# WP 4.2.2 Ukraine

# Recent Developments in Bioenergy

# Summary of Presentation

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# Summary

Ukraine is a big Eastern European country which is developing dynamically. An annual growth of GDP is about 2% except for 2009 due to influence of the economic crisis. Historically, Ukraine has a highly developed agricultural sector that is the main source of biomass resources available for energy production. On average, 15% of Ukraine's territory is covered by forests with up to 40-45% of forest lands in Western regions (the Carpathians and some other areas).

Natural gas (NG) is the main energy carrier in Ukraine contributing with about 41% to the final energy consumption. At that only 30% of the consumed volume is produced domestically and 70% is exported, mostly from Russia. The share of RES in the country's energy balance is now very low, some 0.8%, including 0.65% coming from biomass.

The current challenge is a very high price of NG that puts Ukraine's industry on the verge of its viability. While during 2001-2006 the price of NG was quite stable (about 60 $/1000 m3 – an average wholesale price at the border on Russia), it began rapidly rising since 2006 and came to about 229 $/1000 m3 in 2009 that is nearly 4 times higher than it was before. At that the internal prices of NG are quite different for different kinds of consumers in Ukraine. The lowest price, below the market level, is for population, whereas the highest price, above the market level, is for industry. That leads to such a phenomenon as internal cross-subsidising. In fact the industry subsidises the population and this is not good for the national economy.

While NG is an expensive fuel, solid biofuels are relatively cheap in Ukraine. Comparison of the costs made on the basis of energy content shows that wood processing residues are about 90 times cheaper than NG (the price for industrial consumers is taken into account), firewood and straw bales are about 4 times cheaper, and wood pellets are 2 times cheaper. Ukraine has increasing production of biomass pellets, mostly wood ones, but practically all the produced volume (about 200,000 t/yr) is exported to Europe. It is due to the fact that boilers for pellets are too expensive for the Ukrainian consumers and as a result there is no internal market for pellets in the country.

Ukraine has quite a big potential of biomass available for energy production – about 27 mill tons of coal equivalent (mill tce) – economically feasible potential estimated on the basis of official statistical data for 2007. The two main constituents of the potential are agricultural residues and energy crops.The first is a "real" part of the potential, and the second is currently a "virtual" one. At present there are only a few small pilot plantations of energy crops in Ukraine but a fast development of this sector is expected in the near future. It is due to the fact that currently there are 4-5 mill ha of unused agricultural land in the country of which, according to expert estimation, up to 3 mill ha can be used for energy crops production without causing competition with food and feed production. Last year Ukraine had the highest harvest of agricultural crops during the last 20 years. Nearly the same high harvest is expected this year. Taking into account this increased production, the potential of biomass for 2008 can be estimated at least at 35 mill tce/yr. And Ukraine has further room to increase the potential via approaching the European level of agricultural crops yield (now the yield of some crops like rapeseed, corn for grain and others in Ukraine is 2-3 times less than in Europe).

At the end of 2008/beginning of 2009 Ukraine had another "energy conflict", or crisis, connected with supply of NG by Russia. Just after that Ukrainian government issued a number of resolutions relating to different aspects of biomass usage. The purpose of the resolutions was to encourage replacing NG by biofuels. In addition two important laws have been passed in the country in 2009. The first is "the law on biofuels". The law introduced a number of privileges for the producers and consumers of solid, gaseous and liquid biofuels and also for the producers of bioenergy equipment. Mostly, these privileges are tax exemptions, which will come into force from the 1st January 2010 for

5-10 years. The second law is "the law on green tariff" for power produced from RES including biomass. The strong side of the law is the introduction of quite a high value of the green tariff for power from biomass – 13.45 Euro cents/kWh. The weak, or at least disputable point of the law, is that the value of the green tariff is the same for all the types of biomass installations regardless the feedstock used and their capacity. For this the law is much criticized by local and European experts.

Another important document in bioenergy sector of Ukraine is "Biomass Action Plan for Ukraine" (BAP U) drafted within the G2G Dutch-Ukrainian project "Biomass and Biofuels in Ukraine" (2008-2009). Scientific Engineering Center "Biomass" took part in the elaboration of the document and acted as a local consultant in the project. The draft BAP U was approved by the Ministry of Agricultural Policy of Ukraine and is supposed to be submitted by the Ministry to the Government for consideration. This document identifies the main challenges of Ukraine's biomass sector and suggests actions to solve the problems. One of the suggested actions is adopting a political declaration with clear statement of the national targets on biomass. The following contribution of biomass/biofuels to the final energy consumption seems to be reasonable: 1% (2 mill tce) in 2010, 5% (10 mill tce) in 2020, 10% (20 mill tce) in 2030.

Current status of introducing bioenergy technologies in Ukraine is the following. Over 20 straw fired boilers, mostly below 1 MW, are in operation in rural areas of the country. About 500 modern wood fired boilers are already installed, and over 1000 old boilers were converted from coal and oil to biomass in the forest industry. Heat production from biomass is feasible in Ukraine under present conditions, the relevant projects have a payback period of about 2 years. There are 3 big biogas plants in operation in the country, and 12 biogas plants are under construction/designing. One of the 3 operating installations is the first biomass plant which obtained the license for CHP production and obtained the right to sale the produced power at the green tariff. At the moment there are no CHP plants on solid biomass in the country, but they are expected to appear in the near future due to the quite high green tariff introduced this year.

Still, some types of bioenergy equipment of domestic manufacture are missing in Ukraine's market. They are biomass boilers > 2 MW, steam biomass boilers, and reasonably priced individual boilers of 10-50 kW including boilers for pellets. The latter will help to develop internal market for biomass pellets.

Ukraine has quite good opportunities for implementing biomass projects as Joint Implementation projects in the framework of the Kyoto Protocol. Usually the income from selling Emission Reduction Units (ERUs) covers 20-30% of the project investment costs. In some cases like utilisation of landfill gas the income from ERUs sale can cover over 100% of the investment costs.

Bioenergy equipment which is considered priority for introduction in Ukraine in the nearest future includes hot water boilers operating on wood, straw, other agricultural residues and peat. Since this year mini-CHP plants have been also included in the priority fleet of bioenergy equipment. Total volume of Ukraine's market is estimated at about 57,000 units of 8380 MWth + 100 MWe total installed capacity.

The SWOT analysis of Ukraine's bioenergy sector shows that, inter alia, the strengths (S) include big potential of biomass and availability of unused arable lands; the weaknesses (W) include some gaps in Ukrainian legislation and unstable political situation; the opportunities (O) include strengthening energy security and direct substitution of NG; and the threats (T) include potential competition with food/feed production (that is not a case at the moment).

To speed up the development of bioenergy sector, Ukraine should further work at the relevant legislation, create favorable conditions for attracting foreign investments, carry out dissemination of appropriate information and improve management in the sector in question. Hard work in these four fields is the keystone to success.

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# Recent Developments in Bioenergy Sector of Ukraine

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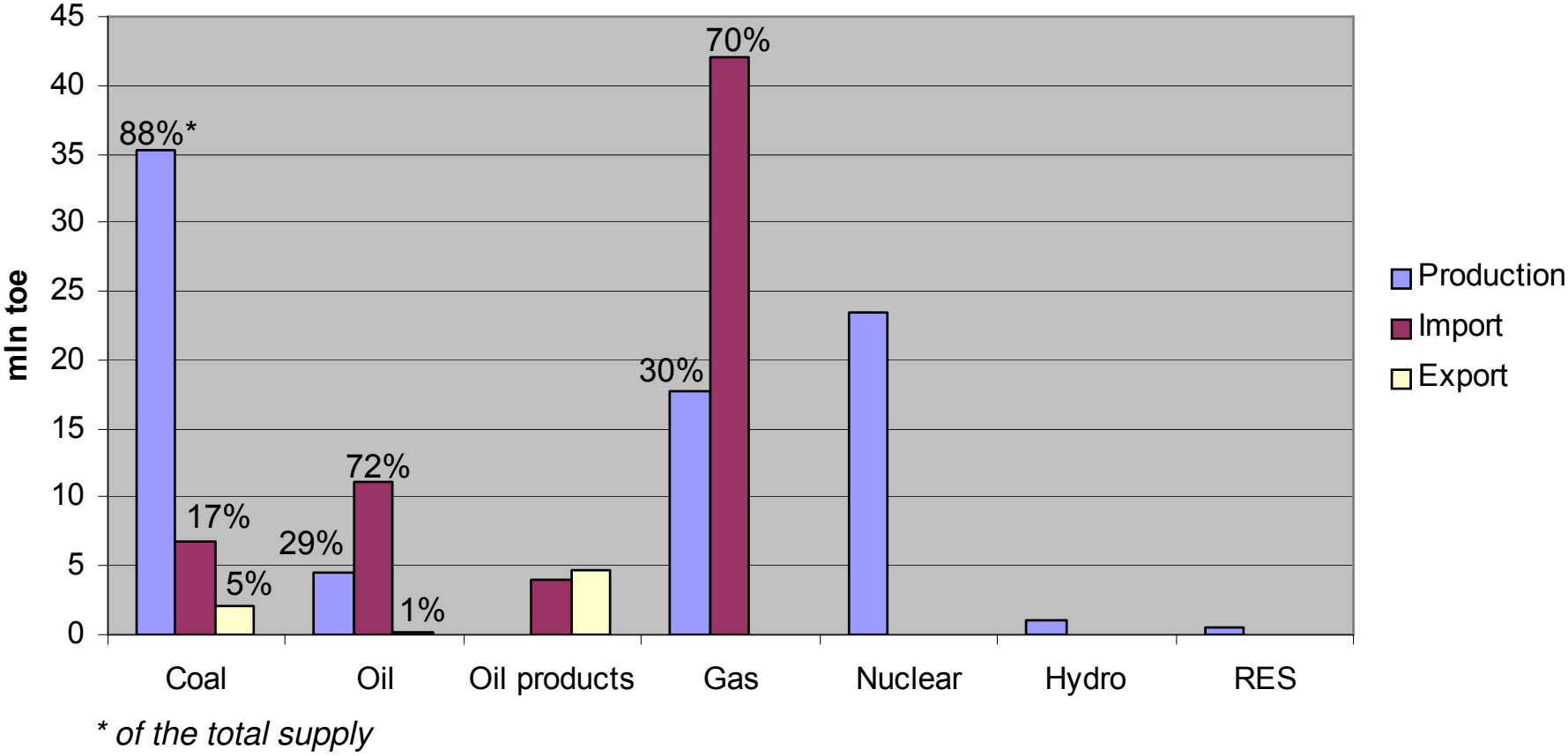
# Ukraine


- **Population** **46.1 mill**
- **Area** **603.5 th. km²**
- **GDP (2008)** **949.864 bill UAH**
  **(eq. 79.16 bill EUR)**
- **GDP per capita (2008)** **20,5 th. UAH**
  **(eq. 1711 Euro)**
- **GDP growth (2008)** **2.1%**

# Energy balance of Ukraine (2007)



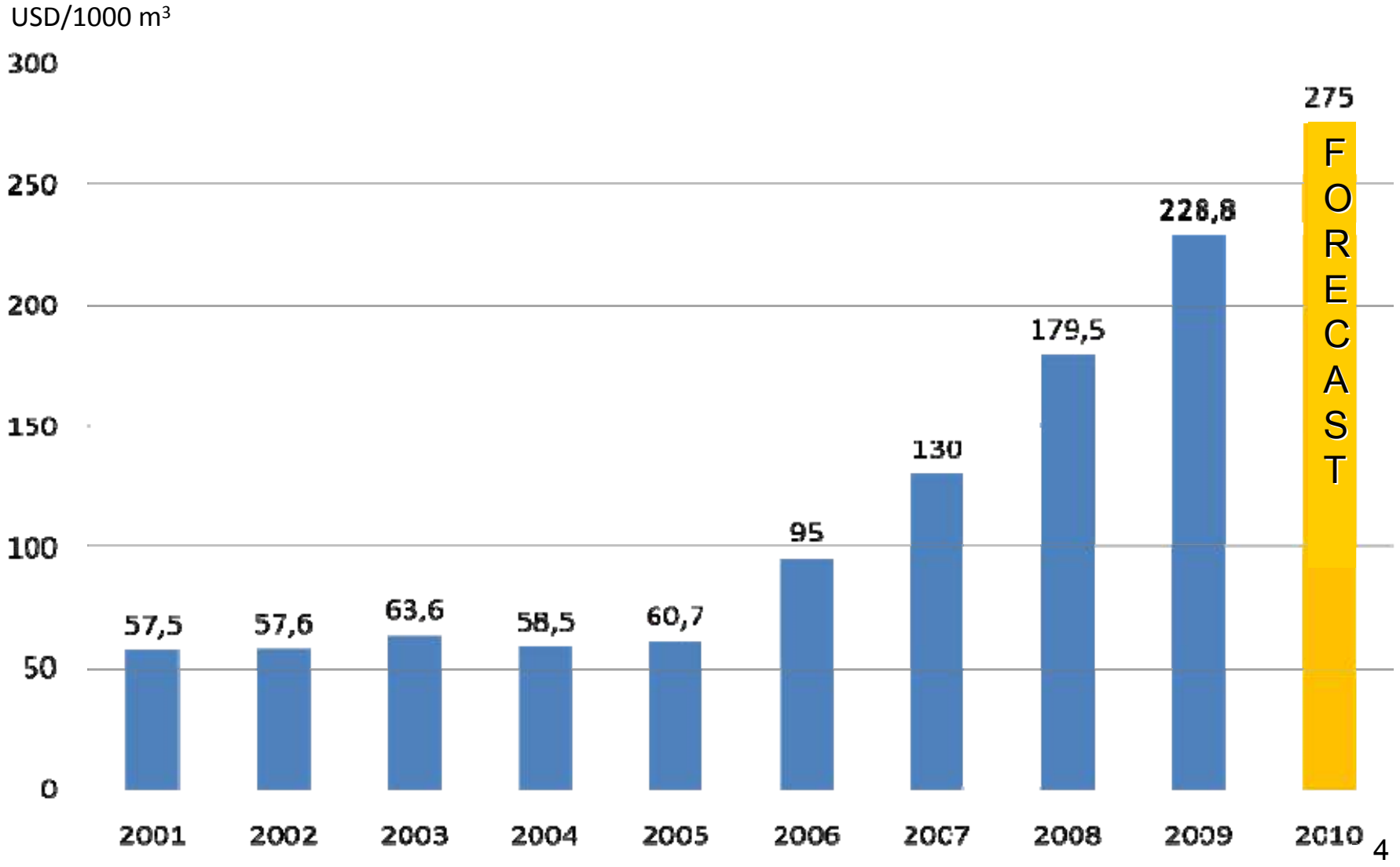

** of the total supply*

## Total Energy Consumption in Ukraine, by Type

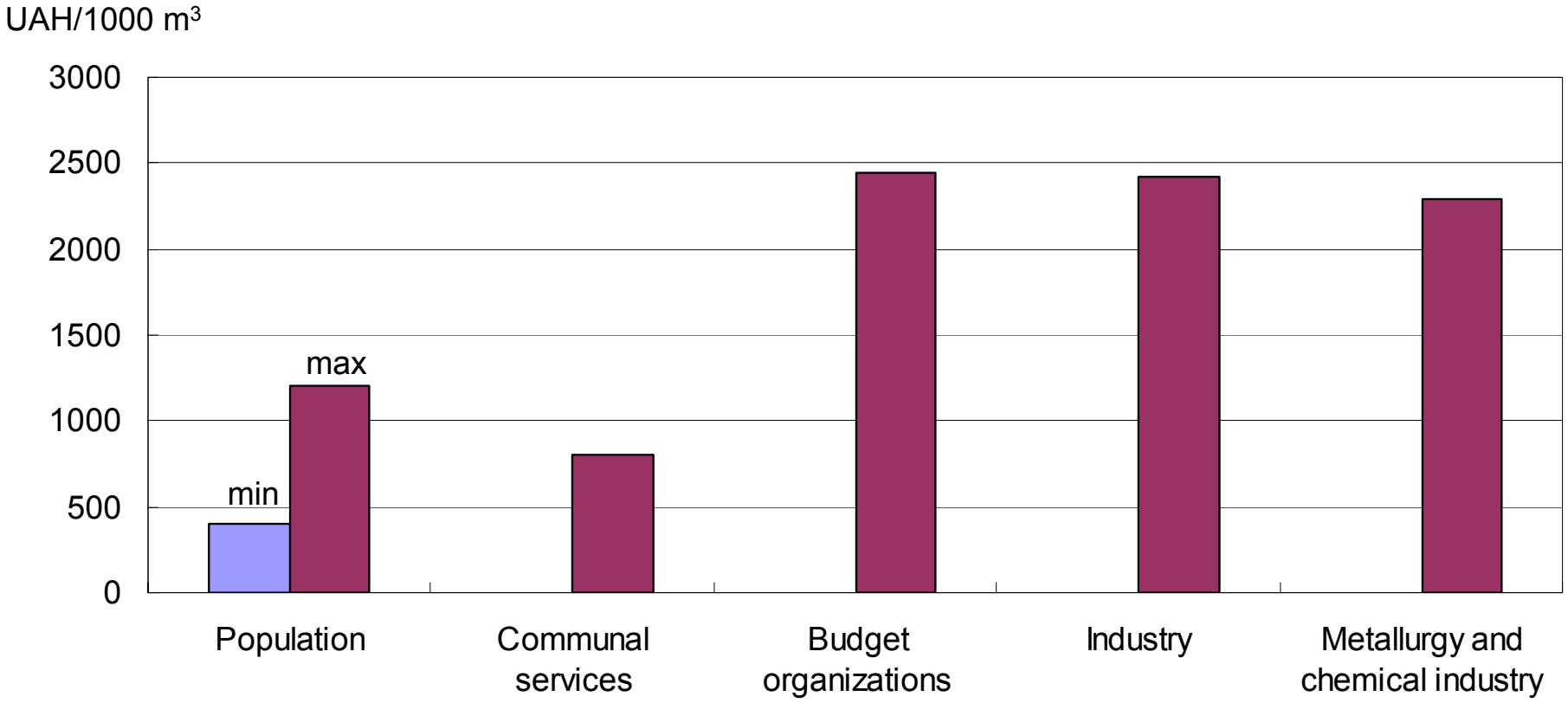
| Coal | Oil | Nat. gas | Nuclear | Large hydro | other RES | TPEC |
|---|---|---|---|---|---|---|
| 28.3% | 10.7% | 41.2% | 17.0% | 2.0% | 0.8% | 148 mtoe/yr |

# Price of natural gas in Ukraine

*Average wholesale price of natural gas at the border with Russia*



# Price of natural gas in Ukraine for different types of consumers

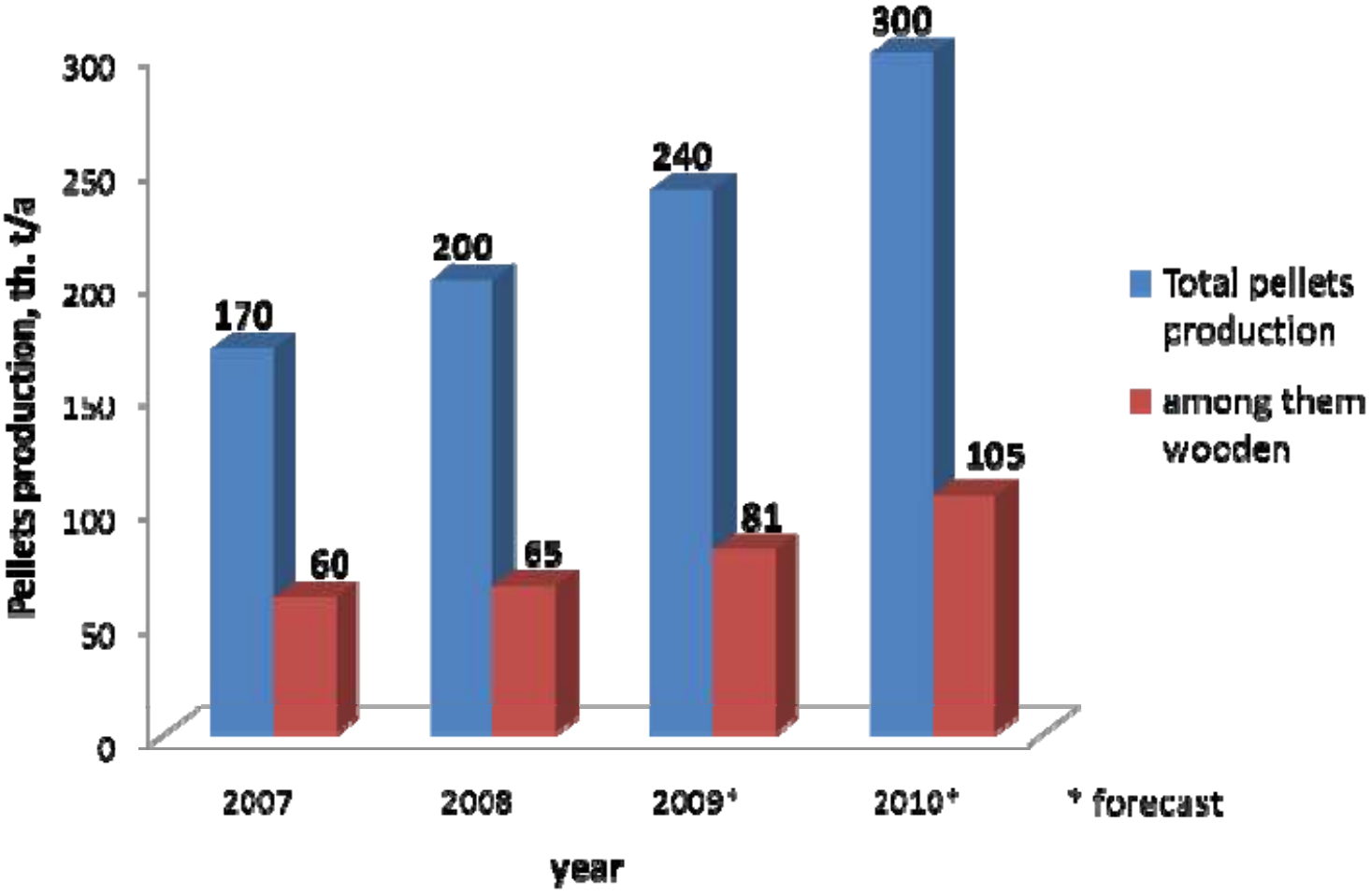


# Cost of solid biofuels

| Fuel type | Typical price, UAH/t | Low heating value, MJ/kg | Cost of fuel energy, UAH/GJ | **Ratio*: cost of NG energy / cost of biomass energy** |
|---|---|---|---|---|
| Wood processing residues | 0...10 | 10…12 | 0...0.9 | **> 88** |
| Firewood (delivered price) | 200 | 10…12 | 18.2 | **4.4** |
| Wood pellets | 800 | 18 | 44.4 | **1.8** |
| Baled straw (delivered price) | 300 | 15 | 20.0 | **4.0** |

** at the price of NG 2650 UAH/1000 $m^3$ and cost of NG energy 80 UAH/GJ*

# Production volume of pellets in Ukraine




According to D&P Consult data

# Energy potential of biomass in Ukraine (2007/2008)

| Types of biomass | Energy potential, mtce | | | |
|---|---|---|---|---|
| | *Theoretical* | *Technical* | *Economic* | |
| Straw of grain crops | 10.39 | 5.21 | 1.34 | (3.79)* |
| Straw of rape | 1.07 | 0.75 | 0.75 | (2.06) |
| Residues of production of corn for grain | 5.7 | 3.99 | 2.79 | (4.31) |
| Residues of sunflower production | 4.27 | 2.86 | 2.86 | (4.48) |
| Wood biomass | 2.13 | 1.66 | 1.48 | |
| Biodiesel | 0.50 | 0.50 | 0.25 | (0.69) |
| Bioethanol | 2.33 | 2.33 | 0.86 | (1.22) |
| Biogas from manure | 3.27 | 2.45 | 0.76 | |
| Landfill gas | 0.77 | 0.46 | 0.26 | |
| Sewage gas | 0.21 | 0.13 | 0.09 | |
| Energy crops<br>- poplar, miscanthus, acacia, alder, willow<br>- rape (straw)<br>- rape (biodiesel)<br>- corn (biogas) | <br>14.58<br>1.65<br>0.78<br>1.59 | <br>12.39<br>1.15<br>0.78<br>1.11 | <br>12.39<br>1.15<br>0.78<br>1.11 | |
| Peat (only renewable part) | 0.77 | 0.46 | 0.40 | |
| **TOTAL** | **50.01** | **36.23** | **27.27** | **(~ 35)** |



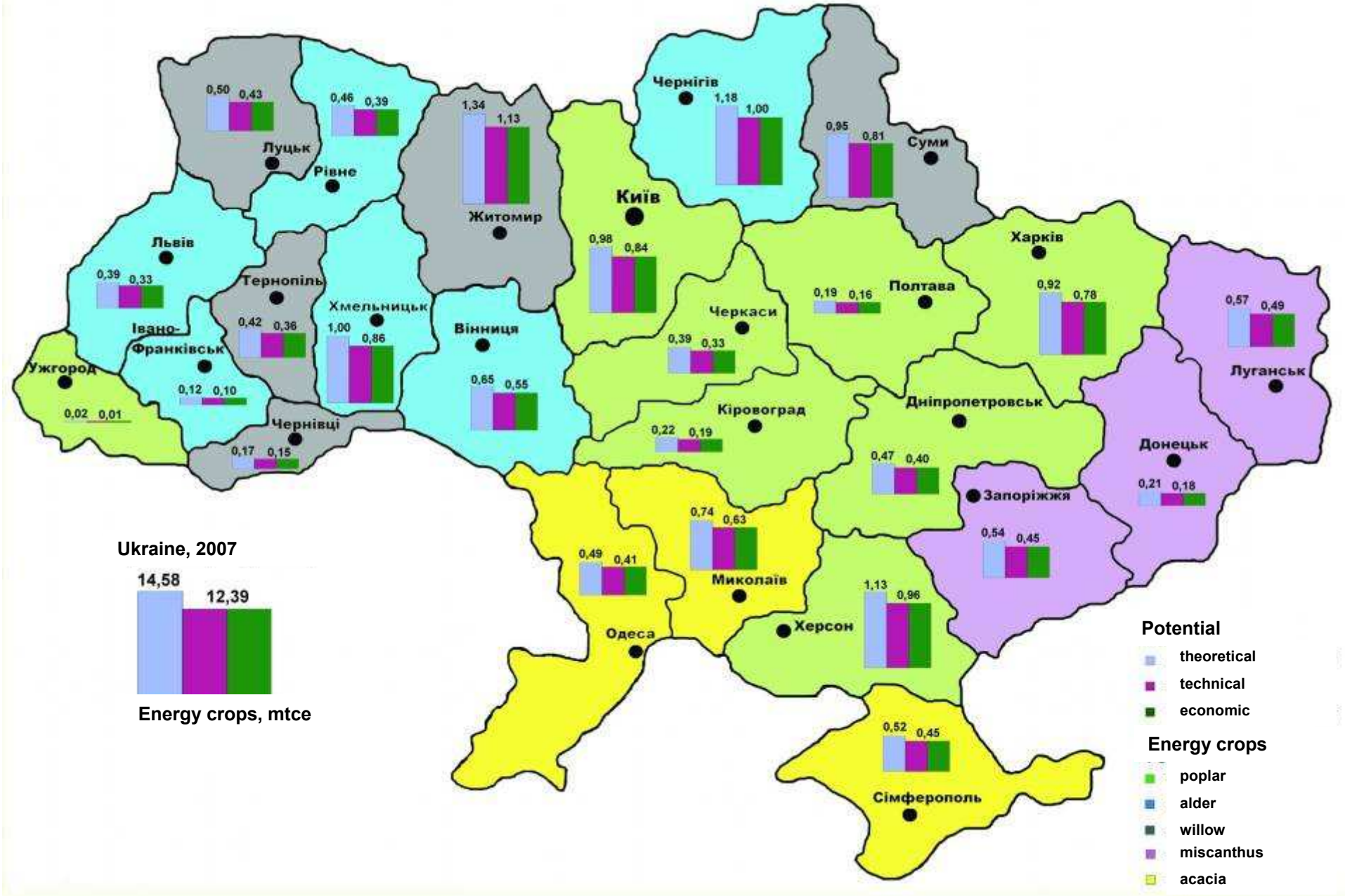
** Figures in the brackets relate to 2008*

# Structure of agricultural lands in Ukraine

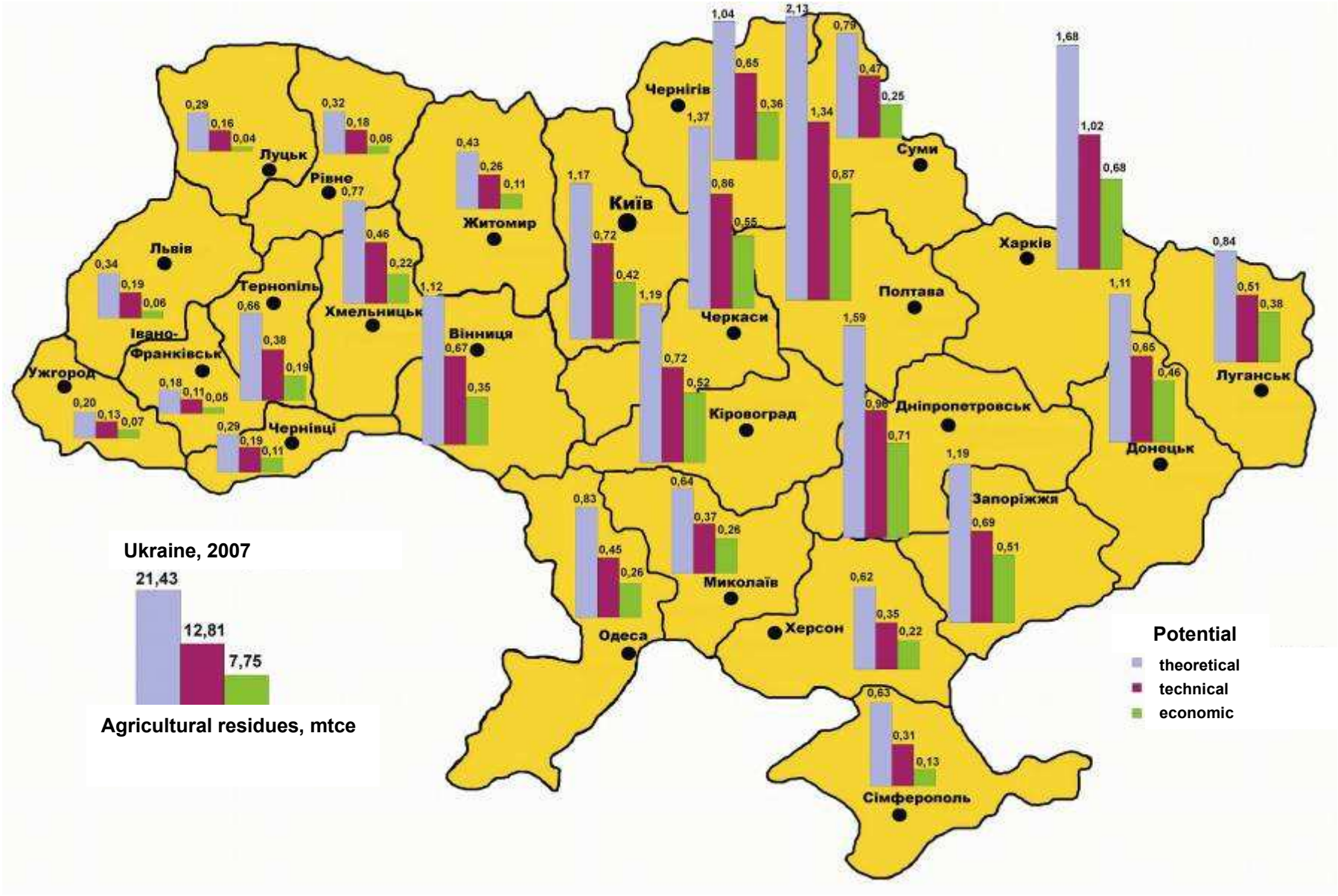
| **Lands** | **1990, th. ha** | **2007, th. ha** |
|---|---|---|
| Arable land | 33400 | 32434 |
| Total sawn area | 32406 | 26060 |
| including: | | |
| grain crops | 14583 | 15115 |
| industrial crops | 3751 | 5920 |
| potatoes, vegetables and cucurbits crops | 2073 | 1997 |
| fodder crops | 11999 | 3028 |
| Fallow | 1427 | 1625 |
| **Unused arable land*** | **994** | **4749** |

** Difference between the area of arable land and sawn area including the fallow area*

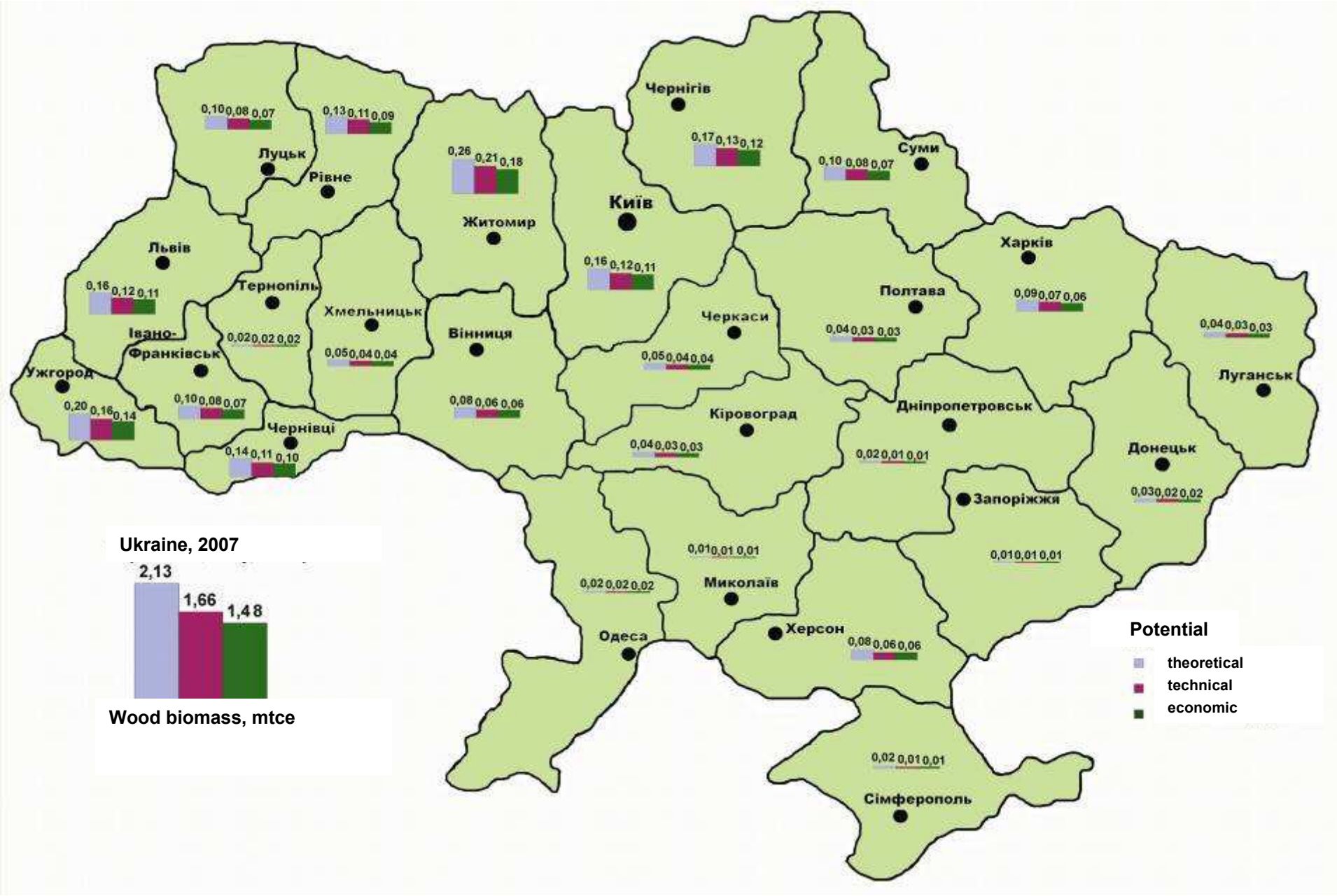
# Potential of energy crops, 2007



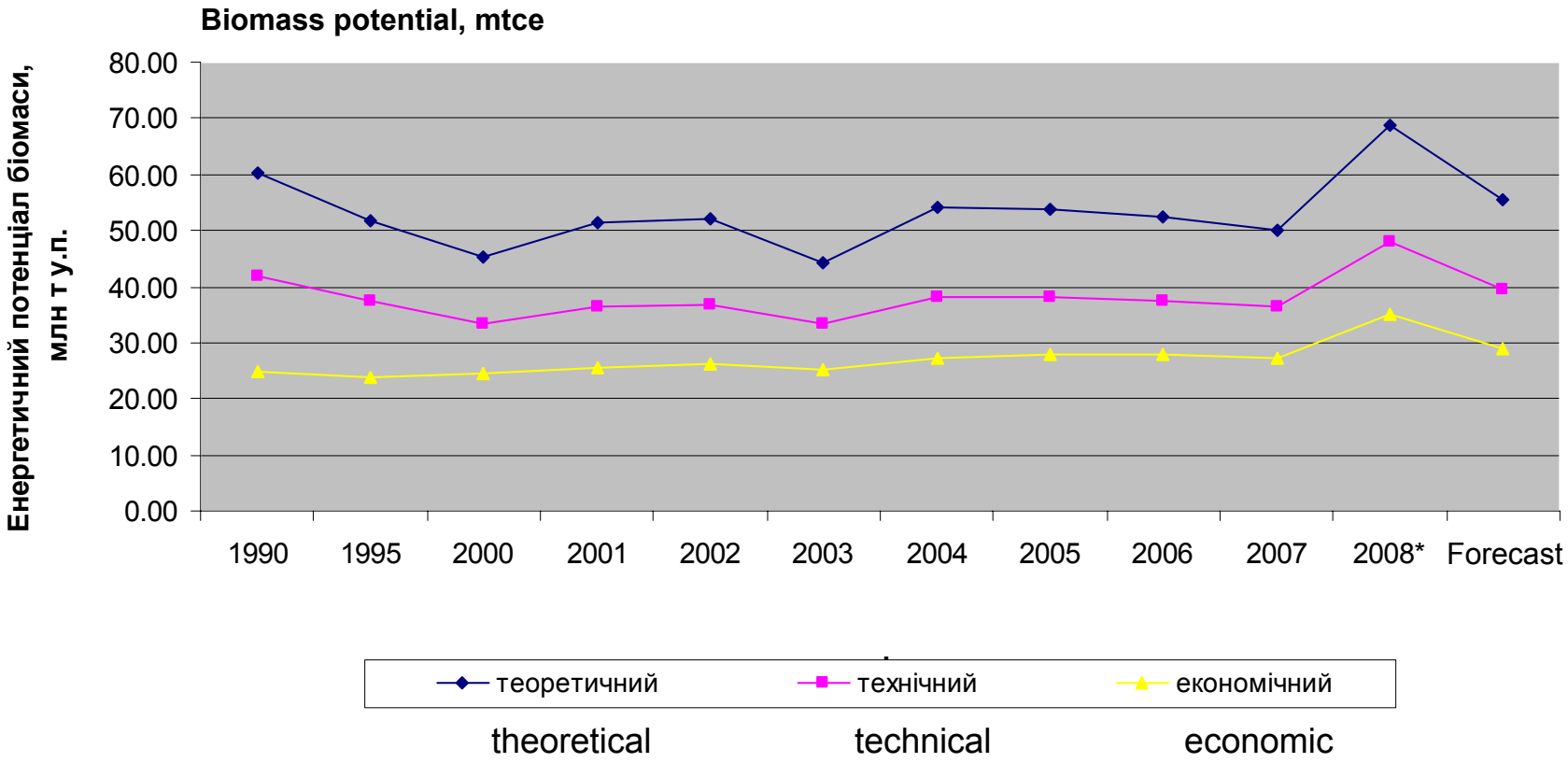
# Energy potential of agricultural residues, 2007



# Energy potential of wood biomass, 2007



# Estimation of the past and future biomass potential in Ukraine




** Preliminary estimation*

# Energy potential of agricultural residues in Ukraine under European level of crops yield

| Type of biomass | Energy potential, mln tce, 2007 | | | | | |
|---|---|---|---|---|---|---|
| | Theoretical | | Technical | | Economical | |
| | Crop yield Ukraine | Crop yield EU | Crop yield Ukraine | Crop yield EU | Crop yield Ukraine | Crop yield EU |
| Straw of grain crops | 10.39 | 30.58 | 5.21 | 15.32 | 1.34 | 6.4 |
| Straw of rape | 1.07 | 2.46 | 0.75 | 1.72 | 0.75 | 1.72 |
| Residues of corn production for grain | 5.7 | 13.15 | 3.99 | 9.21 | 2.79 | 6.44 |
| Residues of sunflower production | 4.27 | 7.68 | 2.86 | 5.15 | 2.86 | 5.15 |
| **TOTAL** | **21.43** | **53.87** | **12.81** | **31.40** | **7.74** | **19.71** |

# State resolutions concerning bioenergy

***resolutions of the Cabinet of Ministers of Ukraine***

- "The measures concerning the use of the alternative energy sources" (4.02.09)
- "Some issues of the state policy implementation in the field of efficient use of fuel-and-energy sources" (11.02.09)
- "Organizing production and use of biogas" (12.02.09 )
- "Approval of conception of the state target scientific and technical program "Development of production and utilization of biological fuels" (12.02.09)
- "Special features regarding connection of the units producing power from the alternative energy sources to power grids" (19.02.09)
- "First priority measures to reduce natural gas consumption during the period till 2010" (19.02.09)

# Recent laws in Ukraine's bioenergy sector

***two important laws were passed in 2009***

**1. The Law of Ukraine** «On Amending Some Laws of Ukraine Regarding the Encouragement of Production and Consumption of Biofuels » (№ 1391-VI from **21.05.2009**) – ***"The Law on Biofuels"***

The Law was created on the basis of the Law of Ukraine «On Alternative Types of Fuels» (№1391-XIV from 14.01.2000, the original title was changed).

The Law envisages a number of **privileges** for the producers and consumers of **biofuels** and also for the producers of relevant equipment:

- ✓ no custom duty and VAT on bioenergy equipment which is imported into Ukraine (from 01.01.2010 to 01.01.2019)
- ✓ no profit tax on (1) sale of biofuels, (2) CHP/ heat production from biofuels, (3) production of bioenergy equipment (from 01.01.2010 to 01.01.2019)
- ✓ no excise tax on the production of motor biofuels (from 01.01.2010 to 01.01.2014)
- ✓ preferential amortization for bioenergy equipment (from 01.01.2010 to 01.01.2019)
- ✓ bioethanol can be produced by the state and private companies (provided the license is available)

# Recent laws in Ukraine's bioenergy sector

**2. The Law of Ukraine** «On Amendments to the Law of Ukraine "On Energy Industry" as for Stimulating the Use of the Alternative Energy Sources» (№ 1220-VI from **01.04.2009**) – ***"The Law on Green Tariff"***

- Green Tariff (GT) is set differently for particular type of renewable energy sources
- GT is in effect till January 01, 2030
- Minimal GT is EUR equivalent of GT calculated in line with the prescribed rule (through retail electricity tariff applicable for the 2nd voltage class consumers and the Green Coefficient ) at the official UAH/EUR exchange rate as of January 01, 2009
- UAH amount of GT should not be below Minimal GT and, thus, has to be revised upward/downward in the case of UAH devaluation/revaluation against EUR
- Green Coefficient is set in the following way:

1.2 - for wind plants with installed capacity < 0.6 MW;
1.4 - for wind plants with installed capacity 0.6-2 MW;
2.1 - for wind plants with installed capacity of more than 2 MW;
**2.3 – for biomass plants;**
4.8 – for solar plants located on the land;
4.6 – for solar plants installed on the roofs of the buildings with capacity > 0.1 MW;
4.4 – for solar plants installed on the roofs of the buildings with capacity < 0.1 MW and for solar plants installed on the front of the buildings irrespective of their capacity;
0.8 – for small hydro plants.

- Green Coefficient will be reduced by 10%, 20% and 30% for renewable energy plants commissioned or materially modernized after 2014, 2019 and 2024 respectively

# Comparison of the "green" tariff value in Ukraine and Germany

| RES | Type of power plant, installed capacity (Ukraine) | "Green" tariff in Ukraine*, €cent/kWh | "Green" tariff in Germany**, €cent/kWh |
|---|---|---|---|
| **biomass** | **All biomass plants**<br><br>(in the Law, **biomass** is products of vegetable or partly vegetable origin, which can be used as a fuel for energy production) | **13.45** | biomass (all):<br>≤150 kW **11.5**<br>150-500 kW **9.9**<br>500-5000 kW **8.9**<br>5-20 MW **8.4**<br>LFG, sewage treatment plant gas, mine gas:<br>≤500 kW **7.67**<br>500-5000 kW **6.65**<br>5-150 MW **6.65** (mine gas)<br>biomass (not treated or modified residues of agricultural, forestry or horticultural operations; manure; vinasse):<br>≤150 kW **11.5+6=17.5**<br>150-500 kW **9.9+6=15.9**<br>500-5000 kW **8.9+4=12.9**<br>biomass (cogeneration):<br>≤150 kW **11.5+2=13.5**<br>150-500 kW **9.9+2=11.9**<br>500-5000 kW **8.9+2=10.9**<br>5-20 MW **8.4+2=10.4** |

* *the base value for calculation via "green" tariff coefficient is 58.46 kop./kWh (without VAT);*

** *the comparison is relative as the "green" tariff in Germany is much more differentiated and there are a lot of conditions for its application*

# “Biomass action plan for Ukraine”

*developed by the Ministry of Agricultural Policy of Ukraine and SEC Biomass in 2009 within the framework of G2G Dutch-Ukrainian project “Biomass and Biofuels in Ukraine”*

*available at www.biomass.kiev.ua (section “Projects”)*

Contents:

# “Biomass action plan for Ukraine”

***Main problems identified***

- Absence of justified targets on the contribution of biomass to the total primary energy consumption
- Absence of working (not declarative) state program with the status of law
- Low financial capability of Ukrainian companies plus high interest rate for bank credits
- Undeveloped market of biomass as a fuel

# “Biomass action plan for Ukraine”

## *Required further incentives*

- ✓ To adopt a political declaration indicating the national targets on biomass

| 2008 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| 1 mill tce (0.5%*) | 2 mill tce (1%) | 5 mill tce (2.5%) | 10 mill tce (5%) | 15 mill tce (7.5%) | 20 mill tce (10%) |

** % of the total primary energy consumption*

- ✓ To assign a single ministry/ state agency responsible for all the aspects of bioenergy development
- ✓ To develop a realistic state program with secured financing and outcomes
- ✓ To exempt biomass as an article of trade from VAT
- ✓ To introduce 20% state subsidy for the purchasers of bioenergy equipment
- ✓ To give target support to R&D activity in the bioenergy sector
- ✓ To develop a realistic scenario of land use for biomass production
- ✓ To identify the amount of biomass needed for national use and export on the basis of balanced approach

# Techno-economic assessment of a typical straw fired boiler

| | |
|---|---|
| Thermal capacity, kW | **600** |
| Nominal operating load, h/yr | 4272 |
| Overall efficiency | 82% |
| Fuel | Rectangular straw bales of up to 2.40×1.20×1.30 m size; cylindrical straw bales of up to 2.00 m diameter |
| Fuel low heating value, MJ/kg | 14 |
| Fuel price, UAH/t | **250** |
| Fuel consumption (straw), t/yr | 804 |
| Produced heat, GJ/yr | 9228 |
| Natural gas substitution, th. $m^3$/yr | 293 |
| Investment costs, th. UAH | 793 |
| Operational costs, th. UAH/yr | 349 |
| Net present value (NPV), th. UAH | 528 |
| Internal return rate (IRR), % | **46** |
| Simple payback period, yr | **2.1** |
| Discounted payback period, yr | 2.3 |

Ukraine, 2009:

more than 20 boilers already installed

***UTEM boiler, Ukraine***

# Techno-economic assessment of a typical wood fired boiler

| | |
|---|---|
| Thermal capacity, kW | **500** |
| Nominal operating load, h/yr | 4272 |
| Overall efficiency | 85% |
| Fuel | wood chips |
| Fuel low heating value, MJ/kg | 10 |
| Fuel price, UAH/t | **200** |
| Fuel consumption (wood chips), t/yr | 905 |
| Produced heat, GJ/yr | 7690 |
| Natural gas substitution, th. $m^3$/yr | 255 |
| Investment costs, th. UAH | 590 |
| Operational costs, th. UAH/yr | 327 |
| Net present value (NPV), th. UAH | 403 |
| Internal return rate (IRR), % | **46** |
| Simple payback period, years | **2.1** |
| Discounted payback period, years | 2.3 |

Ukraine, 2009:

- about 500 boilers already installed
- more than 1000 boilers converted from fossil fuels

***"Zhitomirremkharchomash" boiler, Ukraine***

# Techno-economic assessment of a typical biogas plant

*taking into account the "green" tariff*

| | | |
|---|---|---|
| Installed thermal capacity of a cogeneration unit, kW | | **220** |
| Installed electrical capacity of a cogeneration unit, kW | | 140 |
| Annual biogas production, th. $m^3$ | | 630 |
| Feedstock | | pig manure |
| Investment costs, Euro | | 1 000 000 |
| Operational costs, Euro/yr | | 34 639 |
| Net present value (NPV), Euro: | variant min | 50382 |
| | variant max* | 782578 |
| Internal return rate (IRR), %: | variant min | **11.3** |
| | variant max | **30.7** |
| Payback period, years | variant min | **6.5** |
| | variant max | **3.0** |

** Variant "max" includes revenue from selling digested manure as a fertilizer and selling emission reduction units*

Ukraine, 2009:

- up to 3 big biogas plants in operation
- about 12 biogas plant under designing/ construction

***160 $kW_e$+300 $kW_{th}$ biogas plant, Yelenovka village, Ukraine***

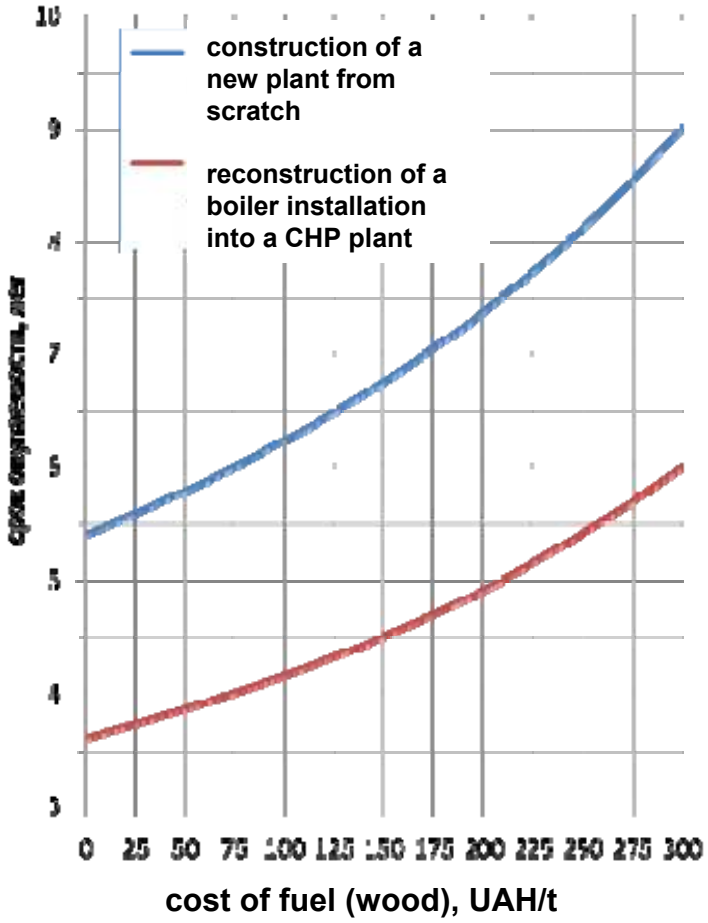
# Techno-economic assessment of a biomass CHP plant
## (based on a condensing steam turbine with steam extraction)

*taking into account the "green" tariff*

### Input data

| | |
|---|---|
| Turbine type | П-6-3,4/0,5-1 |
| Electric power of the CHPP, kW | 6000 |
| Annual load factor of the CHPP | 0.9 |
| Biomass boiler efficiency, % | 85 |
| Operation period of the CHPP, h/yr | 8000 |
| Operation period for heat + hot water supply, h/yr | 4320 |
| Operation period for hot water supply, h/yr | 8000 |
| Low heating value of wood fuel, MJ/kg | 14.5 |
| Power sale tariff, UAH/kWh (without VAT) | 1.345 |
| Heat sale tariff, UAH/Gcal (without VAT) | 200 |
| Specific capital cost of the CHPP, EUR/kWe: | |
| *- construction of a new plant from scratch* | 3000 |
| *- reconstruction of a steam or hot water boiler installation into a CHP plant (replacement of boilers, installation of a turbine, building and construction work, starting-up and adjustment work)* | 2000 |

### Payback period, years



# What bioenergy equipment is missing in Ukrainian market?

- Biomass boilers >2 MW of local manufacture
- Steam biomass boilers of local manufacture
- Commercially proved local technologies for biogas production from manure
- Low-price domestic biomass fired boilers of 10-50 kW (including for pellets)

# Opportunities for biomass projects co-financing within the framework of the Kyoto Protocol mechanisms

| Name of project | Project nature | Total investments, mln. Euro | Total emission reduction (2008-2012), th. t of $CO_2$-eq. | ERU price, Euro/t $CO_2$-eq. | Revenue from ERUs selling, mln. Euro | Share of investments covered by ERUs sales, % |
|---|---|---|---|---|---|---|
| Utilization of the wood residues at "Uniplit" veneer plant, Ivano-Frankivsk region (JI project) | Switch from fossil fuels to biomass | 4.7 | 158 | 10 | 1.58 | 34 |
| Utilization of sunflower seeds husk for steam and power production at the oil extraction plant OJCS "Kirovogradoliya" (JI project) | Switch from fossil fuels to biomass | 6.1 | 220 | 6.5 | 1.43 | 23 |
| Landfill methane capture and flaring at Yalta and Alushta landfills (JI project) | Landfill gas utilization | 2.0 | 287.5 | 8 | 2.3 | >100 |

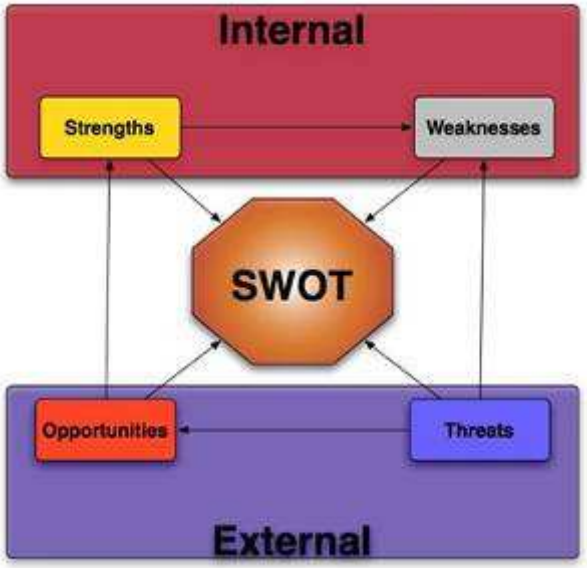
Thereby the share of investments costs covered by ERUs sales could be 100 %

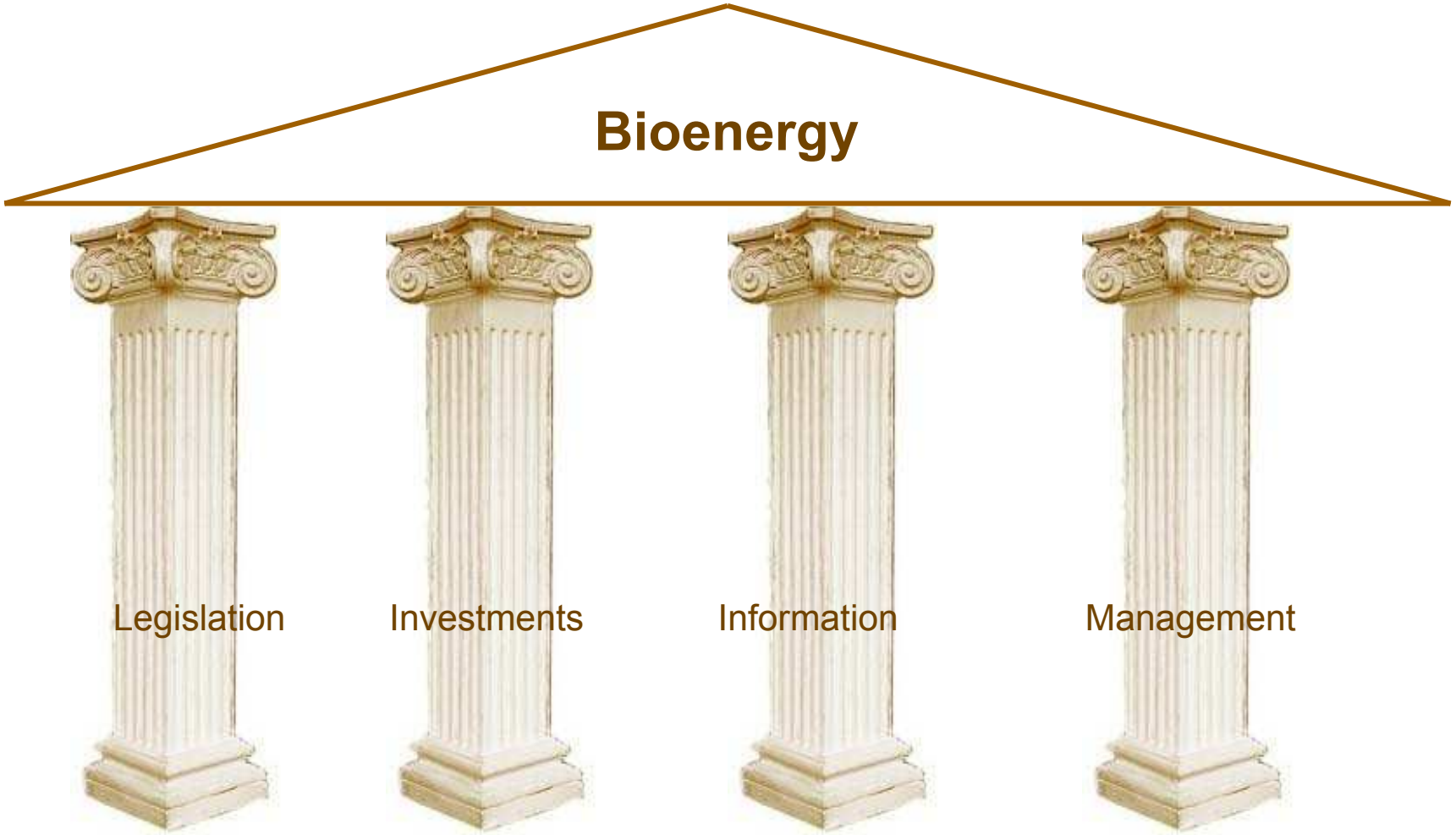
# Opportunities for investments in Ukraine's bioenergy sector

| Type of equipment | Estimation of Ukrainian market volume | Installed capacity | | **Required investments** |
|---|---|---|---|---|
| | units | $MW_{th}$ | $MW_e$ | **mill UAH** |
| Wood fired heating boiler installations, 0.5-10 $MW_{th}$ | 900 | 450 | | **225** |
| Wood fired industrial boilers, 0.1-5 $MW_{th}$ | 400 | 280 | | **140** |
| Wood fired domestic boilers, 10-50 $kW_{th}$ | 35000 | 1050 | | **735** |
| Wood fired mini-CHP plants, 1-10 $MW_e$ | 10 | 100 | 50 | **150** |
| Straw fired farm boilers, 0.1-1 $MW_{th}$ | 10000 | 2000 | | **1400** |
| Straw heating boilers, 1-10 $MW_{th}$ | 1000 | 2000 | | **1200** |
| Straw-fired mini-CHP plants, 1-10 $MW_e$ | 10 | 100 | 50 | **175** |
| Farm sunflower and corn stalk fired boilers, 0.1-1 $MW_{th}$ | 9000 | 1800 | | **1440** |
| Peat boilers, 0.5-1 $MW_{th}$ | 800 | 600 | | **240** |
| **TOTAL:** | 57120 | **8380** | **100** | **5705** |

# SWOT analysis of bioenergy sector

| **Strengths** | **Weaknesses** |
|---|---|
| • Big potential of biomass<br>• Availability of unused lands<br>• $CO_2$ emission reduction potential<br>• Biomass is a cheap local fuel<br>• Availability of a good scientific basis<br>• Successful pilot and demonstration projects already exist | • Shortcomings in the legislative base, “soft” environmental legislation<br>• Lack of knowledge and information; infrastructure; state financial support, especially for realization of demonstration projects; communication between the bioenergy sector actors<br>• Unstable political situation<br>• Underdeveloped feedstock and equipment markets |
| **Opportunities** | **Threats** |
| • Strengthening energy security<br>• Direct substitution of natural gas<br>• Export of biomass/biofuels<br>• Creation of new jobs<br>• Development of local economy<br>• Attraction of additional investments by the Kyoto Protocol mechanisms. | • Potential competition with food production<br>• World prices of fossil fuels could become lower<br>• Competition with the third world countries in cheap biomass production |






Ukrainian realities (% from needed, personal point of view):

**50%** **10%** **60%** **20%**

# Thank you for your attention!

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