

Biomass market for thermal energy, electricity and motor fuels production in Ukraine. Opportunities and challenges

VTT



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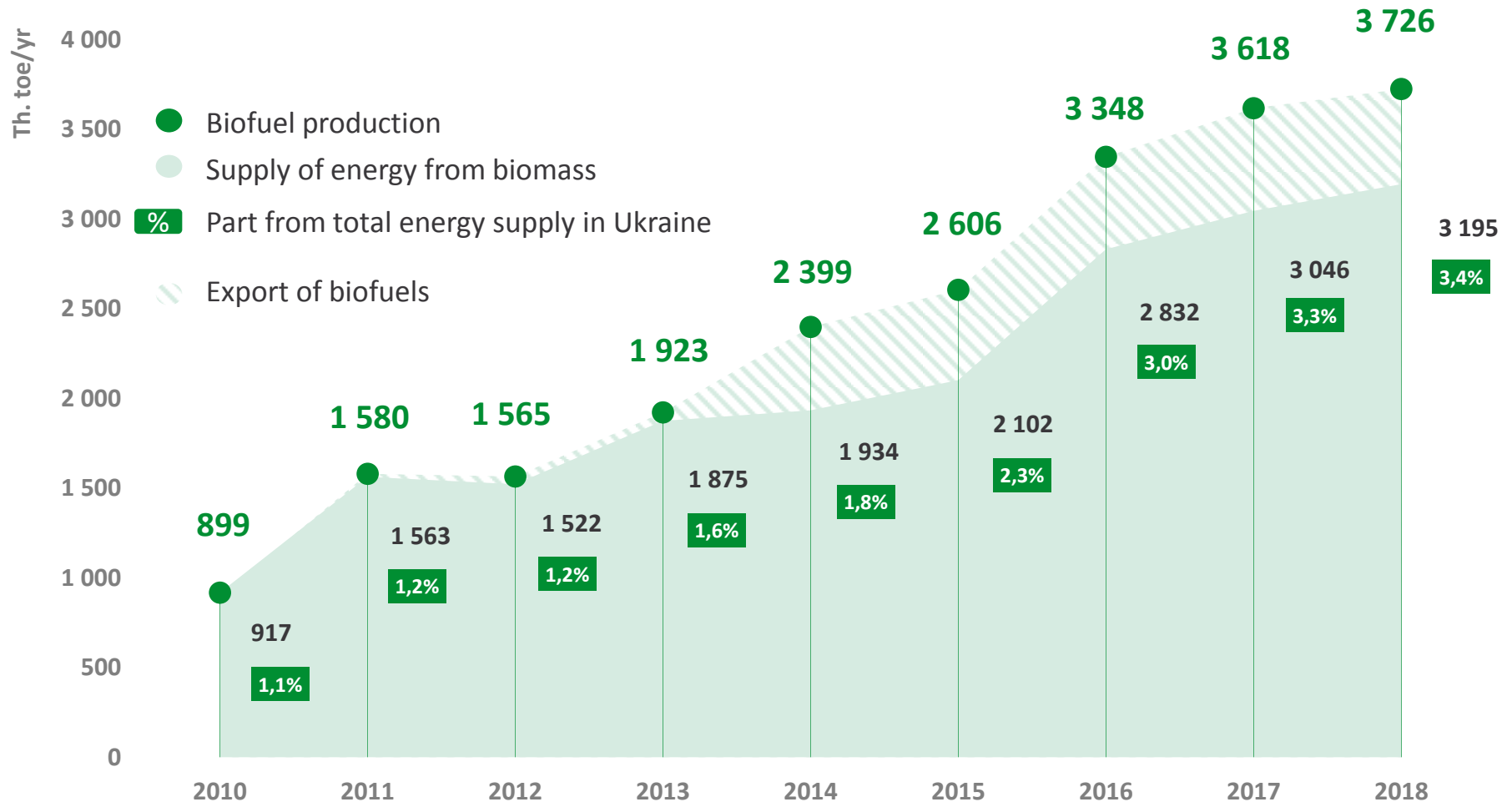


ДЕРЖЕНЕРГОЕФЕКТИВНОСТІ



Bioenergy growth in Ukraine

31%
per annum



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

Structure of total primary energy supply according to the Energy Strategy of Ukraine until 2035

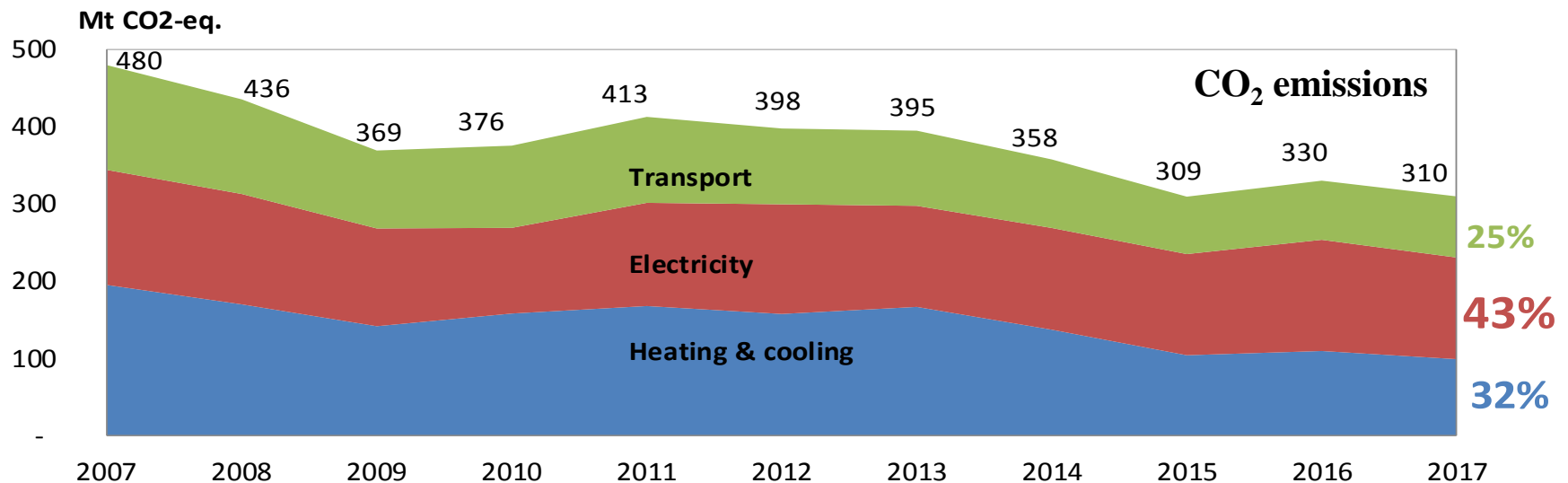
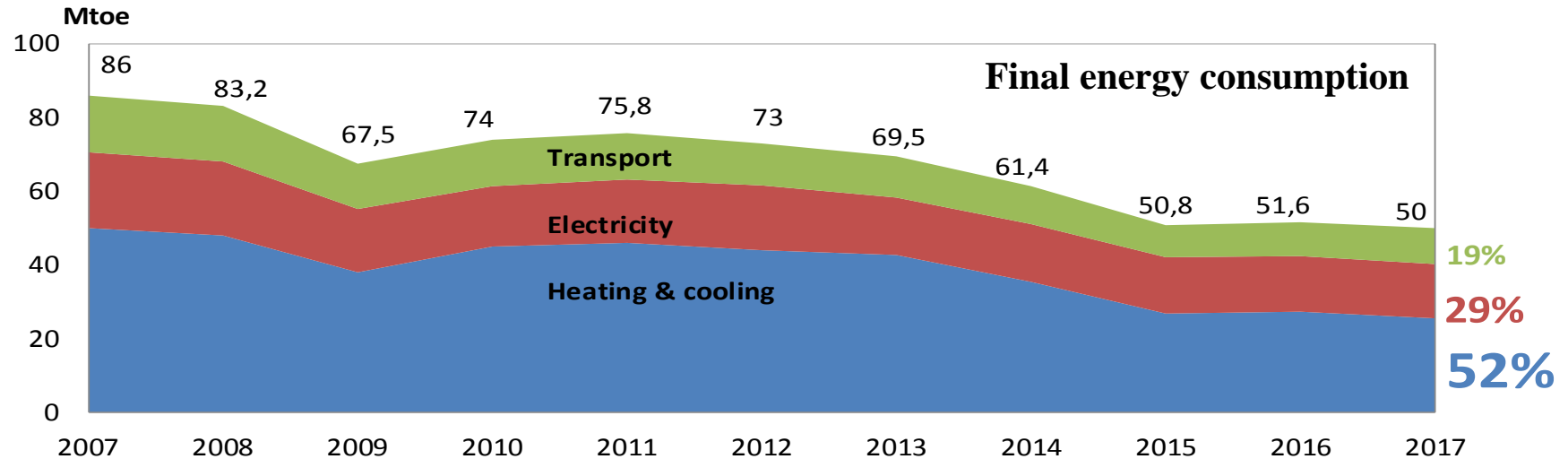
Type of energy source	2015 (fact)	2020 (forecast)	2025 (forecast)	2030 (forecast)	2035 (forecast)
Coal	27,3	18	14	13	12
Natural Gas	26,1	24,3	27	28	29
Oil Products	10,5	9,5	8	7,5	7
Nuclear Energy	23	24	28	27	24
Biomass, Biofuels and Wastes	2,1	4	6	8	11
Solar and Wind Energy	0,1	1	2	5	10
Hydro Energy	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

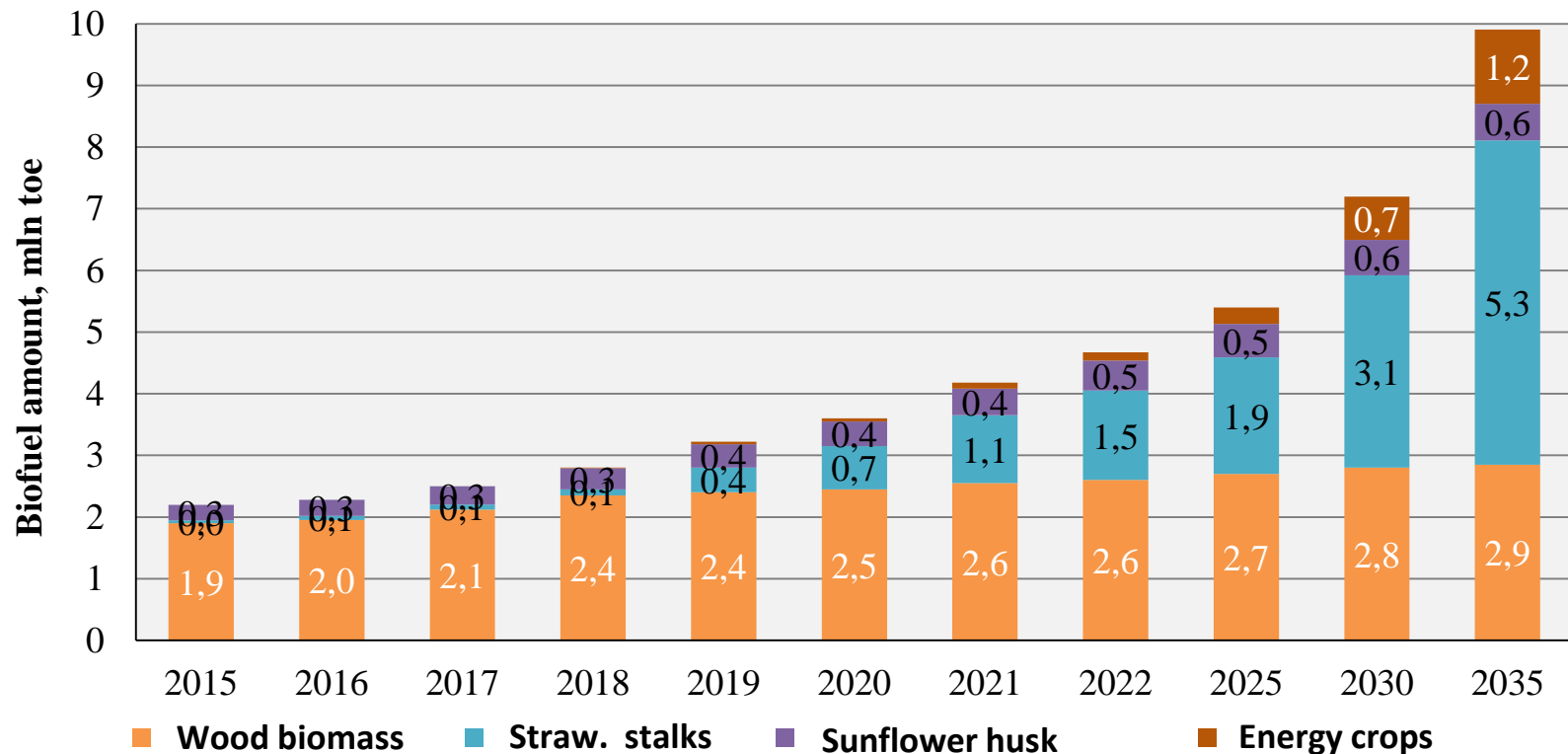
«Energy» is not equal «Electric Energy»

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



Agrobiomass is a Future of Bioenergy in Ukraine

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



Biomass type	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

Energy Potential of Biomass in Ukraine exceeds 25 bln 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
<u>TOTAL</u>	-	-	<u>20,92</u>

43%

36%

* In case of growing on 1 mln ha of unused agricultural land.

Roadmap for biomass-to-energy future market growth up to 2050

Objectives of the Roadmap:

- ✓ To suggest ways to tackle the identified technical and regulatory gaps, problems and bottlenecks in the sector.
- ✓ To define next steps required for the sector growth from technical, economical, legal and institutional perspective.

Integration and synergies of the Roadmap with other existing policies:

Bioenergy Roadmap until 2050 is closely interconnected and coherent with the existing and planned strategic documents in Ukraine's energy sector. Based on this:

- ✓ Materials of the Roadmap can be used for the development of new NREAP until 2030; revised Energy Strategy of Ukraine until 2050; Concept of state policy in energy and environmental protection.
- ✓ Roadmap will show how to achieve the existing bioenergy targets until 2035 fixed in the Energy Strategy of Ukraine until 2035.
- ✓ Roadmap will facilitate contribution of bioenergy to Ukraine's international commitments to reduce greenhouse gas emissions under the 2015 Paris Climate Agreement.
- ✓ Bioenergy Roadmap until 2050 is in line with key objectives and points of Ukraine Green Deal Concept until 2050.

Roadmap for biomass-to-energy future market growth up to 2050 (2)

Basic approach and features:

- Starting point: 2020.
- Roadmap is in line with the scenario of up to **70% RES** in the energy balance in 2050 provided that TPES in 2050 will be 33% less than that in 2018 (~ 63 Mtoe in 2050) and the final energy consumption will increase by 8% (~ 55 Mtoe in 2050) .
- Total installed capacity of bioenergy equipment in 2050: **36 GWth** and **3.5 GWel**.
- Total consumption of biofuels in 2050: **23 Mtoe**.
- Utilisation of biomass potential of 2050 (~**43 Mtoe**): up to **60%**. *Factors for*

Factors for increased biomass potential in 2050:



- increasing yield of crops;



- increasing share of wood increment cutting in forests;

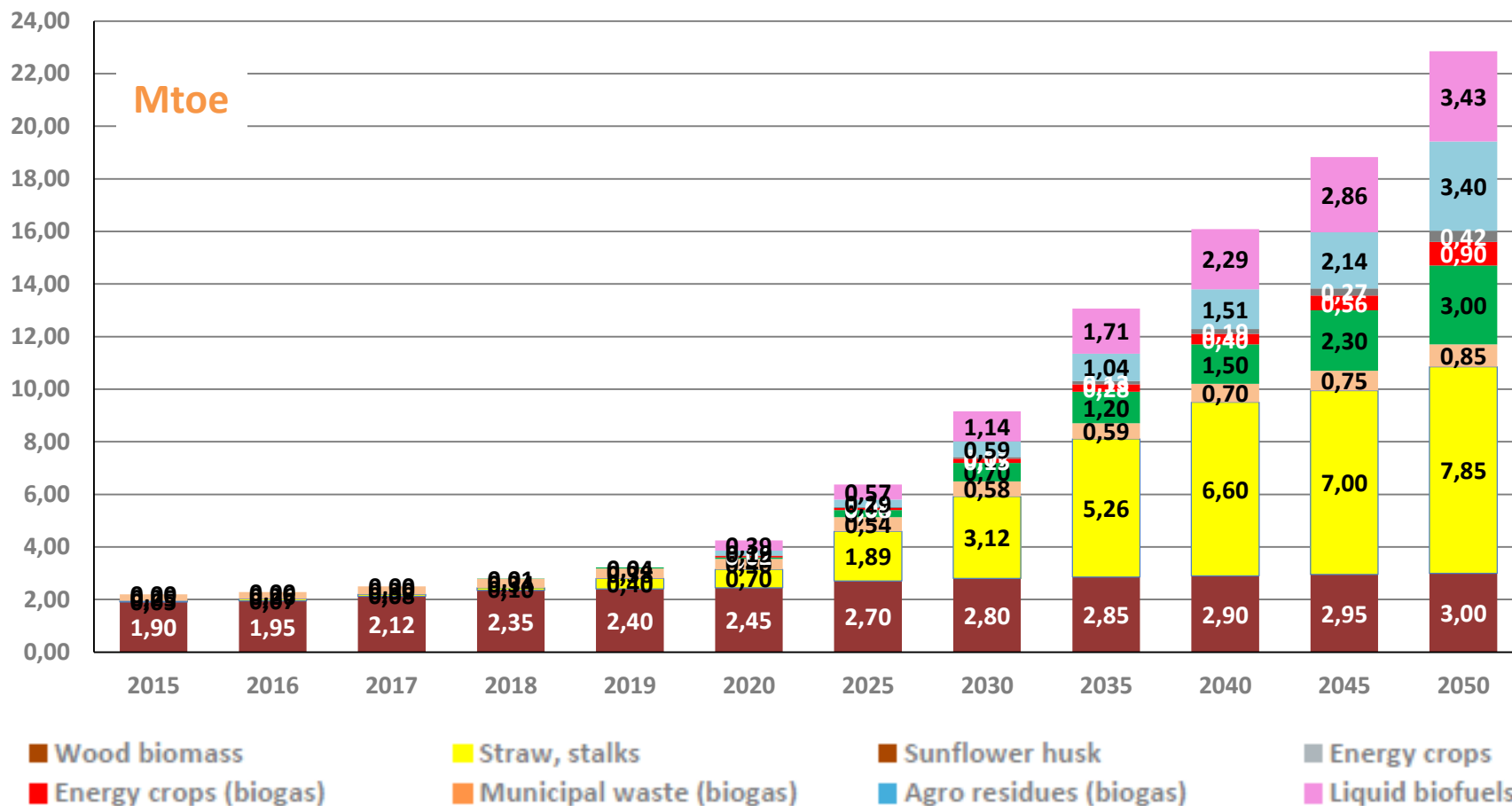


- rising economic potential of biogas from different types of feedstock;

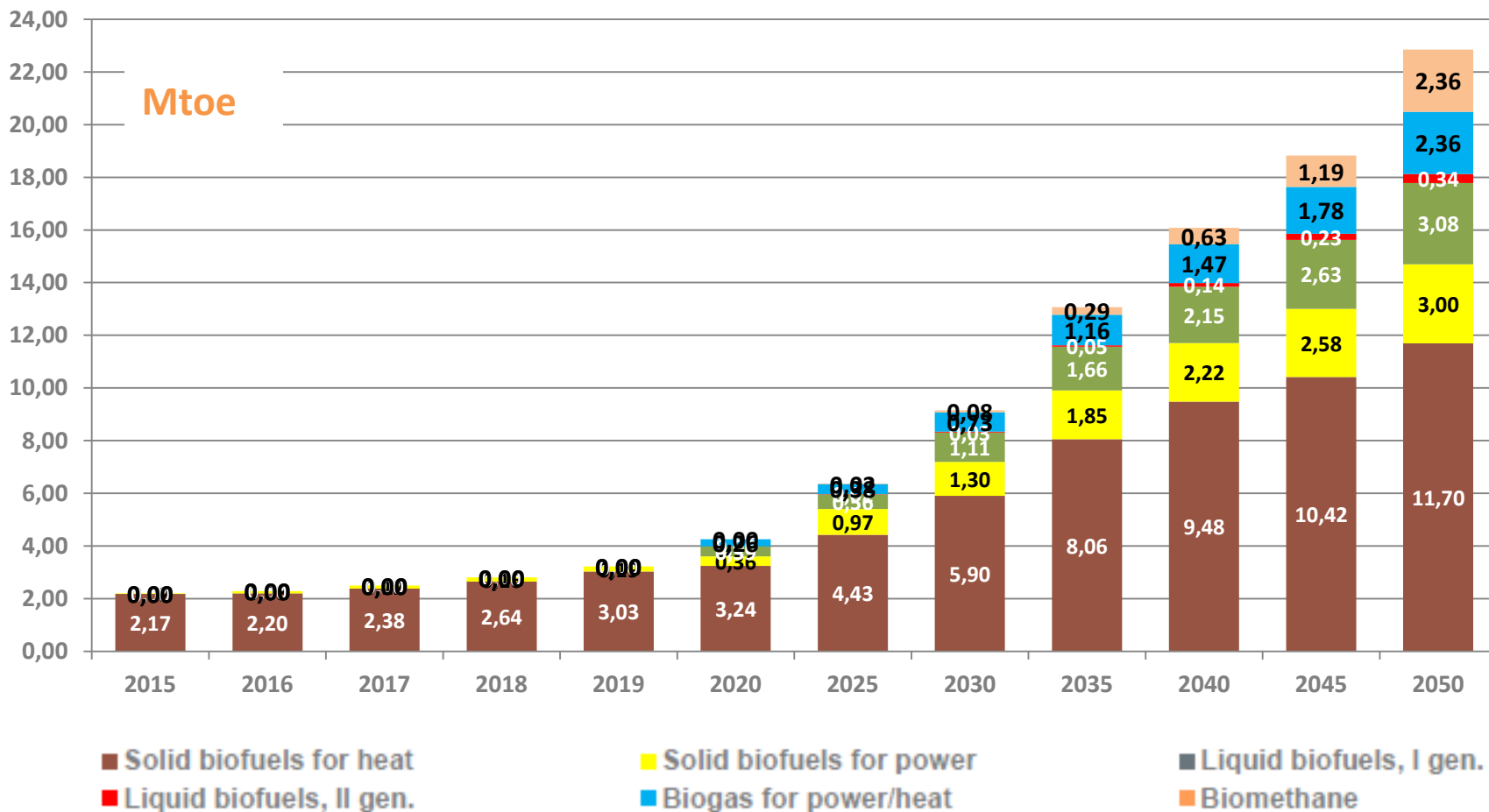


- enlarging areas under energy crops and increasing yield of energy crops.

Roadmap: Suggested structure of biofuel consumption in Ukraine by type until 2050



Roadmap: Suggested structure of biofuel consumption in Ukraine by the type of energy carrier produced

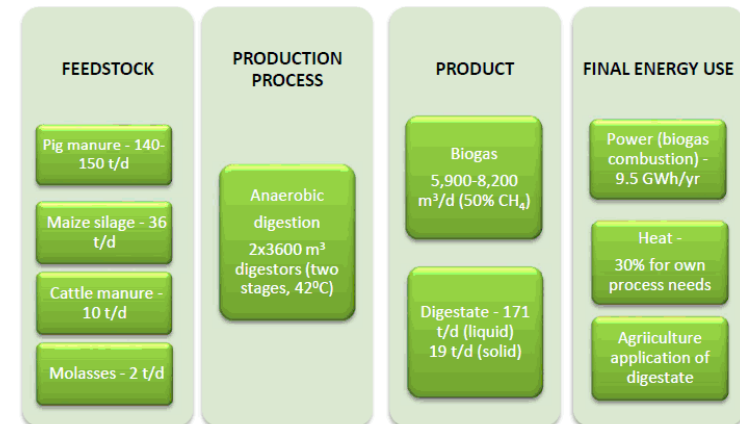
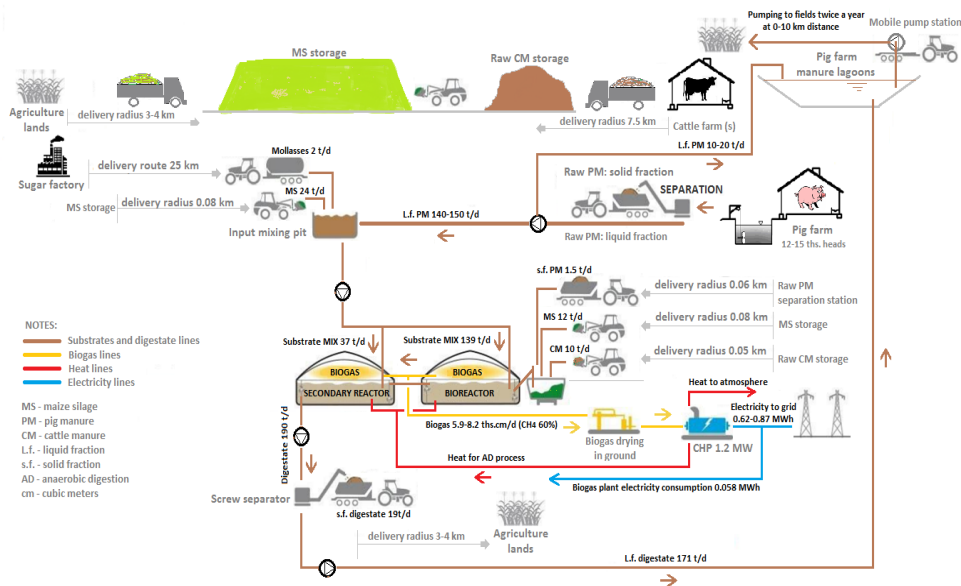


Roadmap for biomass-to-energy future market growth up to 2050 (3)

Key trends during 2020-2050:

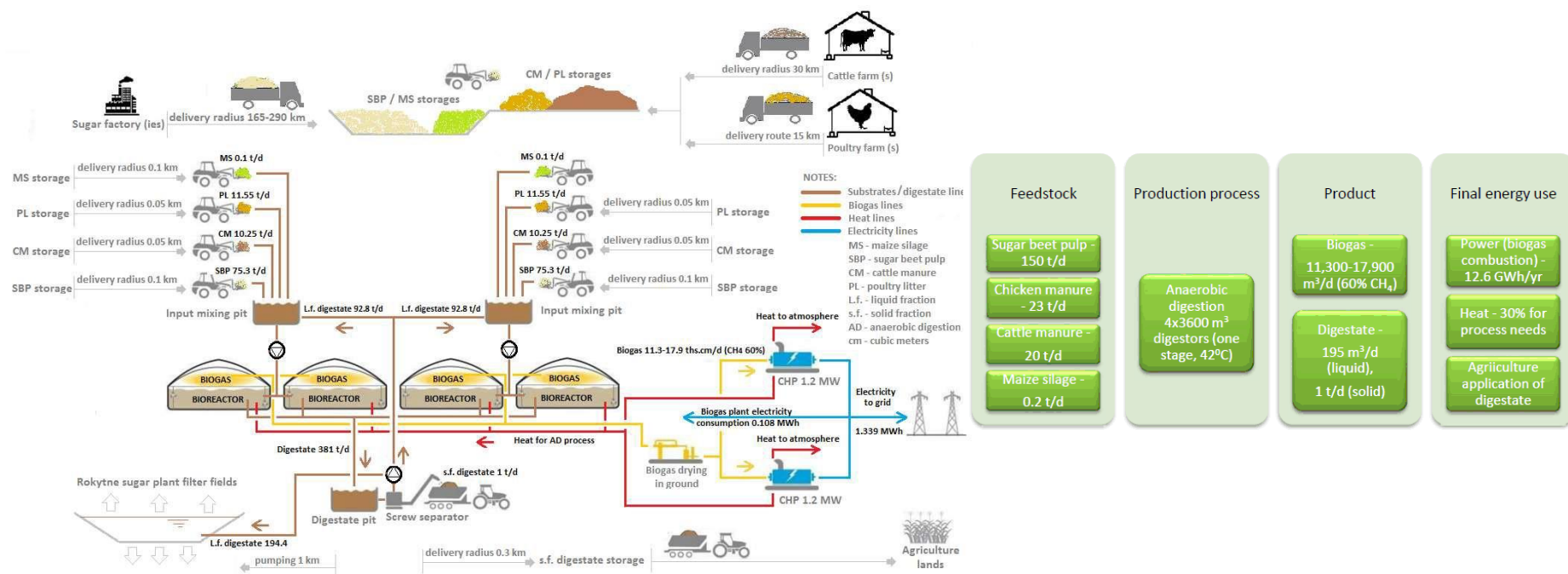
- Increasing shares of agro-residues and energy crops in the structure of solid biofuels consumption: up to **60%** and **20%** of the total, respectively, by 2050.
- Minimal rise in the consumption of wood biofuels: **1.2** times by 2050 (against **8** times for agro-residues).
- Considerable increase in the production of **biogas** and **liquid biofuels**: up to 4.7 Mtoe/yr and 3.4 Mtoe/yr, respectively, by 2050.
- Launching and rising production of **biomethane** and **II generation** transportation fuels: up to 2.4 Mtoe/yr and 0.34 Mtoe/yr, respectively, by 2050.

Case 3: Gals-Agro Biogas plant



Country	Ukraine
Project name	Gals-Agro Biogas plant
Ownership	Gals-Agro corporation
Feedstock	Own agricultural residuals and by-products (pig and cattle manure, molasses) and maize silage. No gate fee. Delivery within 7 km (manure), 30 km (molasses) by own transport
Technology	Standard wet process, raw biogas drying and desulfurization
Final energy use	Electricity generation in CHP unit for grid delivery and sell by FIT, heat for own process only, 1.2 MW _e

Case 4: Biogas plant at Rokytné sugar plant Ltd



Country	Ukraine
Project name	Biogas plant at Rokytné sugar plant Ltd.
Ownership	Silhospprodukt corporation
Feedstock	Purchased agricultural residuals and by-products (sugar beet pulp, cattle and chicken manure) and harvested for biogas maize silage. No gate fee
Technology	Standard wet process, raw biogas drying and desulfurization (4x3600m ³)
Final energy use	Electricity generation in CHP unit for grid delivery and sell by FIT, heat for own process only, 2x1.2 MW _e .

The similarities, contrasts and differences in the practices used in Finland and Ukraine

Article	Ukraine	Finland
Main feedstocks	Predominant treatment of own raw materials, no gate fee. Purchasing if necessary.	Treatment of different raw materials including manure, centralized organic waste treatment based on gate fee
Feedstock quality and quality control	Lack of feedstock quality control, bad quality of purchased materials possible	Quality control. Suppliers of feedstock are often consumers of digestate
The average market price of feedstock, €/t	0-25 (10)	- (30-50) if gate fee applied
Priority of biogas utilization	Main driver - electricity production by green tariff (FIT), no heat utilisation	Priority of raw biogas for external heating, 2 nd priority - biomethane, no power production (except CHP)
Biomethane use	No biogas upgrading to biomethane quality	Biomethane can be use as motor fuel (local feeling station) or delivered to industry consumers in mobile containers
Biomethane prospects	Legislation is needed	Lack of biomethane fuelling car and feeling stations, governmental goal for number of cars and fuelling station
Digestate application	Digestate field application is limited and technically underdeveloped	Digestate field application among local farmers based on no-cost approach
Governmental support	Green tariff (FIT) for power from biogas	Governmental investment support (25%), fixed price for biomethane (1.5€/kg). High price of NG
The level of biogas utilization for heating, %	20-30 (for process heating)	All available customers
Investor interest	Low interest of investors	Mid and high interest of investors

Project #1 Ukraine: Biomass CHP installation of public utility Miskteplovodenergiya

- Biomass boiler heat capacity – 15 MW
- ORC unit power capacity – 1,6 MW
- Main fuel – wood chips
- Investment - 12,2 mill \$
- Loan (WB) - 9.6 mill \$
- Energy production:
 - heat - 44 706 MWh
 - power – 7 160 MWh
- Fuel consumption – 69 548 MW (23 kt)
- Energy efficiency of supply chain – 77%





Project #2 Ukraine: Biomass HOB installation of private company LLC Ukteplo

- Biomass boiler heat capacity –10,5 MW
- Main fuel – wood chips
- Investment - 4 mill \$
- Energy production:
 - heat - 32 564 MWh
 - power – 0 MWh
- Fuel consumption –38 300 MW (15 kt)
- Energy efficiency of supply chain –81 %



Fuel supply chain costs and emissions

Fuel supply chain based on old garden comminution at garden				
				
RAW material - €/MWh	Felling 5,33 €/MWh	Chipping 3,64 €/MWh	Transportation 1,212 €/MWh 4,85 EUR/MWh 100km	Total: 16,0 €/MWh
Motor fuels consumption and emissions CO2				
0 kg/MWh 0 kg CO _{2e} /MWh	0 kg/MWh 0 kg CO _{2e} /MWh	1,97 kg/MWh 6,5 kg CO _{2e} /MWh	0,86 kg/MWh 2,8 kg CO _{2e} /MWh	2,83 kg/MWh 9,4 kg CO _{2e} /MWh

Fuel supply chain from forest residues and firelogs based on comminution at forest				
				
3,2 €/MWh	5,3 €/MWh	3,6 €/MWh	0,823 €/MWh 1,267 EUR/MWh/100km	20,0 €/MWh
Motor fuels consumption and emissions CO2				
0 kg/MWh 0 kg CO _{2e} /MWh	0 kg/MWh 0 kg CO _{2e} /MWh	2,0 kg/MWh 6,5 kg CO _{2e} /MWh	0,5 kg/MWh 1,8 kg CO _{2e} /MWh	Total: 2,5 kg/MWh 8,3 kg CO _{2e} /MWh

The value chain steps with most important gap impacts

- **Production process (Gap impact -20).** No special high productivity equipment for chipping wood residues to provide large quantities of raw materials for powerful energy objects.
- **Product (Gap impact -20).** High price of wood chips from firewood. Produced thermal energy can be not competitive with traditional fuels (gas).
- **Heat/Power generation and product (Gap impact -25).**.. The lack and high cost of special equipment for burning of wet fuel and bark.
- **Final energy distribution (Gap impact -20).** High level of state regulation of heat and electric energy production and limited level of projects profitability.
- **Heat final use (Gap impact -20).** Problems with grid connection, seasonal consumption of thermal energy, lack of a clear state policy and support for waste and renewable energy consumption.

Priorities for improving normative and legal basis of bioenergy



Lobbying the **required level of state support quotas** for biomass / biogas projects.



Improvement of the stimulation mechanism for **biomethane** production and consumption.



Improvement of the of stimulation mechanism for power generating capacities on biomass, biogas and biomethane for operation in the **balancing capacities market**.



Introducing of the stimulating mechanism for **energy crops cultivation and use** in Ukraine.



Support for implementation of e-commerce system for solid biofuels.



Support the introduction of competition in district heating systems.



Support of the developed mechanism for stimulating the production and use of **liquid biofuels and biogas for transportation.**



Promoting the need to abolish the **tax on CO₂ emissions** from boiler houses, TPPs / CHPs on biomass and biogas.

We are making the green future

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