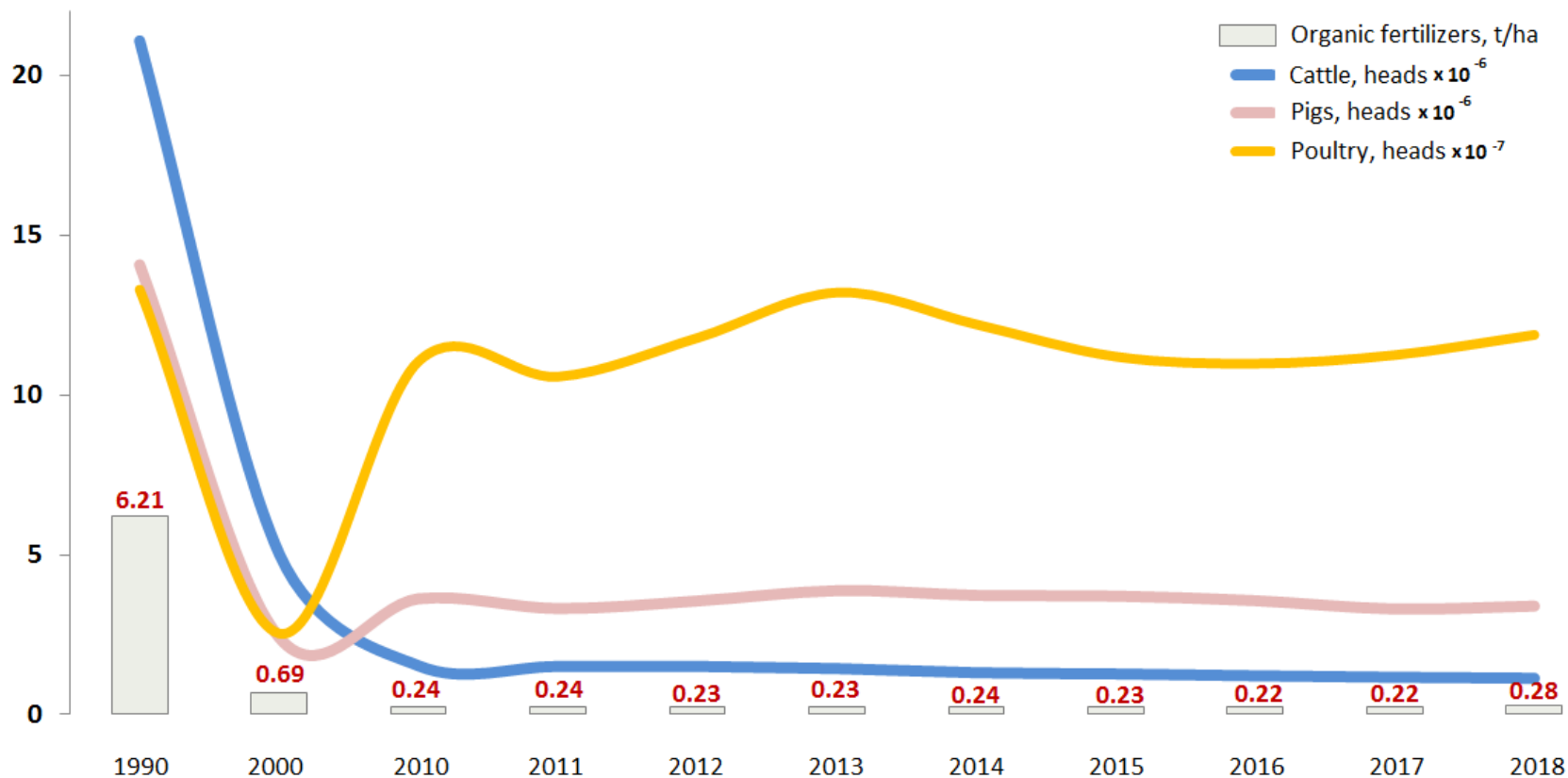
cent/kWh, w/o VAT

Possibility of biomethane stimulation through feed-in-tariff for electricity from biomethane

Changes in the Law of Ukraine "On amendments to the law of Ukraine "On Alternative Energy Sources" are needed

Categories of energy units	Green tariff, EUR/kWh without VAT
For electricity produced from biomethane with more than 60% of heat utilization by unit with installed electrical capacity > 5 Mw_e (new CHP)	0,140
For electricity produced from biomethane with more than 60% of heat utilization by unit with installed electrical capacity < 5 Mw_e (new CHP)	0,160
For electricity produced from biomethane with more than 60% of heat utilization (existing CHP)	0,123
For electricity produced for regulation purpose during peak load hours (6/24, new CHP)	0,20 - 0,24
For electricity produced for regulation purpose during peak load hours (6/24, existing CHP)	0,123

Bioenergy is a Source of Organic Fertilizers for Organic Farming

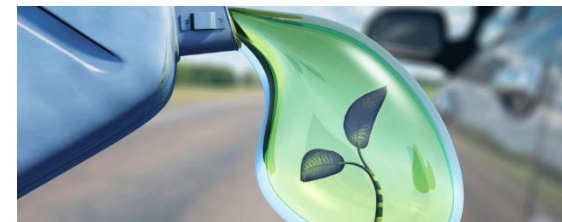


- ❑ Anaerobic digestion is one of the most rational ways to convert organic matter into organic fertilizers
- ❑ The introduction of organics with food by-products, the organic part of MSW, etc., would compensate for the reduction of manure due to the fall in the number of animals in Ukraine
- ❑ Existing methods of digestate pretreatment before the use as fertilizers make it possible to ensure a complete cycle of organic turnover in a sustainable and environmentally sound manner

Ukraine has prospects for the production of bioethanol!

Existing preconditions:

- ❑ Idle sugar mills and alcohol plants can **produce bioethanol**.
- ❑ Production of bioethanol can be **profitable** with payback period of 5-6 yr and IRR > 20%.
- ❑ Under certain conditions (use of molasses as feedstock, use of biomass heat in the production process etc.) first-generation bioethanol may meet CO₂ reduction requirements: **60%** for installations put into operation after 05.10.2015 (RED II, draft Law of Ukraine № 7348 of 29.11.2017).



What shall be done:

- ❑ To reconsider (or postpone) **requirement for CO₂ reduction** in draft Law of Ukraine № 7348 of 29.11.2017.
- ❑ To adopt **draft Law of Ukraine № 7348** of 29.11.2017 which:
 - Sets **targets** for presence of liquid biofuels in Ukraine's market (in energy %). Bioethanol: not less than 3.4% from 01.01.2019 and 4.8% from 01.01.2020; biodiesel: not less than 2.7% from 01.01.2019.
 - Introduces **sustainability criteria**: requirements for CO₂ reduction and restrictions for feedstock origin (land use and protection, biodiversity).

Prospects of energy utilization of municipal solid waste

Project type	MBT with biogas production	MBT with SRF production for cement industry	Production of SRF for energy use (DH)	MSW incineration with energy use
CAPEX, €/t/yr)	200–400	150–300	400–600	500–1000
MSW treatment cost, €/t	30–80	25–60	80–100	90–150
Potential income, €/t	30–50	0–(5)	40–75	40–75
MSW treatment tariff (gate fee), €/t	0*–40	25–60	40–50	50–100

* - for electricity and thermal energy commercial use

MSW management tariff (2018): 87,4-116,7 UAH/m³ (total), including 60,2 – 83 UAH/m³ (for transportation) and 27,2-33,7 UAH/m³ (for landfilling); or

16-22 €/t (total), including 11 –16 €/t (for transportation) and 5-6 €/t (for landfilling)

At MSW generation rate 350 kg/year per person allocation 1% of average household resource for solid waste service, the tariff corresponds to 1316 UAH/t (or **41 EUR/t**), including 11 –16 €/t (for transportation) and **25-30 €/t (for gate fee)**.

This value corresponds to monthly fee of 99 UAH per household or 38 UAH per person.

Auctions are more profitable for bioenergy projects than green tariffs

Feasibility Study of Biogas Plant 2 MW (maize silage – 35%, pig manure – 65%)

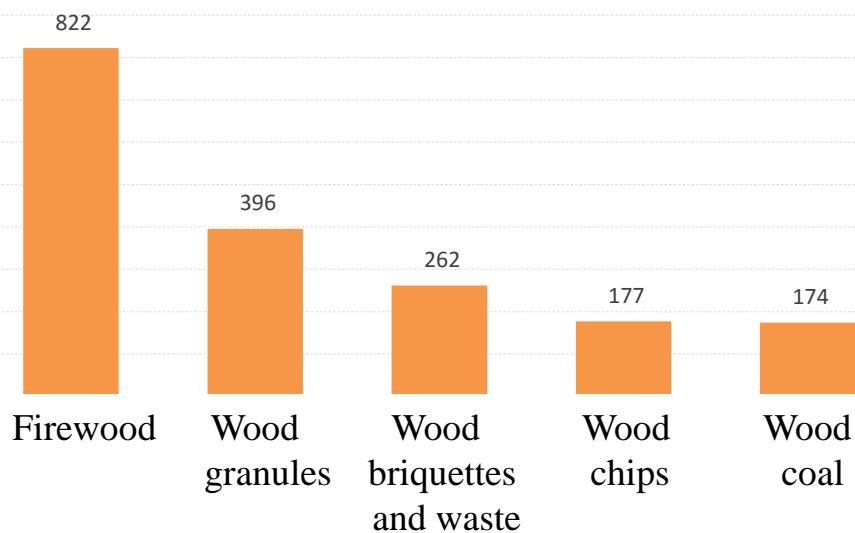
Project parameters	Model	
	Green tariff	Auctions
Electricity tariff, cents/kWh (w/o VAT)	12,39 (by end of 2029) 6,0 (from 2030)	11,15 (for 20 years)
CAPEX, mill €	5.74	5.74
CAPEX, €/kW _{el}	2 700	2 700
NPV, th. €	1 833	3 364
IRR, %	14.2%	15.3%
SPP, years	5.5	6.5

Ukraine exports **2.38 million tones** of solid biofuels per year, equivalent to **0.7 billion m3 of natural gas/ year**

Export of solid biofuels from Ukraine
in 2018, in thousand tons

Total: **2.38 million tons**

Export, th. t



Export of solid biofuels from Ukraine
in 2018, in million UAH

Total: **6.48 billion UAH**

Export, mill. UAH



Priorities for improving normative and legal basis of bioenergy



Introduction of the system for electronic trade of solid biofuels. Draft Law of Ukraine has been developed jointly with the State Agency on Energy Efficiency and Energy Saving of Ukraine.



Introduction of competition in district heating systems. Draft Law of Ukraine has been developed jointly with the State Agency on Energy Efficiency and Energy Saving of Ukraine.



Development of stimulation mechanisms for power production facilities based on biomass, biogas and biomethane for the operation in **balancing facility market**.



Development of a stimulation mechanism for the production and consumption of **biomethane** for feeding into gas network and for use in the transport sector.



Development of a stimulation mechanism for the **growing and use of energy crops** in Ukraine.



Development of a stimulation mechanism for the **production and use of liquid biofuels and biogas in the transport sector** in Ukraine. It is necessary to adopt draft Law of Ukraine № 7348.



It is necessary to amend Law of Ukraine «On heat supply» as for **setting tariffs for heat from alternative energy sources**.



It is necessary to **repeal CO₂ tax** for biomass/biogas boiler plants and TPP/CHP plants.

Project «Promoting the penetration of agri biomass heating in European rural areas»



Funded through EU Program Horizon 2020

Duration: January 2019 – December 2021

Consortium: 13 partners from 9 European countries (Greece, Spain, Austria, Denmark, Belgium, Croatia, Romania, Ukraine, France).

Coordinator: Centre for Research and Technology Hellas (CERTH, Greece).

Bioenergy Association of Ukraine (UABio) is a project partner from Ukraine.

In AgroBioHeat, among others, UABio is Leader of Task 5.2 «National Strategic Plan», Task 5.3 «National policy workshops & Advocacy actions», and is primarily responsible for the preparation of a booklet on «**Maize Residues-to-Energy**».

Through its activities, AgroBioHeat aims **to raise confidence on agri biomass**, empower local stakeholders to unblock the market and influence the development of the European and national framework in a way that is favourable to **agri biomass heating solutions** market uptake. Actions will be mainly located in **6 European countries**: Greece, Spain, France, Romania, Croatia and **Ukraine**.

Horizon 2020 Project “Promoting Sustainable Use of Underutilised Lands for Bioenergy Production through a Web-Based Platform for Europe”

Duration: 1 Nov 2018 – 31 Oct 2021

Consortium: 12 partners from 10 European countries (Germany, Italy, Hungary, Austria, **Ukraine**, Spain, Romania, Belgium, Netherlands, Finland).

Coordinator: WIP-Renewable Energies (WIP) Wirtschaft & Infrastruktur GmbH & Co Planungs KG

BIOPLAT-EU will produce a comprehensive online web-based platform for supporting the decision-making process for new bioenergy investment projects that rely on biomass from marginal, underutilized and contaminated lands in Europe and Ukraine.

BIOPLAT-EU platform

Project website		webGIS tool		
		GIS maps		STEN tool
Information about the project	Help Desk	data from other projects	own data	



Contact person in Ukraine :
Oleksandra Tryboi
tryboi@biomass.kiev.ua



European Union's H2020-LCE research and innovation programme under grant agreement No 818083.

Project «REnewable GAs TRAdE Centre in Europe»



*Funded through EU Program Horizon 2020
Duration: 36 months (June 2019 – May 2022)*

Consortium: 15 partners in 10 countries: ISINNOVA, CIB (IT), EBA, AIB, ERGaR, Fluxys (BE), RFGI (IE), DENA, DBFZ (DE), AGCS (AT), Elering (EE), UPEBI (PL), ARBIO (RO), NEDGIA (ES), Amber (LT).
12 EBA (European Bioenergy Association) Linked Third Parties + 5 ERGaR (European Renewable Gas Registry) Linked Third Parties

Bioenergy Association of Ukraine (UABio) is linked to EBA and involved in the task «Support for biomethane market uptake»

REGATRACE project aims creating an efficient trade system based on issuing and trading biomethane/renewable gases Guarantees of Origin (GoO). This objective will be achieved through the founding pillars: - European biomethane/renewable gases GoO system - Set-up of national GoO issuing bodies - Integration of GoO from different renewable gas technologies with electric and hydrogen GoO systems - Integrated assessment and sustainable feedstock mobilisation strategies and technology synergies - Support for biomethane market uptake - Transferability of results beyond the project's countries.

Contact person in Ukraine : Yuri Matveev (UABio). T.: +380 44 453-28-56, matveev@uabio.org



Welcome to Ukraine and to UABio!



Georgii Geletukha, PhD

Head of the Board, Bioenergy Association of Ukraine (UABio)

tel./fax: +380 44 332 9140

E-mail: geletukha@uabio.org