Session 2 • Socio-economic Dividends of Climate Change Mitigation

The Forgotten Benefits of Climate Change Mitigation

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CTI Capacity Building Seminar for CEE/CIS Countries,
October 22 – 26, 2005
Hotzel Breitenfelder Hof
Leipzig, Germany

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The basic assumptions

The anthropogenic climate change will persist if the global volume of greenhouse gas emissions will not be reduced significantly.

A dangerous and irreversible climate change will occur if atmospheric concentrations of greenhouse gases in the year 2100 exceed 450 ppm and global surface temperature is 2 °C higher than its pre-industrial level.

The consequence of exceeding these limits would be both more frequent and more violent extreme climate events. In order to avoid this, it is necessary to stabilize global greenhouse gas concentrations at nearly today's level.

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What seems to be clear

- International experts agree that the emission of greenhouse gases by mankind is rising further and further, and causing climate change.
- This can clearly be seen in the rise in the average global temperature and sea level.
- It is also evident in the increase in extreme weather events and natural catastrophes, which are causing enormous economic damage.

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What had been the observations within the last years?

- The economic damage from extreme weather events has increased by the factor 15 in the last three decades.
- In 2002 the insurance company Münchner Rück put the global damage at 55 billion US dollars. The strong rise in damage is partly due to the fact that coastal regions that are particularly affected by climate change are becoming increasingly densely populated.
- An extrapolation of the economic trend in the data from Münchner Rück shows the damage increasing tenfold by 2050, to 600 billion euros. Insurance companies will be less and less willing to offer insurance.

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Extreme Climate Events and their Effects (I)

Extreme Climate Events and their Effects	Effects
Higher maximum temperatures. More hot days and heat waves	Rising number of deaths and serious ill-health of the elderly, particularly in poor regions Rise in heat stress in animals Shift in tourism areas Rise in risk of harvest damage Less certainty in energy supply Rise in demand for energy for cooling purposes
Fewer cold days and fewer cold waves	Less likelihood of deaths from cold Less risk of harvest loss Rise in spread of tropical diseases Greater spread of pests Less demand for energy for heating purposes
More extreme rainfall	Rise in damage from floods, landslides and avalanches More soil erosion Higher expenditure by the state on compensation payments Higher risks for insurance companies
Rise in summer dry periods and the risk of drought	Lower harvest yields Rise in damage to buildings from changes in ground conditions and contraction (subsidence) Reduction in water resources and poorer quality of water Greater risk of forest fires

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Extreme Climate Events and their Effects (II)

Extreme Climate Events and their Effects	Effects
Rise in the strength of hurricanes. Increase in medium and heavy rainfall (in some regions)	High Greater risk to human life Greater risk of disease and epidemics Increased coastal erosion and more damage to buildings and infrastructure near to coasts Increase in damage to the eco systems on coasts (like coral reefs and mangroves)
More floods and droughts from El Niño effects High Lower agricultural productivity in areas liable to drought and flooding	Lower agricultural productivity in areas liable to drought and flooding Rise in damage in Central Asia Fewer water resources in drought regions
Greater fluctuation in monsoon rainfalls in Asia	More flooding and droughts
Greater severity of storms in equatorial regions	Greater risk to life and health Greater loss of welfare and more damage to infrastructure More damage in coastal areas
Source: Intergovernmental Panel of Climate Change (IPCC 2001)	

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Costs for Climate Protection and Climate Damages (in billion US dollars at 2002 prices)

source: DIW Berlin	Climate protection commences			
	2005		2025	
	2050	2100 (+2°C)	2050	2100 (+3,5°C)
Cost of climate protection	430	3000	480	3350
Climate damages	1300	3400	3800	15300
Difference	-870	-400	-3320	-11950
Climate damages without climate protection with an increase of the global surface temperature more than 4°C in 2100: up to 20 trillion US dollars				

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What good is climate protection? (I)

- In the absence of climate protection policy, the year 2100 could bring climate change damages amounting to up to 20 trillion US dollars (at 2002 prices).
- If climate protection policy were introduced in 2005, the damages in 2100 could amount to up to 3.4 trillion US-$.
- If climate protection policy were introduced in 2025, the damages in 2100 could amount to up to 15 trillion US-$. Under these conditions, the damages incurred as a result of climate change would be much higher in the second half of this century than if climate protection policy were initiated today.
- So, damages amounting up to 12 trillion US-$ could be averted in 2100.

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What good is climate protection? (II)

- Moreover, in view of the long life span of greenhouse gases in the atmosphere, an active climate protection policy that commences at a later date would not succeed in reducing climate damage to the required extent and it would even be more costly than a earlier climate protection policy.
- According to this thesis, climate damages can thus only be avoided if the implementation of far-reaching climate protection policy commences immediately.

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What are the most important strategies of climate change mitigation?

It will only be possible to stabilize greenhouse gas concentrations at today's level by the year 2100 if the energy system is completely restructured and the energy demand for fossil fuels drastically reduced.

This means:

- Improve the energy efficiency as high as possible
- Increase the contribution of energy sources free of emissions like renewable energy at the most possible amount.

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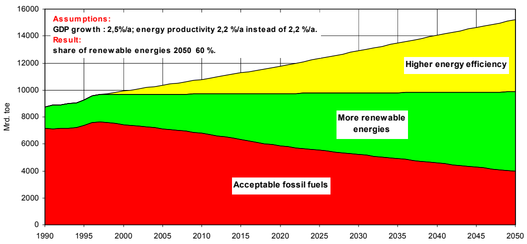
Reduction of worldwide CO_2 emissions by 2050 to a level 50% lower than 1990



source: DIW Berlin.

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What is the precondition of realizing strategies for improving energy efficiency and expanding the contribution of renewable energies?

Improving energy efficiency as well as expanding the contribution of renewable energies investments are indispensable.

I.e. Without the investments needed in the field of energy efficiency and renewable energies there is no way to meet the climate protection targets.

Apart from the priority goal of the avoidance of the temperature rise some further effects especially of these investment activities have to be considered.

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What are the side effects of investments for improving energy efficiency and expanding the contribution of renewable energies?

These effects can accelerate...

- the conservation of energy resources
- the industrial production and the overall economic growth
- the employment
- the regional added value
- the process of innovations

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General effects of investments for improving energy efficiency and expanding the contribution of renewable energies (I)

1. Investment effects
   Investments for itself are inducing positive production and employment effects
2. Operating effects
   - Operation and maintenance
   - Reduction or substitution of energy consumption
3. Budget effects
   If there are extra costs of investments in energy efficiency measures or in renewable energies withdrawal effects regarding other expenditures will be induced

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General effects of investments for improving energy efficiency and expanding the contribution of renewable energies (II)

4. Dynamic effects

New markets, new products, new processes will develop.
Moving along the learning courves with the result of cost reductions
All in all: Innovations can be induced

5. Foreign trade effects

- New export-import-relations will occur
- Lower income for energy exporting countries (inducing lower imports from energy consuming countries)

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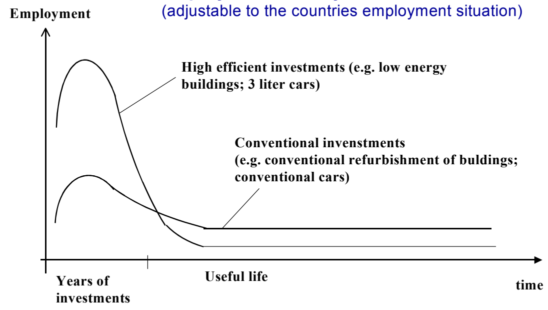
More energy efficiency induces higher employment in the years of investment

(adjustable to the countries employment situation)



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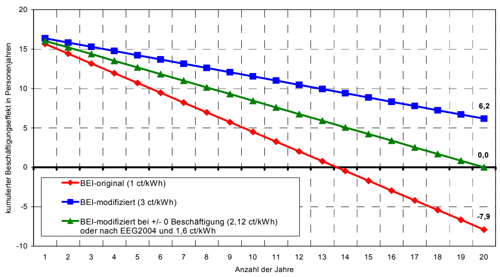
Total effect of a 1.2 MW wind turbine investment on employment



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Specific effects of a 1.2 MW wind turbine investment on employment

	Employment (persons per year)	
	first year	20 years
Investment effect	16,9	16,9
Operation effect	0,7	13,4
Budget effect (I)	-1,9	-38,2
Total effect	15,7	-7,9
Budget effect (II)	-1,2	-24,1
Total effect (II)	16,4	6,2

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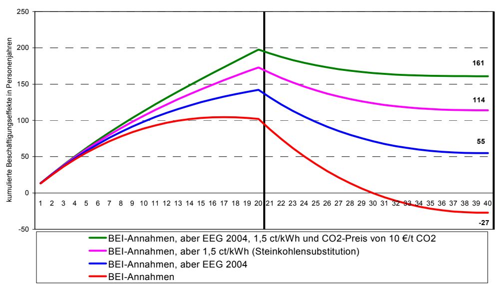
Cumulated effects of continuous investments in wind turbines (1 GW per year over 20 years)



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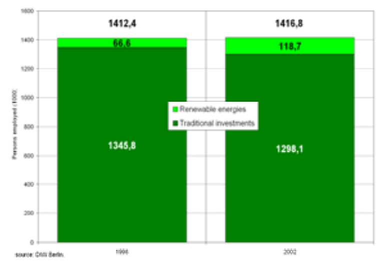
Employment effects of investments for environmental protection in Germany 1998 and 2002



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Turnover from construction and operation of plants for the use of renewable energy sources in Germany 2004

	Construction	Operation	Total	
	million Euro			%
Wind	2400	2200	4600	39,8
Biomass	1750	1850	3600	31,1
Photovoltaics	1500	200	1700	14,7
Solar thermal	600		600	5,2
Geothermal	200		200	1,7
Hydro	20	850	870	7,5
Total	6470	5100	11570	100,0

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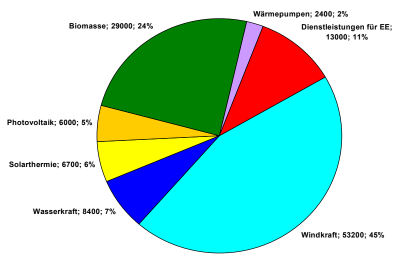
Renewable energies: Persons employed in Germany 2002 (total: almost 120,000)



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Conclusions (I)

- Climate changes cause enormous damages.
- The costs of damages exceed the costs of avoidance by far.
- The sooner a policy of climate protection is implemented, the fewer climate change damages humankind will face in future decades and the lower the costs of avoidance will be.
- Energy efficiency and renewable energies are the most important options for climate protection
- This requires an enormous investment activity. This will not only help climate change mitigation but will also have some forgotten benefits.

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Conclusions (II)

Climatic protection policy and the investments in energy efficiency and renewable energies can contribute also

- to improve the employment situation
- to increase the industrial and overall economic production
- to develop new products and procedures
- to strengthen the regional economy and welfare
- to conserve the finite energy reserves and
- to lower the dependence on energy imports in many countries

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Finally

With the necessary structural change of the economy and the radical transformation of the energy system we will reach both:

We make a crucial contribution to climate change mitigation

and at the same time

create the basis for a long-term path of sustainability.

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Thanks for your attention

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Slide 26

Sustainable Biomass Energy: Results from Research in Germany [1]

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Abstract

Biomass is nowadays used widely for energy, materials, and food. As land to grow biomass on is a finite resource, bio energy competes with other uses. The question of *sustainable* production and use of bio energy must consider environmental, cost, and employment impacts, and requires an *integrated analysis* of biomass flows in agriculture, forestry, and waste management.

To define a "sustainable bio energy corridor", different scenarios need to be set up including technology development, potential biomass sources (e.g. energy crops, short-rotation forestry), energy efficiency, non-biomass renewables, developments of population, food consumption and agriculture (e.g., yields, im- and export, share of organic farming), and considering land-use for nature protection, biodiversity in forestry, and soil protection. *Within* this corridor, synergies between nature protection, greenhouse gas reduction, and bio energy use can arise, and societal benefits in economic and social terms could be provided.

In a recent study, the sustainable bio energy contribution for Germany was analyzed until year 2030, and policy recommendation were derived regarding adequate means of implementation. The German sustainable potential of bio energy is in the order of some 2,000 PJ/a. Depending on the technology to yield and convert biomass, rural areas could significantly benefit, greenhouse-gas emissions could be reduced by some 65%, and a net gain of some 200,000 jobs could occur. The work was sponsored by the German Federal Ministry for Environment.

For more information, see www.oeko.de/service/bio

1 Biomass: A renaissance

Already today, energy is being produced from biomass: predominantly for heating and cooking. In comparison, the potentials of agriculture, forestry, and waste management have hardly been developed, and could sustainably provide much more

[1] Co-authors: Günther Dehoust, Wolfgang Jenseit, Katja Hünecke, Lothar Rausch, Doris Schüler, Kirsten Wiegmann (Oeko-Institut), Andreas Heinz, Markus Hiebel, Markus Ising, Stephan Kabasci, Christoph Unger (FhI-UMSICHT), Daniela Thrän, Nicolle Fröhlich, Frank Scholwin (IE Leipzig), Guido Reinhardt, Sven Gärtner, Andreas Patyk (IFEU Heidelberg), Frank Baur, Ulrich Bemmann, Bodo Groß, Marylin Heib, Claudia Ziegler (IZES), Michael Flake, Meike Schmehl (TU Braunschweig), Sonja Simon (TU Munich)

than they do now. What importance will biomass have in the future supplying of our energy? Which technologies will catch on? What costs will its development have and how greatly will it effect the environment and employment?

The Biomass Material-Flow Analysis (MFA) Project researchers have found answers to these questions and have looked ahead to the year 2030. The project was supported by the German Federal Ministry of the Environment

What Would It Be Like...?

If it's "business as usual," then we'll fall short of our goals for climate protection; in the 90s, levels of greenhouse gas emissions sunk considerably, but since then they've stagnated.

Scenarios that are serious about sustainability look very different. If Germans are persistent about saving energy and make use of the existing potential of renewable energies, future electricity will be green: by the year 2030, biomass could produce almost 25 % of our electricity, in addition to around 10 % of our heat and 14 % of the fuel for our cars. Thus, biomass has a greater potential in the next 25 years than brown and hard coal combined. With the addition of sun, wind, water, geothermal and energy conservation, CO_2 emissions will be reduced to the extent that long-term goals for climate protection can be fulfilled. The vast majority of savings are dependent on gains in efficiency on the demand side.

With successful implementation of energy-saving measures, the future supply of energy will be not only lower in emissions, but more economical as well: in scenarios, costs lay almost 20 % lower than those extrapolated from the current energy supplied by coal and nuclear energy. However, the costs of energy efficiency have not been determined by the project

In addition to the development of renewables, energy efficiency is the second pillar for a sustainable energy supply. That's why closing down old power plants is as important as their replacement with modern facilities. Here, only those possibilities for energy efficiency which are economically feasible have been considered.

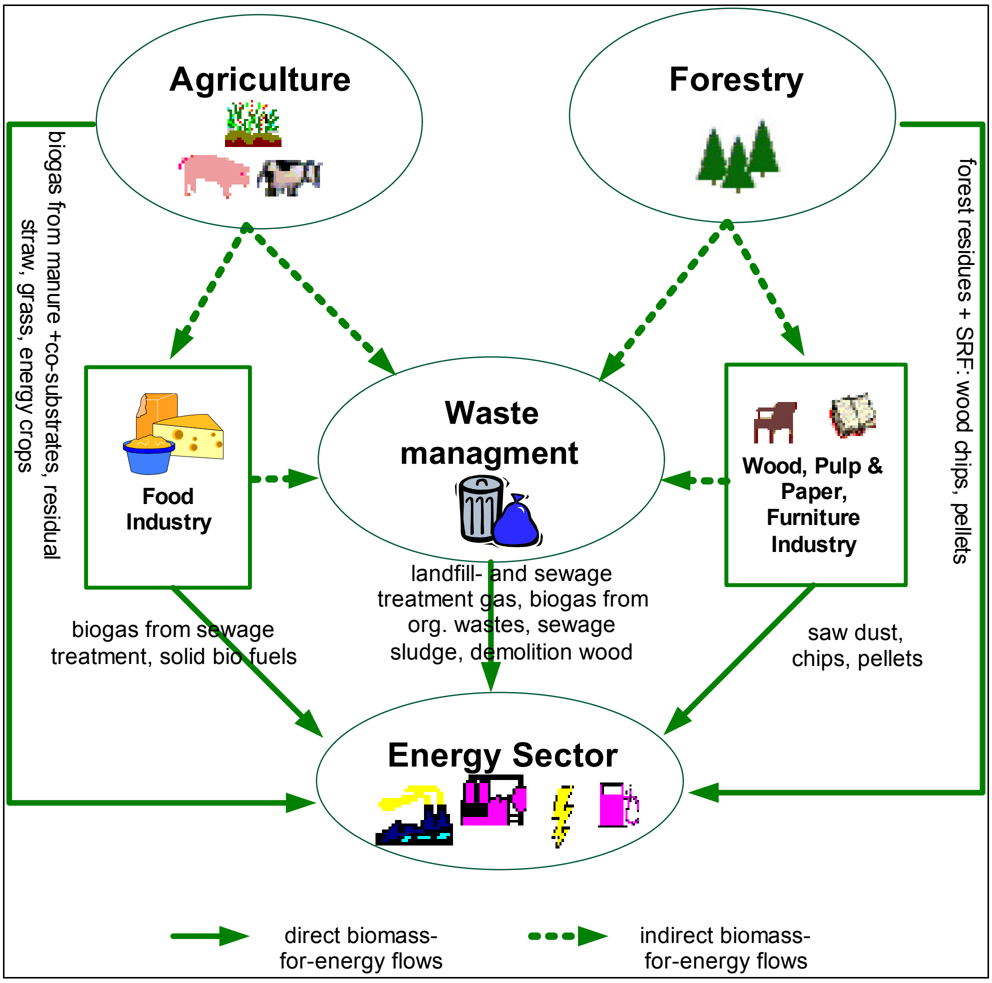
2 (Bio)mass is energy

The project's approach to analyze sustainable biomass potentials is based on material-flow analysis (MFA) which tracks biomass from resource extraction to final use, and include life-cycles.

The amount of energy availability from biomass by-products and energy crops is, from the current standpoint, about the same. A strategy for development must, therefore, take into consideration cultivation as well as by-products. The project's system boundaries were quite comprehensive, as shown in the following figure.

Biomass by-products accumulate anyway, but at the moment they are hardly used. In the future, a second life as a source of energy awaits these solid as well as liquid materials – they can supply 700 Peta Joules (PJ) per year. That's enough for the energy supply of ten cities as big as Munich (including business and industry).

Fig. 1: The system boundaries of the Sustainable Biomass Material-Flow Analysis



The greatest potential is offered by wood from forest thinning, biogas from manure, straw from grains, and wood wastes like old furniture, woody construction material, or cutting by-products from industry. Until the near future, methane-rich landfill gasses are also available. However, the dumping of organic wastes is being phased out.

4.4 million hectares of fields and meadows can, by the year 2030, become “free” for the cultivation of energy crops, as agriculture’s increasing yields require less and less area to provide for the decreasing population – despite a fundamental change towards sustainable organic agriculture, which can require more land than non-organic farming. This newly available area would yield a maximum of 1,200 PJ bio energy per year.

3 Job-engine running on biomass

Biomass secures and creates employment. In fact, it also replaces jobs in the field of fossil energies, with more jobs per kilowatt hour being brought about through bio energy than by coal, oil or natural gas (see result tables in section 5).

The project scenarios give an indication of what the results of the development of biomass could look like, all in all. The replacement of fossil energy sources has already been considered in these figures.

Every economy has direct and indirect employment impacts. Direct employment results from the actual operation, while indirect employment stems from investments in construction and infrastructure. In the long-run, direct employment is especially important for the job market. This is most significant in energy crop cultivation and in the production of electricity by combined heat and power generation (CHP, or cogeneration). If biomass is only used for heating or fuel, considerably fewer direct jobs will be created.

This means that, above all, work in rural areas is created. These are areas where, in the past, many people's opportunities for income have been lost.

4 Potential means opportunity

Potential always indicates the supply of energy based on specific assumptions within a specific timeframe. Competition for different uses limits the potential. The results presented here already consider the essential requirements of the environment and of nature conservation, as well as the land demands of housing, waste management, and transport. What would it be like if...in the year 2010, 20 % of farmers were actually farming organically? Or, if...? The project considered, by means of scenarios, ways of increased but sustainable bio energy production and use based on the following assumptions:

- Conditions for use of forests and protected areas guarantee a sustainable forestry for the future as well.
- Political demand for a fundamental change towards organic agriculture with 20 % or more organic farming to be implemented – the REFERENCE scenario (business as usual) being the exception. In spite of predictions to the contrary, large areas for energy crops remain available.
- In addition, ecologically valuable grasslands may not plowed up into fields for agrarian areas, there is a lack of structural elements such as hedges or trees, as refuges for plants and animals. What the natural environment lacks must be restored; in energy crops.

Besides the REFERENCE scenario, alternate views on the future were part of the Biomass MFA Project:

- The BIOMASS scenario creates as much bio energy as possible with minimum emissions of greenhouse gasses.
- The ENVIRONMENT scenario considers comprehensive environmental and nature conservation restrictions which inevitably decrease the potential.
- These project recommendations are based on the SUSTAINABILITY scenario. Consequently, only these findings are printed here.

There are synergies between nature conservation and biomass: perennial energy crops enrich the landscape. Cutting by-products from landscape management can be used for energy: what is missing are logistics concepts and evidence of its profitability.

- The unbridled consumption of land for building and transport is coming to an end. This is because, with a decreasing population, land consumption also decreases, and more land can be recycled.
- Agricultural foreign trade is, more or less, the import or export of arable land for agricultural use. Current trends are extrapolated here: subsidized exports become fewer, imports stagnate. This is how land becomes “free.”
- Many future technologies for biomass are still in their infancies. They develop along so-called *learning curves*. In the beginning, big advances take place within a short time, causing technologies to become more efficient in less and less time, sinking costs. Biomass use profits from this mechanism.

5 “Who’s Who” of technology

Biomass can be used to produce energy in many different ways – for example, wood can either be burned directly in an oven for heat production, or a gasifier can produce wood gas that subsequently drives an engine, which produces electricity and heat. An engine can run on biogas obtained from manure just as easily.

To figure out which technology makes most sense for which biomass, we must determine which one costs the least and creates the least environmental impacts for each unit of energy produced. A comparison of technologies by the computer model GEMIS (Global Emission Model for Integrated Systems) provides clarity here. The emission of greenhouse gasses and air pollutants, solid wastes , cumulative energy and land-use, as well as costs and effects on employment serve as criteria for this assessment.

The following tables give *some* of the results – there is more than 1,500 different technology data available from the project.

Table 1: Results of the technology analysis of bio electricity from biogas

	costs 2010	2030	jobs	CO_2-eq.	SO_2-eq.
	c/kWh_{el}		pers./TWh_{el}	g/kWh_{el}	
fossile reference systems					
natural gas CC	**4,9**	5,7	**79**	**420**	**0,4**
ard coal (import) ST	**5,0**	4,4	**142**	**913**	**1,4**
biogas					
c+p-300-ICE-cogen-25	14,0	10,0	1.468	-329	1,5
c+p-300-ICE-cogen-100	12,7	8,6	1.476	-269	1,4
c+p-300-ICE-cogen-200	11,0	7,6	1.186	-296	1,4
c+p-1500-ICE-cogen-200	7,8	5,5	746	-317	1,4
c+p-1500-ICE-cogen-500	6,9	4,5	642	-241	1,3
c+p-1500-ICE-cogen-1000	6,6	4,6	585	-212	1,2
biowaste-only-ICE-cogen-500	8,1	5,9	522	-372	0,7
manure-only-ICE-cogen-500	9,6	8,1	898	-240	1,1
biowaste-4000-ICE-cogen-500	3,5	2,0	539	-339	0,6
manure+maize-ICE-cogen	18,5	15,2	518	-187	1,9
manure+maize-org.-ICE-cogen	24,0	19,9	920	-233	1,2
moist-crops-ICE-cogen	10,2	7,7	5.233	-182	1,6

Note: results include credit for co-generated heat

Anaerobic fermentation with subsequent use of biogas is a process that is already available on the market for use in packaged heat and power plants. The impacts on emissions, costs, and employment are especially positive if the biogas is produced from moist crops (so-called “wet route”), or if the biomass derives from organic wastes that have been separately collected.

The project also analyzed electricity and heat generation from solid biomass (wood residues, short-rotation forestry, straw), co-firing, and various bio fuels (see website).

6 An active biomass policy

Biomass can, at over 14 %, cover a considerable share of Germany’s energy supply in the future. Already considered in this figure are restrictions which arise from limited land-use and strict environmental criteria. Both proven and new methods are needed to provide the necessary push:

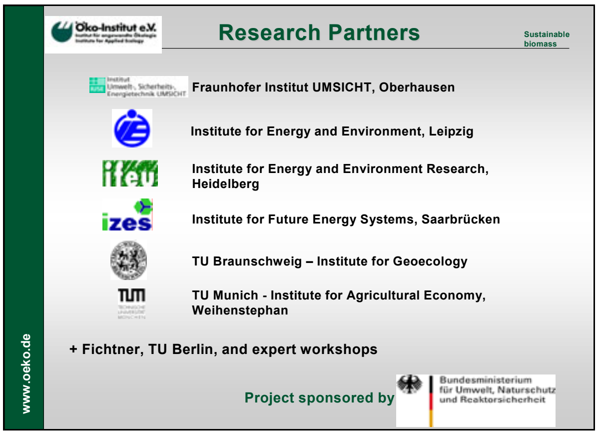
The German Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz = EEG) guarantees fixed feed-in tariffs for green electricity that has been innovatively generated. The 2004 EEG revision increases support for small-scale power plants. It also makes special effort to support decentralized plants that use biogas, and those which integrate themselves into the natural material cycles of agriculture without accumulating hazardous substances. The EEG also includes now a bonus provision for clean agricultural residues, and energy crops.

For decentralized CHP systems, *local heating grids are the key to success*: here, an effective instrument to support their implementation is urgently needed. This would be of benefit not only to biomass, but to solar and geothermal as well as decentralized fossil-fuel-based CHP systems at the same time. This is why the CHP bonus in the new EEG is an important step towards efficient biomass use.

It is often implied that the development of bio energy is at conflict with the goals of nature conservation. However, the results of this project have *shown that nature conservation goals and the use of biomass for energy can be compatible*. In fact, the cultivation of productive perennial crops contributes valuably to erosion protection. On the other hand, the cultivation of energy crops on ecologically valuable wet grasslands should be avoided – the potentials are great enough without the use of these areas.

A *synergy* could even be achieved between nature conservation and biomass cultivation through the use of energies from agricultural and landscape management by-products. Questions of the economic feasibility of such concepts call for further research. Here, Federal and State Governments must cooperate and should, above all, come to realistic agreements about the implementation of legislative goals.

The project scenarios show that the chosen basic conditions decisively influence the level of potential for the use of biomass. This is why future policy must link together waste management, nature conservation, and agriculture and include questions of what is acceptable. Of particular importance are the roles of employment, the development of rural areas, landscape preservation, and the supply of clean energy. bio energy offers, all in all, great opportunities for a sustainable development – not only on a national level, but also for states and local communities, as well as globally.



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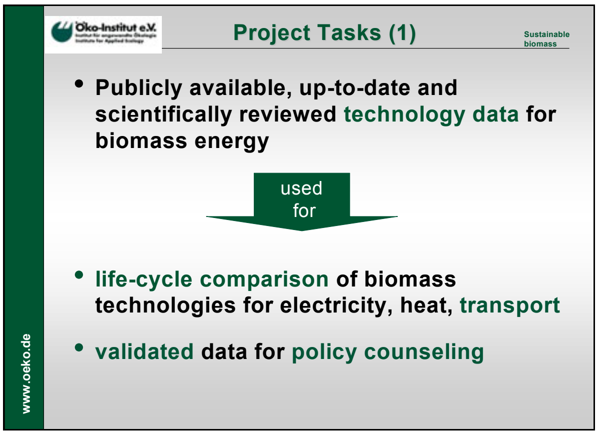

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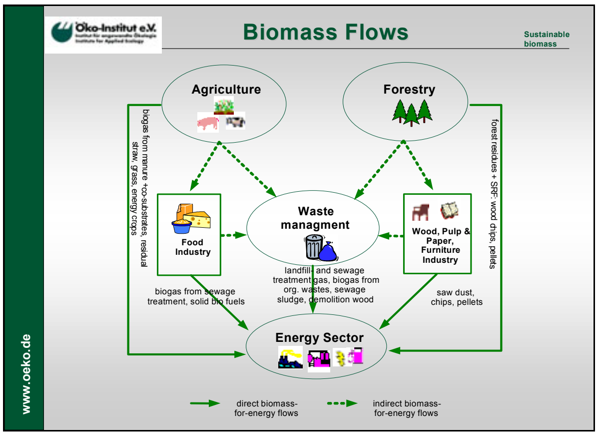

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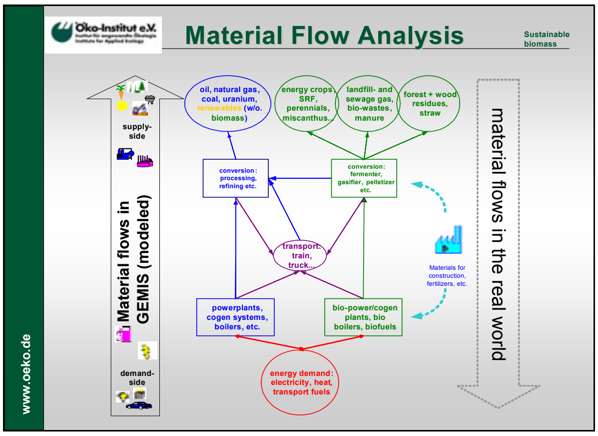

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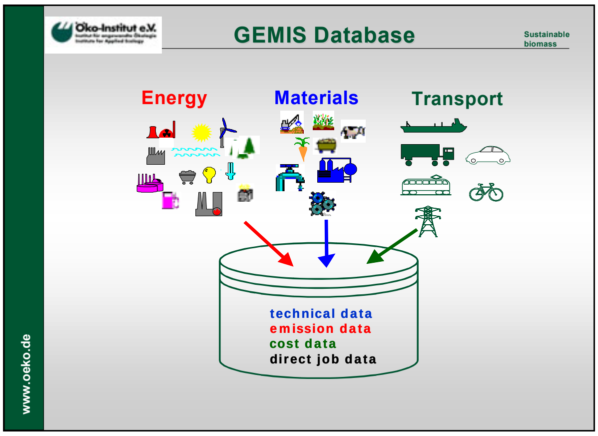

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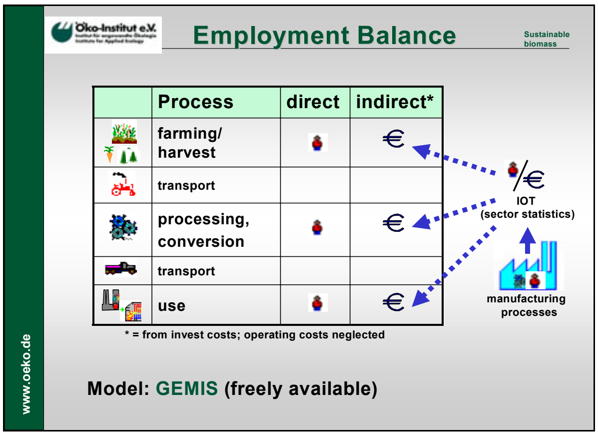

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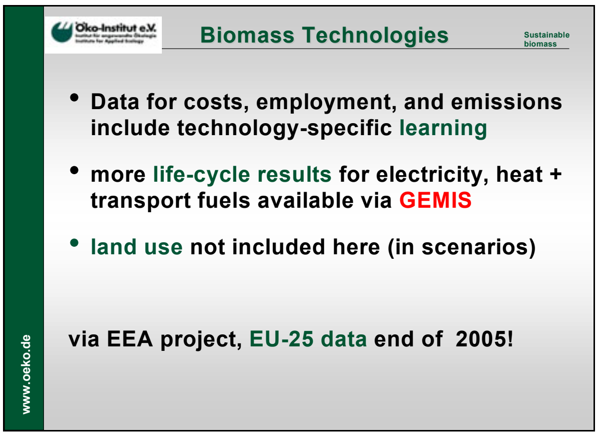

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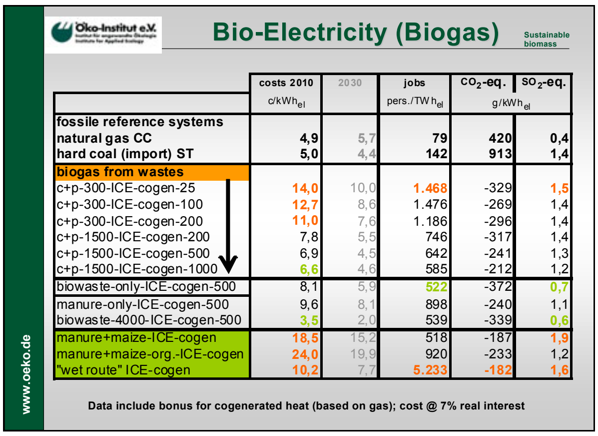

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c+p-1500-ICE-cogen-200	7,8	5,5	746	-317	1,4
c+p-1500-ICE-cogen-500	6,9	4,5	642	-241	1,3
c+p-1500-ICE-cogen-1000	6,6	4,6	585	-212	1,2
biowaste-only-ICE-cogen-500	8,1	5,9	522	-372	0,7
manure-only-ICE-cogen-500	9,6	8,1	898	-240	1,1
biowaste-4000-ICE-cogen-500	3,5	2,0	539	-339	0,6
manure+maize-ICE-cogen	18,5	15,2	518	-187	1,9
manure+maize-org.-ICE-cogen	24,0	19,9	920	-233	1,2
"wet route" ICE-cogen	10,2	7,7	5.233	-182	1,6

Data include bonus for cogenerated heat (based on gas); cost @ 7% real interest

Slide 8

Bio-Heat (Wood)

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	costs 2010	2030	jobs	CO_2-eq.	SO_2-eq.
	c/kWh$_{th}$		pers./TWh$_{th}$	g/kWh$_{th}$	
gas heating 10 kW	**10,2**	11,4	**266**	**296**	**0,36**
oil heating 10 kW	**10,6**	11,2	**333**	**383**	**0,42**
wood residues					
chips heating 10 kW	7,6	7,5	378	29	0,5
chips heating 50 kW	6,1	6,1	289	29	0,5
pellet heating 10 kW	11,3	11,5	446	34	0,4
pellet heating 50 kW	10,9	11,1	420	33	0,4
pellet heatplant 0.5 MW + grid	8,3	8,7	796	40	0,4
chips heatplant 1 MW + grid	5,3	5,3	340	33	0,4
chips heatplant 5 MW + grid	5,4	4,8	358	32	0,4
SRF-poplar/Miscanthus					
pellet heating 10 kW	13,7	14,1	1.322	56	0,6
pellet heating 50 kW	13,2	13,7	1.277	55	0,6
pellet heatplant 0.5 MW + grid	10,8	11,4	1.728	64	0,6
chips heatplant 1 MW + grid	6,9	7,1	1.275	52	0,6
chips heatplant 5 MW + grid	6,7	7,0	1.272	50	0,6
miscanth.heatplant 1 MW + grid	6,4	6,6	413	53	1,5
miscanth.heatplant 5 MW + grid	7,0	7,3	430	47	1,0

Cost data @ 7% real interest

Slide 9

Biofuels (Transport)

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	person transport	costs 2010	2020	jobs	CO_2-eq.	SO_2-eq.
		€cent/kWh$_{input}$		pers./TWh$_{input}$	g/kWh$_{input}$	
DIESEL-CAR	**fossil diesel with tax**	**9,9**	10,8	**8,8**	**325,9**	**0,5**
	dito, without tax	**3,5**	4,0			
	RME-DE	7,7	8,2	314	65,8	1,0
	RME-from-PL	7,3	7,3	-	77,3	0,9
	BtL-wood-residue-DE	6,9	5,3	238	31,7	0,8
	BtL-wood-SRF-DE	8,8	7,7	1.758	-105,6	0,8
	BtL-wood-SRF-from-CZ	5,1	6,3	-	-82,8	0,8
	BtL-wood-SRF-from-HU	5,4	6,7	-	-70,6	0,7
	BtL-wood-SRF-from-PL	4,4	5,8	-	-145,4	-0,1
	BtL-wood-SRF-from-RO	4,6	5,9	-	-22,5	0,5
OTTO-CAR	**fossil gasoline, with tax**	**13,0**	14,2	**9,1**	**342,8**	**0,5**
	dito, without tax	**5,2**	5,7			
	BioEtOH wheat-DE	7,2	7,8	217	197	0,7
	BioEtOH wheat-DE-organic	9,5	10,2	518	130	0,2
	BioEtOH sugarbeet-DE	11,9	12,7	253	230	0,9
	BioEtOH wheat-from-PL	3,3	3,4	-	219	0,8
	BioEtOH-sugarcane-from-Bl	3,4	3,4	67	108	1,0
	Biogas (maize)	6,9	6,7	220	87	0,6
	Biogas (maize-organic)	8,8	8,7	360	71	0,4
	Biogas (double-cropping)	4,0	3,8	1.870	89	0,5

Biofuels with credits for upstream **couple products** (electricity, materials); **excl. taxes!**

Slide 10

Project Tasks (2)

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- **Potentials and Scenarios for sustainable biomass energy production and use**

used to

- **Analyze trade-offs between scenarios**
- **Policy recommendations for biomass energy in Germany**

Slide 11

Scenario Storylines

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- **Reference (REF): business-as-usual**
- **Environment (ENV): reduced demand by efficiency; more non-biomass renewables; environmental restrictions for biomass, +10% area for nature protection (2010)**
- **Biomass (BIO): less restrictions than ENV; + 5% nature protection area til 2030; maximum sustainable biomass supply**
- **Sustainable Dev. (SD): mix of ENV + BIO**

Slide 12

Scenario Drivers

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- **In ENV, BIO and SD: 30% organic farming for food until 2030**
- **Dynamics: population, food consumption, yields, ex- and imports**
- **Land use for settlements & transport**
- **Land use for nature protection; biodiversity in forestry; soil protection (straw)**
- **No bioenergy ex- or imports (yet)**

Slide 13

Potential Bio-Wastes

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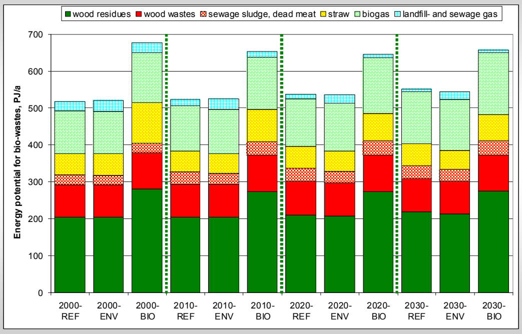
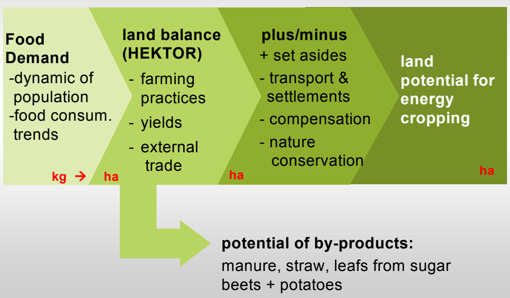


Slide 14

Land Potential

Öko-Institut e.V. — Sustainable biomass — www.oeko.de

Model-based analysis of land potential from agriculture



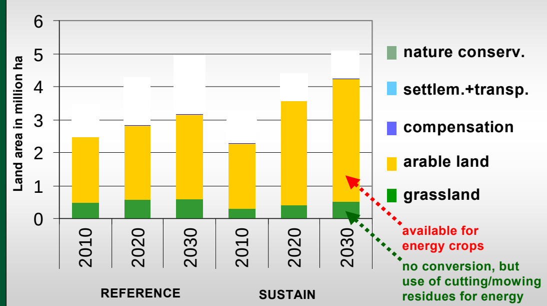
potential of by-products:
manure, straw, leafs from sugar beets + potatoes

Slide 15

Net Land Potential

Öko-Institut e.V. — Sustainable biomass — www.oeko.de

Net balance, including competing use:



Slide 16

Qualitative Assessment

Sustainable biomass

Risk for nature/landscape	wheat	triticale	rape	sunflower	maize	sugarbeets
erosion	A	A	B	C	D	E
damage from compression	A	A	A	A	C	E
eutrophication	A	A	B	B	C	B
biocide impacts	A	A	C	A	C	A
ground water contamination	A	A	B	B	C	B
surface water contamination	A	A	B	C	C	C
loss of habitats/biodiversity	B	B	A	A	B	B
quantified aspectes			**relative valuation**			
CO_2 equivalent emissions	-	-	+	+/-	-	+/-
SO_2 equivaltent emissions	-	-	+	+/-	-	+
land use	-	-	+/-	+	-	+/-
			relative valuation			
nature + environment total	**1**	**1**	**2**	**2**	**2-3**	**3**

categories for nature/landscape	symbols for environmental aspects	total valuation
A	- = low	1 = favorable
B	+/- = moderate	2 = medium
C	+ = high	3 = unfavorable
D		
E	(relative within lines)	

risk expression

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Slide 17

Sustainable Crops

Sustainable biomass

- short-rotation forestry/coppice help soil and erosion protection, also reduce N input
- for nature conservation + biodiversity, SRF + perennials better than annual crops
- "wet route" (double-cropping): minimum (external) input + max. output, less biocides/fertilizers, no tilling → priority !
- residues from "nature management" need extraction anyway → positive impact

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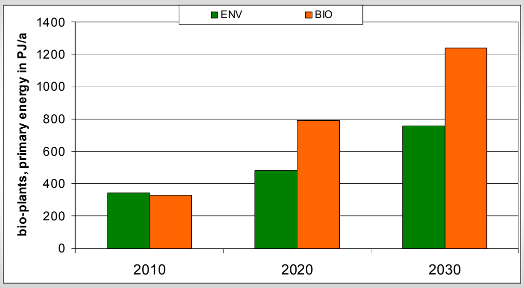
Slide 18

Potential Bio-Crops

Sustainable biomass



Data for model mix; in scenarios, the mix varies

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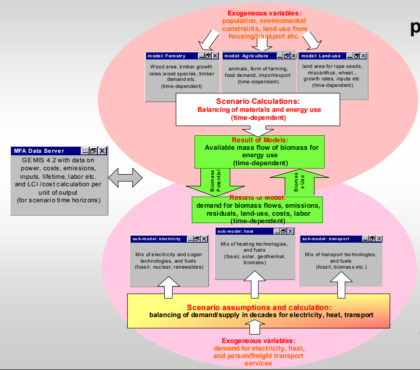
Slide 19

Biomass Model

Sustainable biomass

potential



demand

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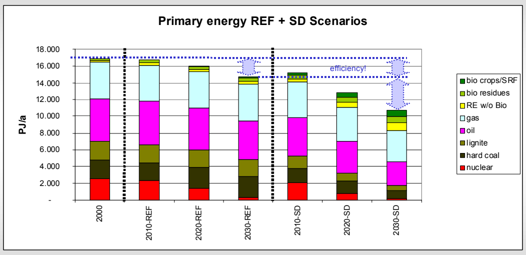
Slide 20

Biomass Results

Sustainable biomass



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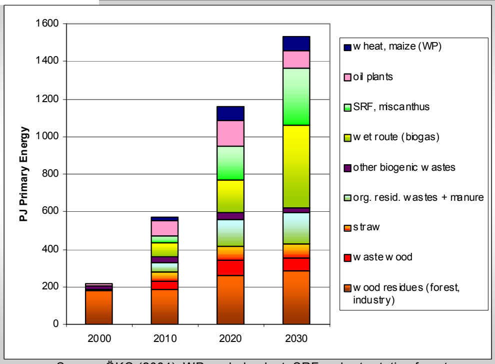
Slide 21

Sustainable Biomass in D

Sustainable biomass



Source: ÖKO (2004); WP = whole plant, SRF = short-rotation forestry

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Slide 22

Biomass Policy

Sustainable biomass

- Cogeneration is key, needs heat users
- Co-firing cost-effective with CO_2 trading
- Additional RT&D program for small/medium gasifier (BIG-ICE + BIG-STIG/BIG-CC)
- "wet route" + SRF offer synergies (nature, biodiv, jobs), market intro needed !
- Biofuels: BtL + hemicellulosic bioEtOH promising, biogas !
- Imports could be interesting in addition

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Slide 23

More Information

Sustainable biomass

Brochure, full report, appendix, and all data:

www.oeko.de/service/bio

Model + database (freely available):

www.gemis.de

Languages: German, English, Czech
(Spanish in summer 2005, French in 2006)

www.oeko.de

Slide 24

Selected Aspects of Biomass Logistics Issues in Poland

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1 Introduction

1.1 Framework for operation of biomass market in Poland

Primarily the framework for implementation of renewable energy resources is defined by the energy law implemented on 10th April 1997 with further modifications. The Law obliges the communes to prepare energy plans incorporating renewable energy resources. The Ministry of Industry, Labor and Social Policy (MGPiPS) has the right to impose the necessity of purchase of energy coming from renewable resources. Additionally, there is a directive issued by MGPiPS related to a specific requirements for electricity from RES purchases of 30 May 2003. Another document defining the development of renewable energy sector in Poland is a Strategy for the development of Renewable Energy issued in August 2003. It states a limit of 7.5% for a share of energy coming from renewable resources in the year 2000 and 14% share in 2020. Finally, on 2 October 2003 there was a Law announced, namely the bio component Act, which allows the Council of Ministers to determine the contents of bio components in fuels for domestic usage on annual basis.

1.2 National Development Plan (NDP)

In years 2007-2013 in Poland there is going to be implemented a National Development Plan, where energy issues are strongly pronounced as they have been devoted a special chapter on energy related issues. The priorities are:

- *Development of market infrastructure and assurance of safety of supplies of traditional fuels and electricity* – support of investments dealing with development of fuel and energy transfer, increasing of storage capacity and infrastructure indispensable in operation of energy markets.
- *Extension and modernization of energy distribution systems for electricity, heat and natural gas* – assurance of adequate access to supplies of electricity, heat and natural gas to its recipients together with improvement of quality of supplies at regional and local level.

- *Increase of energy conversion efficiency and reduction of industrial energy consumption* – support to investments contributing to production efficiency, supplies and utilization of fuels and energy, promotion of CHP and dispersed sources, promotion of demanded attitudes of recipients.
- *Increase of a share of energy from renewable resources and alternative fuels* – support of development of utilization of renewable sources of energy (RES): wind, hydropower, biomass, solar and geothermal energy, alternative fuels for vehicle drive (LNG, bio fuels).
- *Reduction of negative environmental impact of traditional power sector* – modernization of infrastructure with the view of emission of gases, dust and other environmental influences.

Poland is involved in realization of its National Renewable Energy Strategy, where a target is set of achieving 7,5% contribution of electricity production from RES in 2010 and 14% in 2020, respectively. That task is by no means simple to be achieved, and there must be special attention devoted to realization of the strategy.

1.3 Framework for availability of biomass

Poland has very good conditions for development of the biomass sector. The total area of the country is 312 000 km2 of which 59.67% are agricultural areas and 29.41% are forests, which translates to almost 89% of the country possible for cultivation of biomass. In realization of RES strategy it has been officially confirmed that the required status is to be primarily achieved by biomass related technologies. A comparative tabulation of adequate numbers resulting from relevant advised recommendations for EU15 and Poland has been presented in Table 1. There has been assumed an annual increase in electricity production by 1.6%, similarly as in EU15, as well as sustaining of a constant consumption of primary energy. It has been assumed that the share from RES in primary energy in 2001 was 4.5%, despite the fact that some Polish resources state 2.5%. The differences result from unaccounted, non-commercial timber consumption (an official statement for the discrepancy).

Table 1: RES in Poland and European Union [1], [2]

		POLAND				EU 15			
		2001		2010		2001		2010	
			%		%		%		%
Primary energy	Mtoe	4,08[4]	4,5	6,79	7,50	86,12	5,80	178,2	12,00
Electricity	TWh	2,78[4]	1,9	13,00	7,50	408,50	15,30	675,0	22,10
Bio fuels	Mtoe	0,033	0,3	0,65	5,75	0,82	0,31	17,0	5,75

It seems, that in order to justify the share of RES at the level of 4.5%, which is an official number, the numbers contained in Table 2 and Table 3 must be acknowledged, which partially find confirmation in data disclosed by the national forest [3] or non-scientific contributions.

Table 2: Tabulation of share of renewable energy in Poland in 2001 and 2010 [4]

	Unit	2001	2010
Total primary energy	Mtoe	91	91
RES primary energy	Mtoe	4.08	6.83
Electricity	TWh	145	175
	%	1.9	7.5
Electricity from biomass	%	0	2.8
	TWh	0	4.9
Primary energy corresponding to electricity from hydropower and wind power	Mtoe	0.71	2.12
Primary energy from biomass	Mtoe	3.37	4.7
Primary energy from biomass for production of electricity from CHP	Mtoe	0	2.8
Amount of dry biomass for production of electricity	mln t	0	6.7
Amount of dry biomass for production of heat	mln t	7.9	12.4

Table 3: Possible consumption of biomass in Poland in 2002 [4].

No.		mln m^3	PJ	
1.	National forests	3,1	22,5	Total biomass: 144 PJ = 7,9 mln.t.m.s. = 3,37 Mtoe – 3,7 % of primary energy (additionally included can be 0,8 % of primary energy from hydro-power and wind power); 3,7+0,8 = 4,5 % , i.e. the cited share coming from RES.
2.	Private forests	1,0	7,5	
3.	Industrial waste	6,0	44,0	
4.	Recycling	4,5	30,0	
5.	Afforestation	5,5	40,0	
		20,1	144,0	

The increase of contribution by the year 2010 of electricity from RES by 10.22 TWh requires, for example, installation of about 1000 MW power in wind farms together with about 600 MWe of heat and power units fired with biomass. Some comparisons will now follow based on assumption of equal production of electricity at the level of 5.11 TWh from each kind of energy.

For production of electricity in the amount of 5.11 TWh in heat and power stations fired using biomass there is required from 6 to 12 mln tones of fresh biomass with calorific value of about 10 GJ/t and humidity of about 43%, with respect whether CHP efficiency is 15% (small scale CHP) or 30% (large CHP). That means that required is between 3.42 and 6.84 mln tones of dry biomass, which corresponds to 7 ÷ 14 mln m^3 of wood. Bearing in mind that the wood sector declares additional supplies in the amount of about 1.5 mln tones of dry substrate, that means that remaining 3 to over 5 mln tones of wood must come from afforestation of fast growing wood. That translates to harvesting of a surface ranging from 200 000 ÷ 500 000 ha, which further means that it is from 0,6 to 1,6 % total surface of the country.

At a disposal in Poland there is also several mln tones of straw, wheat and rapeseed, available for utilization in power sector. It must be however noted that current consumption of dry biomass is running at approximately 8 mln tones, of which about half comes from forests, whereas the rest from afforestation, orchards and secondary market for wood. The demand for biomass is by no means shocking and can be attained easily without any problems but there must be a quick stabilization of conditions for taking up decisions by investors. In the discussion, which recently is present we must add, that combustion of biomass in condensation power stations will render a loss of about 37 PJ of heat, which could be used in usage of biomass in heating. The cheapest way of utilizing biomass is its combustion in the immediate neighborhood of its acquisition.

1.4 Case study for the development of RES

Presented below is a speculation to prove that 7.5% share of electricity production based on wind energy and biomass applied in small size CHP can contribute to reaching the target of 7.5% electricity from RES in 2010. In consecutive years there is given a number set by the strategy for implementation of RES which must be met in order to reach the objective of 7.5%. It can be noted from table 4 that in 2001 implemented have been 2,32 %, which corresponds to 2,32 TWh. In that year 0,08 % was missing, i.e. 0,08 TWh, i.e. 32 MW. In tables 5 and 6 presented are missing amounts of energy for the main actors in the Pomeranian Province.

Table 4: Increase of RES installed power [1)]

Year	Percentage share of electricity		Amount of electricity	Wind[2)] power	Wind [2)] power	Biomass[3)] CHP power
		Increase	Increase	VARIANT A	VARIANT B	
				100%	50%	50%
			TWh	MW	MW	MW
2001	2,4	- 0,08	0,08	32	16	8
2002	2,5	0,1	0,1	40	20	10
2003	2,65	0,15	0,15	60	30	15
2004	2,85	0,2	0,2	80	40	20
2005	3,1	0,25	0,25	100	50	25
2006	3,6	0,5	0,5	200	100	50
2007	4,2	0,6	0,6	240	120	60
2008	5,0	0,8	0,8	320	160	80
2009	6,0	1,0	1,0	400	200	100
2010	7,5	1,5	1,5	600	300	150
Total				2 072	1 036	518

1) According to the Directive by the Minister of Industry of 30 May 2003 when electricity is produced either entirely from wind power (Variant A) or fifty-fifty share from wind power and biomass fired CHP (Variant B). As a base assumed is a sale in the domestic scale of 100 TWh/annum

2) 2 500 h of operation with full power is assumed

3) 5 000 h of operation with full power is assumed

Table 5: Data as above with the prospects for the ENERGA company [1)]

Year	Percentage share of electricity		Amount of electricity	Wind[1)] power	Wind [1)] power	Biomass[1)] CHP power
		Increase	Increase	100%	50%	50%
			TWh	MW	MW	MW
2001	2,4	- 0,4	0,016	6,4	3,2	1,6
2002	2,5	0,1	0,004	1,6	0,8	0,4
2003	2,65	0,15	0,006	2,4	1,2	0,6
2004	2,85	0,2	0,008	3,2	1,6	0,8
2005	3,1	0,25	0,01	4,0	2,0	1,0
2006	3,6	0,5	0,02	8,0	4,0	2,0
2007	4,2	0,6	0,024	9,6	4,8	2,4
2008	5,0	0,8	0,032	12,8	6,4	3,2
2009	6,0	1,0	0,04	16,0	8,0	4,0
2010	7,5	1,5	0,06	24,0	12,0	6,0
Total				88,0	44,0	22,0

1) as a base serves 4 TWh of electricity purchased in 2001.

*Table 6: Data as above with the prospects for ZE Słupsk**

Year	Percentage share of electricity		Amount of electricity	Wind[1)] power	Wind [1)] power	Biomass[1)] CHP power
		Increase	Increase	100%	50%	50%
			TWh	MW	MW	MW
2001	2,4	+ 0,05				
2002	2,5	+ 0,05	0,0004	0,16	0,08	0,04
2003	2,65	0,15	0,0012	0,48	0,24	0,12
2004	2,85	0,2	0,0016	0,64	0,32	0,16
2005	3,1	0,25	0,002	0,8	0,4	0,2
2006	3,6	0,5	0,004	1,6	0,8	0,4
2007	4,2	0,6	0,0048	1,92	0,96	0,48
2008	5,0	0,8	0,0064	2,56	1,28	0,64
2009	6,0	1,0	0,008	3,2	1,6	0,8
2010	7,5	1,5	0,012	4,8	2,4	1,2
Total				16,16	8,08	4,04

1) as a base serves 0,8 TWh of electricity purchased in 2001.

2 Realized projects in Poland

According to various sources in Poland are in operation from 100 ÷ 150 waste wood fired boilers of the power over 1 MW in the wood processing factories. Incorporated into the heating system is one heat and power station, which continuously co-fires biomass, wood chips and bark. That is Ostrołęka power station, which utilizes for that purpose a fluidized boiler of the power of 35 MWt, which is a modification of a dust boiler OP 100. In 2003 EC Ostrołęka produced about 700 000 GJ of heat from biomass. In thermal systems domestically there is installed about 100 boilers with powers above 500 kW. The boilers featuring automatic systems of fuel supplying have been tabulated in table 8 (wood) and 9 (straw).

It should be mentioned that two principal producers of large water boilers firing large bales of straw, namely Metalerg Oława and Graso Starogard present reference lists of sales and assemblies of 40 boilers each with power over 500 kW.

3 Biomass logistics

In table 7 presented are the prices of fuel in Poland in 2004. Since then only prices of oil increased significantly.

Table 7: Mean prices of fuels in Poland (2004)

	Calorific value		Unit price		zł/GJ	Eur/GJ	efficiency	zł/GJ
Straw	14,5	GJ/t	125	zł/t	8,62	2,16	0,80	10,78
Chopped wood (20% moisture)	14,7	MJ/kg	100	zł/t	6,80	2,13	0,80	8,50
Wood chips (30% moisture)	11,5	MJ/kg	130	zł/t	11,30	3,53	0,80	14,13
Wood pellets	18	Gj/t	380	zł/t	21,11	6,60	0,80	26,39
Koks	30	GJ/t	550	zł/t	18,33	6,11	0,75	24,44
Coal	26	GJ/t	450	zł/t	17,31	5,77	0,75	23,08
Oil	42	GJ/t	1700	zł/t	40,48	10,65	0,95	42,61
Natural gas	35	MJ/m^3	1,02	zł/m^3	29,14	7,67	0,95	30,68
LPG	46	GJ/t	1,60	zł/l	67,13	17,67	0,95	70,66
Heat pump COP=3			0,290	zł/kWh	26,85	6,71	1,00	26,85
Electricity (tariff G11)			0,340	zł/kWh	94,44	23,61	1,00	94,44
Electricity (tariff G12)			0,200	zł/kWh	55,56	13,89	1,00	55,56

As far as prices of biomass are concerned the following have been collected:

- damp sawdust(50 %) 40 PLN/ m^3
- dry sawdust (12 %) 60 PLN/ m^3
- wood chips 1st class 120 PLN/ m^3
- wood chips 2nd class 105 PLN/ m^3
- willow chips (50 %) 90 PLN/ m^3
- straw (20 %) 120 - 150 PLN/ t

Presented below will be an example of preparation of biomass in drum driers. That can be implemented at any location. Most of the utilities are interested in prices which are commercially viable. Location of such drier at sites with significant unemployment would contribute to its reduction. It is estimated that implementation of 1GWh of electricity produced from RES would bring about 0.1 to 0.9 of a job, which is more significant than any conventional power, which contributes between 0.01 to 0.1

of a job. Most of the jobs in RES will appear in the biomass related business, as that is most effort consuming one. The jobs are created in the rural areas, where structural unemployment is most present. It is apparent that most of the unemployment is in the eastern and northern parts of Poland, particularly in rural areas. Introducing of some incentives to biomass planting and processing would contribute nicely to reduction of unemployment. The estimates of the benefits is difficult to be judged as such activities have yet to be started. At the moment only very few municipalities have invested in biomass fired boilers. Primarily that has contributed to a rapid increase of biomass in the vicinity of such plants. Therefore there must be some price policy established to refrain from such price pushing. In the example blow presented is a case study, where the one of the items from the logistics process is considered, namely the price of drying of biomass in a drum drier M-829.

3.1 Biomass drying process in a drum dryer M-829

The drying process in the drum dryer is very convenient as it allows drying of loose material such as sawdust, straw, grass, wood chips and other similar stuff cut into small pieces. It permits to process also post-production waste, therefore it can be used in post-production of waste, for example in distilleries, fruit and vegetable processing factories, etc. Construction of the dryer enables for its operation in the open terrain, with the relatively inexpensive shelter. The drum drier features high efficiency and versatility, proves to be effective in the case drying of damp sawdust, wood chips, turf. Recommended for drying and management of post-production waste. Presented below is a technical characteristics of such dryer. The total cost of such drier, including 10% surplus for assembly, training and service is about 430 000 PLN + VAT.

Technical characteristics of drum dryer M-829	
Efficiency at input material moisture 40-50% and final about 10%	ca.1500 kg/h
Efficiency at input material moisture 60-70% and final about 10%	ca.1000 kg/h
Maximum temperature of drying air at drum inlet	750 oC
Average intake of fuel	
wood pellets	ca. 200kg/h
sawdust, bark, chips	ca. 300kg/h
Installed electrical power:	
material tank equipped with vibration sieve	3,5 kW
damp material conveyor	2,2 kW
stoker fuel supply with blowers	3,5 kW
drum supply	1,1 kW
drum drive	1,1 kW
principal ventilator	7,5 kW
dry material conveyor	3,0 kW
Total installed power :	ca. 22 kW
Total mass of dryer with insulation	ca. 18 500 kg

Table 8: Calculation of biomass drying costs in drum drier M-829.

Calculation of biomass drying costs in drum drier M-829		
Operation	**Unit**	**Drying**
Dryier efficiency	kg/h	1500
Consumption of biomass for combustion	kg/h	300
	%	0,17
Operation time	h/a	5000
Moisture of raw biomass	%	50%
Moisture of dry biomass	%	10%
Calorific value of raw biomass	GJ/t	7
calorific value of dry biomass	GJ/t	14,5
Annual production	t/a	7500
Investment costs (+10%)	PLN	462000
Depreciation rate	%	10%
Overhaul costs (3% investment)	PLN/a	13860
Depreciation	PLN/a	46200
Installed electrical power	kW	22
Electricity purchase price	PLN/a	300
Cost of electricity	PLN/a	33000
Employment costs (2 persons)	PLN/a	72000
Other costs	PLN/a	10000
Total cost of drying	PLN/a	175060
Unit drying costs	**PLN/GJ**	**1,61**
	PLN/t	23,34

The biomass cost loco power station can be calculated using the formulae [3]:

$$c_{bspt} = \frac{K_b + K_s + K_p + K_t}{B^{ch}_{bspt}}$$

- c_{bspt} – biomass cost loco power station [PLN/GJ in transported biomass]
- K_b – wet biomass purchase cost [PLN/a]
- K_s – biomass drying costs (excluding the raw material) [PLN/a]
- K_p – biomass processing costs (excluding the raw material) [PLN/a]
- K_t – biomass transport costs (excluding the raw material) [PLN/a]
- B_{bspt}^{ch} – chemical energy of dry, processed and transported biomass [GJ]

In table 8 presented are calculations of unit cost of drying. In the process considered below the unit cost amounts to 1.61 PLN/GJ. That value is quite useful, as is independent of the cost of transport, which on road amounts to 2PLN/km in a truck having a load of 24 tons (80m^3) and 55 PLN/t in a carriage having a load of 30 tons (82m^3). Experience shows that high moisture content biomass as well as pellets are worth transporting by train, whereas dry biomass is better off by trucks. However, the prices may vary and these conclusions cannot be regarded as final.

4 Investment financing

Heat and power stations together with boilers utilizing biomass form a priority for environmental protection funds. All, up to date assembled boilers received support in the form of donations or low-interest rate loans.

The most significant donations have been obtained from Ekofundusz foundation, ranging from 30 to 50% with respect whether the recipient was a part of local authorities or not. Smaller donations (calculated as a percentage share) have been obtained from the National Fund for Environmental Protection and Water Management NFOŚiGW. A low interest-rate loans granted by Provincial Fund for Environmental Protection and Water Management WFOŚiGW could be wiped out in amount ranging from 15% to 40% of the total loan, whereas the loans from NFOŚiGW from 10 to 15 %. In practice there could be carried out assembly of a CHP or a boiler, where about 40 ÷ 50 % of donations was received.

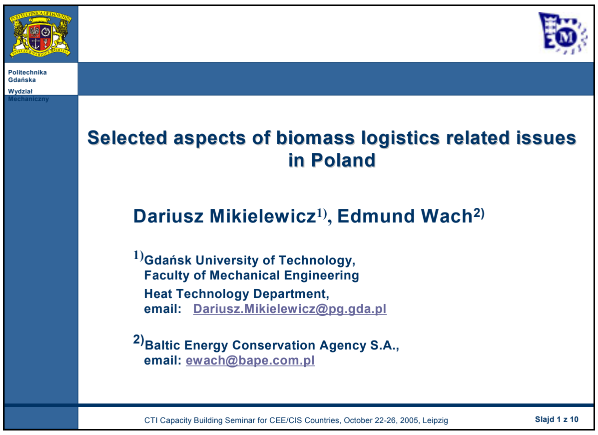
Real values of costs, obtained donations and loans has been presented in the table below in relation to the commissioned boilers. In tables further below presented have been sample financial analyses for the investments to be implemented.

5 Conclusions

- Biomass potential in Poland enables fulfilling of the dues as far as electricity production from RES is concerned by the years 2010 and 2020.
- Pilot heat stations fired with wood and straw enable for a survey of technologies available on the Polish market.
- Economical analysis indicate the inevitability of financial aid to such investments until the number of present installations or the increase of the price of coal will allow for a full commercialization of such enterprises.
- Implementation of biomass fired boilers contributes inevitably to job creation in the local markets.
- Investment in local dispersed power sector brings about local taxation increase and contributes to increasing of local wealth.

Literature

[1] – International energy Agency Statistic 2003.
[2] – EREC – European Renewable Energy Council Statistic 2003.
[3] – Generalna Dyrekcja Lasów Państwowych, dane za 2002 r.
[4] – BAPE – internal calculations and estimates.



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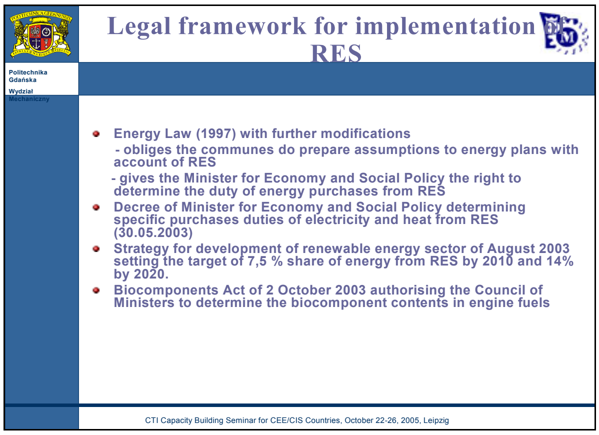

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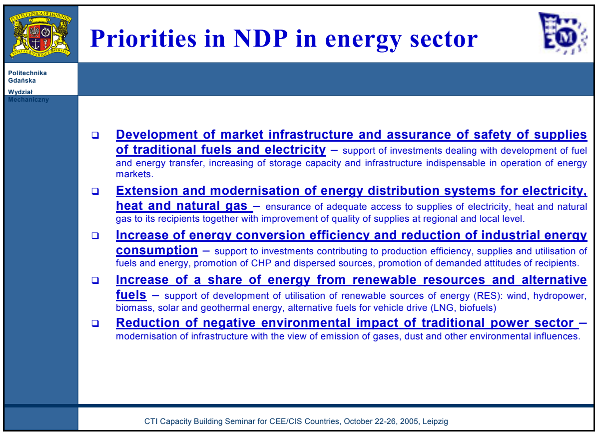

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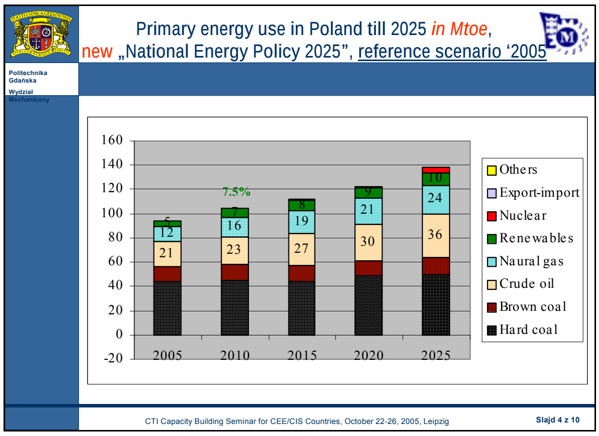

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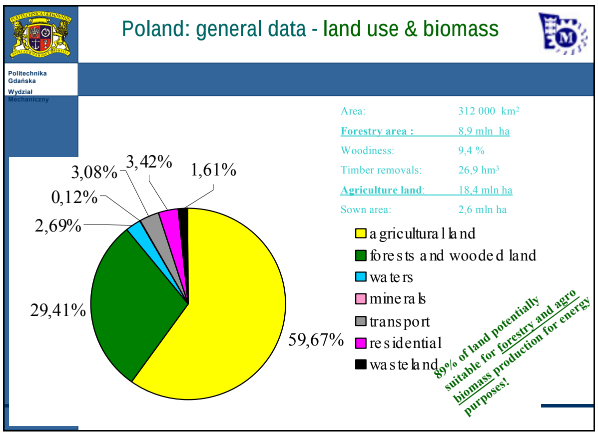

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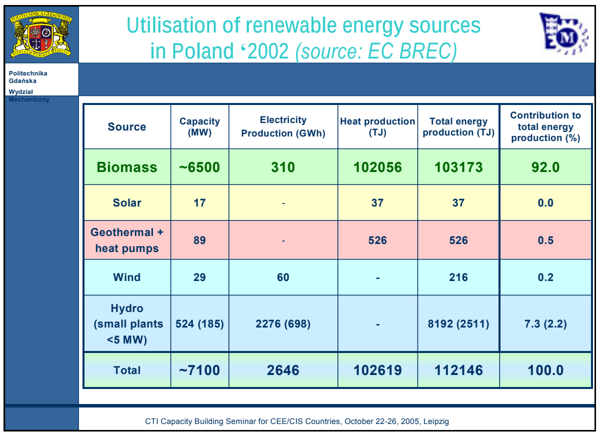

Source	Capacity (MW)	Electricity Production (GWh)	Heat production (TJ)	Total energy production (TJ)	Contribution to total energy production (%)
Biomass	~6500	310	102056	103173	92.0
Solar	17	-	37	37	0.0
Geothermal + heat pumps	89	-	526	526	0.5
Wind	29	60	-	216	0.2
Hydro (small plants <5 MW)	524 (185)	2276 (698)	-	8192 (2511)	7.3 (2.2)
Total	~7100	2646	102619	112146	100.0

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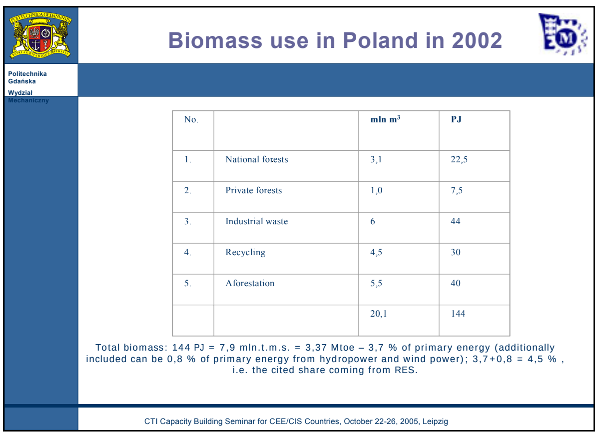
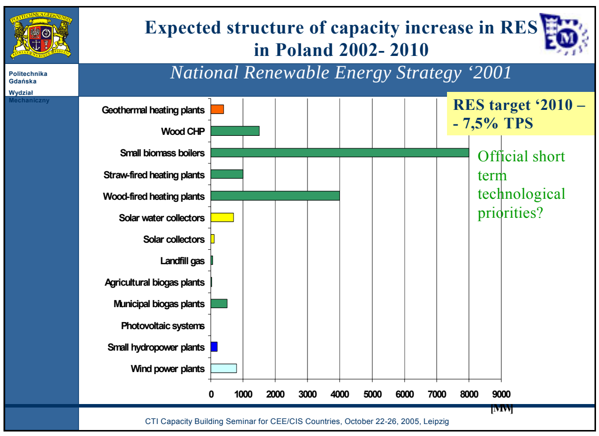


No.		mln m^3	PJ
1.	National forests	3,1	22,5
2.	Private forests	1,0	7,5
3.	Industrial waste	6	44
4.	Recycling	4,5	30
5.	Aforestation	5,5	40
		20,1	144

Total biomass: 144 PJ = 7,9 mln.t.m.s. = 3,37 Mtoe – 3,7 % of primary energy (additionally included can be 0,8 % of primary energy from hydropower and wind power); 3,7+0,8 = 4,5 %, i.e. the cited share coming from RES.

Slide 7



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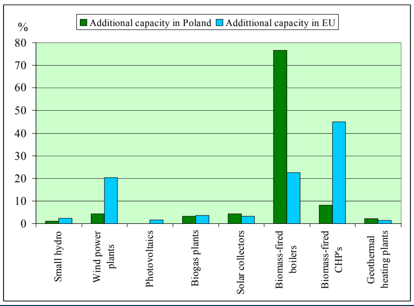
Structure of RES capacity increase in PL and EU-15 by ‘2010



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Slide 9

Commissioned projects

- In Poland operate 100 ÷ 150 wood fired boilers with powers exceeding 1 MW, mainly in wood processing industry.
- In heating systems 1 CHP continuously co-fires biomass – bark and chips (Ostrołęka heat and power station). Adopted has been a fluidised bed boiler of 35 MWt as a modification of a dust boiler OP 100. In 2003 700 000 GJ of heat has been produced.
- In domestic heating systems approx. 100 boilers with powers exceeding 500 kW is installed.

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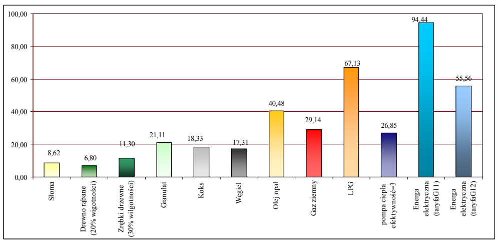
Slide 10

Average fuel prices in Poland



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Slide 11

Average fuel prices in Poland

- damp sawdust (50%) – 40 PLN/m³
- dry sawdust (12%) – 60 PLN/m³
- wood chips Ist class – 120 PLN/m³
- wood chips IInd class – 105 PLN/m³
- willow chips (50%) – 90 PLN/m³
- straw (20%) – 120 – 150 PLN/ t

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Slide 12

Aspects indicating biomass as potential fuel for production of heat

- Modernisation of equipment for heat production in view of restriction of emmissions to atmosphere – reduction of CO2
- Increase of effectiveness of energy conversion processes in view of reduction of consumption of traditional fuels
- Influence on regional increase of economical activities and change of agricultural policy

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Slide 13

Scenario for 7.5% RES in 2010

The increase of contribution by the year 2010 of electricity from RES by 10.22 TWh requires installation of about 1000 MW power in wind farms together with about 600 MWe of heat and power units fired with biomass.

Two scenarios will be discussed of equal production of electricity at the level of 5.11 TWh from each kind of energy.

For production of electricity in the amount of 5.11 TWh in heat and power stations fired using biomass there is required from 6 to 12 mln tones of fresh biomass with calorific value of about 10 GJ/t and moisture content of about 43%, with respect whether CHP efficiency is 15% (small scale CHP) or 30% (large CHP). That means that required is between 3.42 and 6.84 mln tones of dry biomass, which corresponds to 7 ÷ 14 mln m³ of wood.

The wood sector declares additional supplies in the amount of about 1.5 mln tones of dry substrate, that means that remaining 3 to over 5 mln tones of wood must come from afforestation of fast growing wood. That translates to harvesting of a surface ranging from 200 000 ÷ 500 000 ha, which further means that it is from 0,6 to 1,6 % total surface of the country.

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Slide 14

Scenario for 7.5% RES in 2010

At a disposal in Poland is also several mln tones of straw, wheat and rapeseed, available for utilisation in power sector.

Present consumption of dry biomass runs at approximately 8 mln tones, of which about half comes from forests, whereas the rest from aforestation, orchards and secondary market for wood.

The demand for biomass is by no means shocking and can be attained easily without any problems but there must be a quick stabilisation of conditions for taking up decisions by investors.

In the discussion, which recently is present we must add, that combustion of biomass in condensation power stations will render a loss of about 37 PJ of heat, which could be used in usage of biomass in heating. The cheapest way of utilising biomass is its combustion in the immediate neighbourhood of its acquisition.

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Slide 15

Scenario for 7.5% RES in 2010

Year	% electricity		Amount of electricity	Wind* Capacity [MW}	Wind* Capacity [MW}	Biomass** CHP power
		Increase	Increase	100%	50%	50%
			TWh	MW	MW	MW
2001	2,4	- 0,08	0,08	32	16	8
2002	2.5	0,1	0,1	40	20	10
2003	2,65	0,15	0,15	60	30	15
2004	2,85	0,2	0,2	80	40	20
2005	3,1	0,25	0,25	100	50	25
2006	3,6	0,5	0,5	200	100	50
2007	4,2	0,6	0,6	240	120	60
2008	5,0	0,8	0,8	320	160	80
2009	6.0	1,0	1,0	400	200	100
2010	7,5	1,5	1,5	600	300	150
TOTAL				**2 072**	**1 036**	**518**

* 2 500 h of operation with full power is assumed
** 5 000 h of operation with full power is assumed

As a base assumed are sales of 100 TWh/annum. In 2001 implemented have been 2,32 %, which corresponds to 2,32 TWh. As can be seen, in that year 0,08 % was missing, i.e. 0,08 TWh, i.e. 32 MW

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Slide 16

Politechnika Gdańska Wydział Mechaniczny

Energa - Gdańsk

Year	% electricity		Amount of electricity	Wind* Capacity	Wind* Capacity	Biomass* CHP power
		Increase	Increase	100%	50%	50%
			TWh	MW	MW	MW
2001	2,4	- 0,4	0,016	6,4	3,2	1,6
2002	2.5	0,1	0,004	1,6	0,8	0,4
2003	2,65	0,15	0,006	2,4	1,2	0,6
2004	2,85	0,2	0,008	3,2	1,6	0,8
2005	3,1	0,25	0,01	4,0	2,0	1,0
2006	3,6	0,5	0,02	8,0	4,0	2,0
2007	4,2	0,6	0,024	9,6	4,8	2,4
2008	5,0	0,8	0,032	12,8	6,4	3,2
2009	6.0	1,0	0,04	16,0	8,0	4,0
2010	7,5	1,5	0,06	24,0	12,0	6,0
Total				**88,0**	**44,0**	**22,0**

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Slide 17

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ZE Słupsk

Year	% electricity		Amount of electricity	Wind* Capacity	Wind* Capacity	Biomass* CHP power
		Increase	Increase	100%	50%	50%
			TWh	MW	MW	MW
2001	2,4	+ 0,05				
2002	2,5	+ 0,05	0,0004	0,16	0,08	0,04
2003	2,65	0,15	0,0012	0,48	0,24	0,12
2004	2,85	0,2	0,0016	0,64	0,32	0,16
2005	3,1	0,25	0,002	0,8	0,4	0,2
2006	3,6	0,5	0,004	1,6	0,8	0,4
2007	4,2	0,6	0,0048	1,92	0,96	0,48
2008	5,0	0,8	0,0064	2,56	1,28	0,64
2009	6,0	1,0	0,008	3,2	1,6	0,8
2010	7,5	1,5	0,012	4,8	2,4	1,2
TOTAL				**16,16**	**8,08**	**4,04**

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Slide 18

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Lp.No	Utility	Demand power [MW]	Energy produced in 2001 [TJ]	Suggested biomass fired CHP [Mwel]
1.	GPEC Gdańsk	717	8 060	
2.	OPEC Gdynia	251	1 960	
3.	EC Słupsk	122	1 200	5
4.	MPEC Lębork	38	350	2
5.	ZEC Tczew	57	450	3
6.	KOSPEC Kościerzyna	20	150	1
7.	MZEC Chojnice	35	340	2
8.	PGK Puck	7,4	70	
9.	PPC Pruszcz Gd..	10,6	90	
10.	PEC Kwidzyn	50	370	2
11.	ZEC Kartuzy	17	130	
12.	PEC Malbork	48	480	2
13.	Unikom Gdańsk	28	110	1
14.	ZEC Kępice	4,8	40	
15.	PK Człuchów	15	140	
16.	ZEC Starogard Gdański	46	380	2
17.	ZUK Gniew	9	80	
	TOTAL	**1475,8**	**14 400**	**20**

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Slide 19

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Threats to implementation of biomass in Poland

- Lack of adequate agricultural policy in macroscale – local policy is insufficient for assurance of a long term quantitative and economical stabilisation in biomass market
- Lack of a long term fuel policy in the scale of country, which does not allow for unanymous determination of biomass position amongst other fuels – coal and coal industry restructurisation, natural gas and its prospective increase of consumption, etc.

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Slide 20

Politechnika Gdańska Wydział Mechaniczny

ANALYSIS OF BIOMASS PREPARATION AND PROCESSING

BIOMASS DRYING PROCESS

Three types have been considered:

- Standard process in drum dryier
- Drying process using heat of condensation in the reaction system
- Using drying furnaces in sugar factories :
- - Rejowiec,
- - Przeworsk

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Slide 21

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ANALYSIS OF BIOMASS PREPARATION AND PROCESSING

- Drum drier enables drying of loose material such as sawdust, straw, grass, wood chips and other similar stuff cut into small pieces. It permits to process also post-production waste
- Construction of the dryier enables for its operation in the open terrain, with the relatively inexpensive shelter.
- Features high efficiency and versatility, prooves to be effective in the case drying of damp sawdust, wood chips, torf. Recommended for drying and management of post-production waste in distilleries, fruit and veg processing factories.

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Slide 22

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ANALYSIS OF BIOMASS PREPARATION AND PROCESSING

- **Technical characteristics of drum dryier M-829**
- Efficiency at input material moisture 40-50% and final about 10%
- **- ca.1500 kg/h**
- Efficiency at input material moisture 60-70% and final about 10%
- - **ca.1000 kg/h**
- Maximum temperature of drying air at drum inlet - 750 °C
- Average intake of fuel
- - wood pellets ca. **200kg/h**
- - sawdust, bark, chips ca. **300kg/h**
- Installed electrical power:
- - material tank equipped with vibration sieve **- 3,5 kW**
- - damp material conveyor - **2,2 kW**
- - stoker- fuel supply with blowers - **3,5 kW**
- - drum supply - **1,1 kW**
- - drum drive - **1,1 kW**
- - principal vntillator - **7,5 kW**
- - dry material conveyor - **3,0 kW**
- **Total installed power : ca. 22 kW**
- Total mass of dryier with insulation ca. **18.500 kg.**
- Cost ca. 430 000 PLN + VAT

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Slide 23

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ANALYSIS OF BIOMASS PREPARATION AND PROCESSING

Calculation of biomass drying costs in drum drier M-829

Operation	Unit	Drying
Dryier efficiency	kg/h	1500
Consumption of biomass for combustion	kg/h	300
	%	0,17
Operation time	h/a	5000
Moisture of raw biomass	%	50%
Moisture of dry biomass	%	10%
Calorific value of raw biomass	GJ/t	7
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Other costs	PLN/a	10000
Total cost of drying	PLN/a	175060
Unit drying costs	**PLN/GJ**	**1,61**
	PLN/t	23,34

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Slide 24

Investment financing

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- Heat and power stations together with boilers utilising biomass form a priority for environmental protection funds.
- All, up to date assemblied boilers received support in the form of donations or low-interest rate loans.
- The most significant donations have been obtained from Ekofundusz foundation, ranging from 30 to 50% with respect whether the recipient was a part of loal authorities or not.
- Smaller donations (calculated as a percentage share of investment) have been obtained from the National Fund for Environmental Protection and Water Management NFOŚiGW.
- A low interest-rate loans granted by Provincial Fund for Environmental Protection and Water Management WFOŚiGW could be wiped out in amount ranging from 15% to 40% of the total loan, whereas the loans from NFOŚiGW from 10 to 15 %.
- In practice there could be carried out a CHP or a boiler investment, where about 40 ÷ 50 % of donations is received.

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Slide 25

Conclusions

Politechnika Gdańska Wydział Mechaniczny

- Biomass potential in Poland enables fulfilling of the obligations as far as electricity production from RES is concerned by the years 2010 and 2020.
- Pilot heat stations fired with wood and straw enable for a survey of technologies available on the Polish market.
- Economical analysis indicate the inevitability of financial aid to such investments until the number of present installations or the increase of the price of coal will allow for a full commercialisation of such enterprises.
- Attainment of 7,5% contribution from RES will enable to raise 30-40 thousands of new work places and reduce about 18 mln. Tonnes of greenhouse gases

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Slide 26

Conclusions

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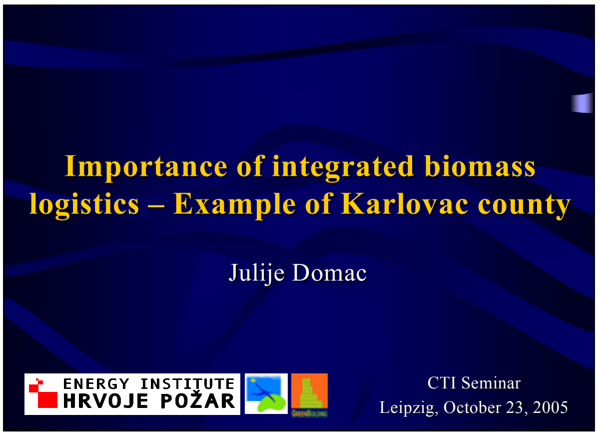
Slide 27

Importance of Integrated Biomass Logistics

Dr. Julije Domac

Energy Institute "Hrvoje Požar", Zagreb



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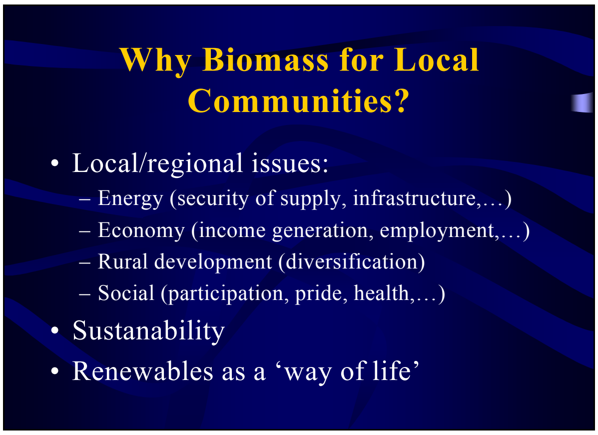

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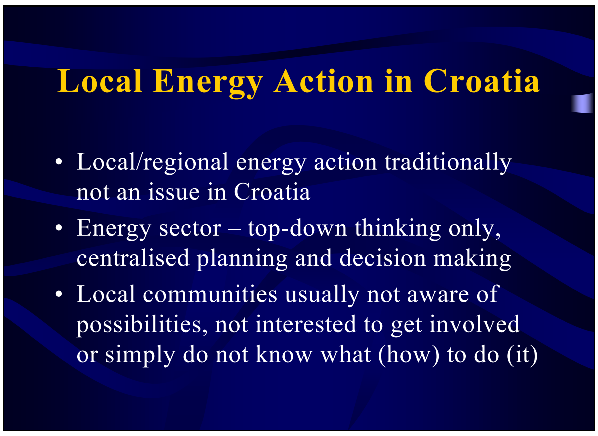

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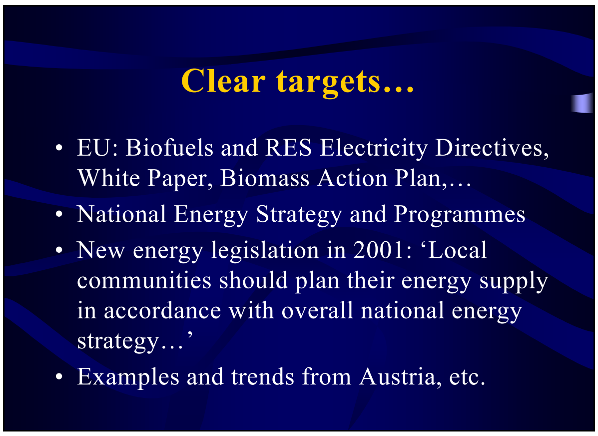

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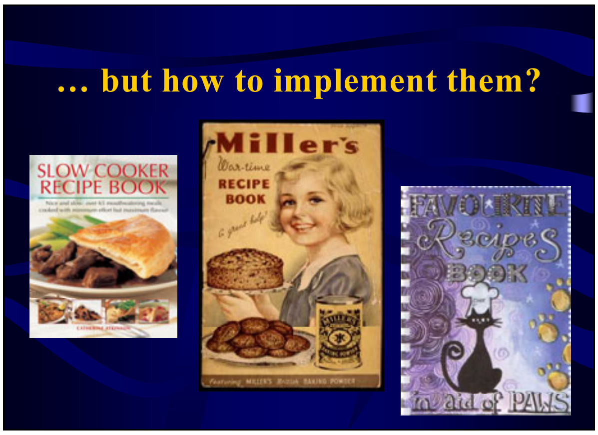

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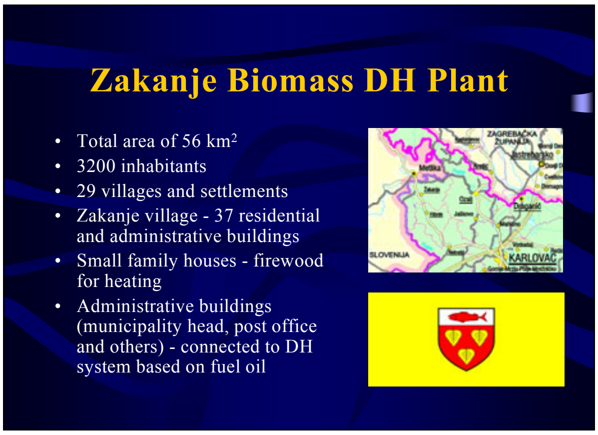

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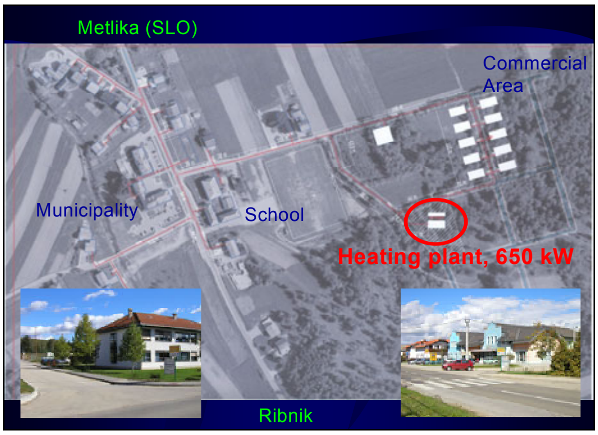

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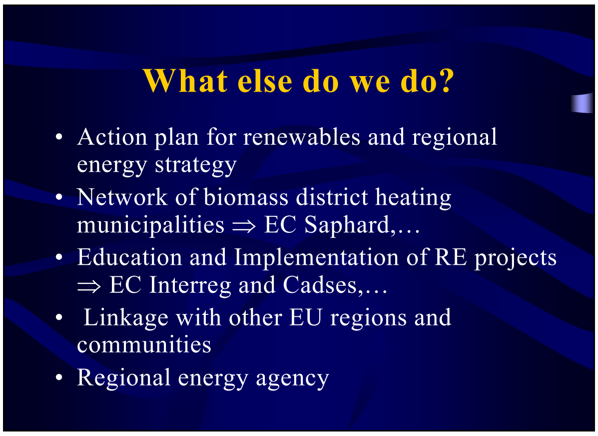


Slide 17

Slide 18

Cost-efficient Biomass Logistics: Case-studies for Small-scale Projects (Bulgaria) and Large-scale Projects (Bavaria/Germany)

Volkmar Schäfer

eta energy-consulting

1 Introduction

When we speak about a “market” for forest wood chips in Central Europe we have to recognize that there is no established and stable “market” yet, e.g. trying to compare it with the oil market. In fact there are some isolated installations and special solutions growing up and developing with the design and building period of a special heat (and power) plant. That’s why the know how for an efficient and optimized logistics for forest wood chips is often find only around installations having an high demand on fuel all the year.

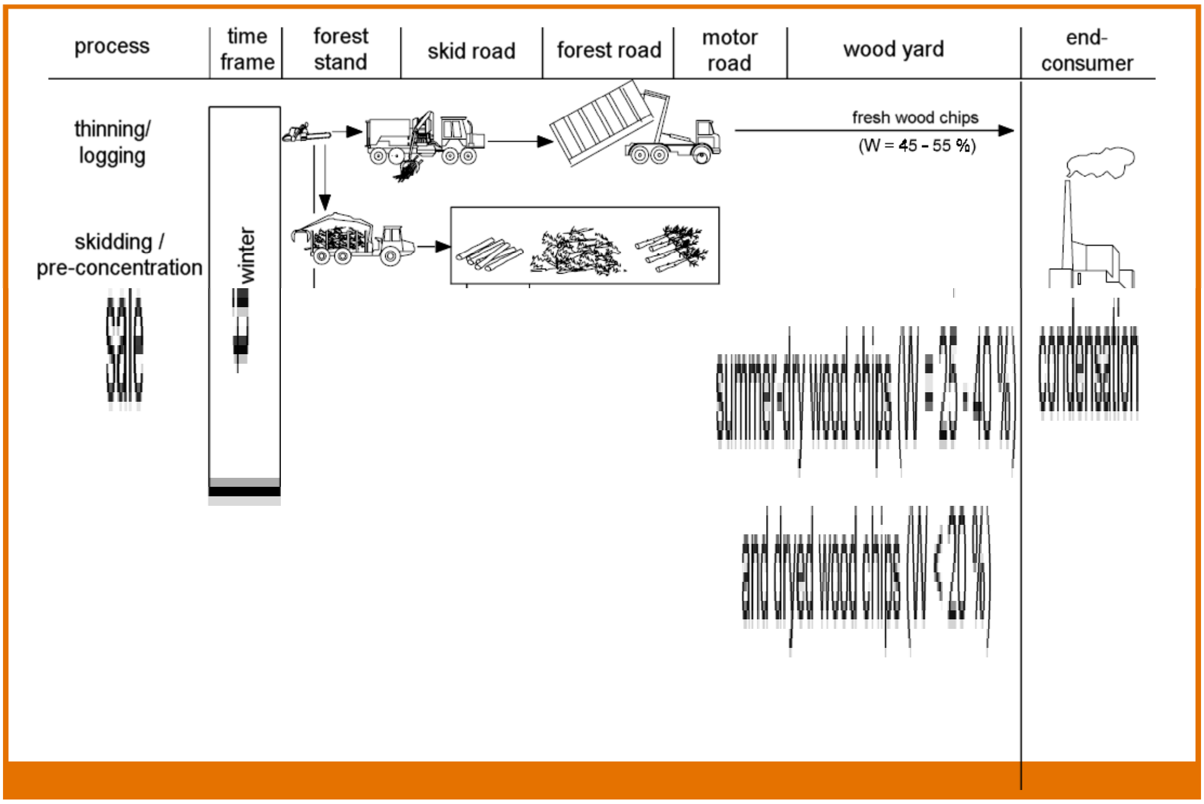
Often a comparing market analysis or fuel orders per phone within different regional locations is not feasible due to unstable market conditions.

Therefore we offer our know how based on praxis driven experience for realization of new projects and set up of an appropriate and cost efficient fuel logistic in the bio mass sector.

2 Market trends

Today many companies (even traditional oil enterprises) make a high effort to get access to the market of forest wood chips. There has been a rapid growth of this market during the last years due to a high demand based on high and guaranteed feed-in tariffs by law for electricity generated from biomass. At the same time structures of forestry are changing relating to large parts of state forest.

The following schema clarifies the supply chain of forest wood chips for in small-scale and large-scale logistics [source: Leitfaden Bioenergie]:



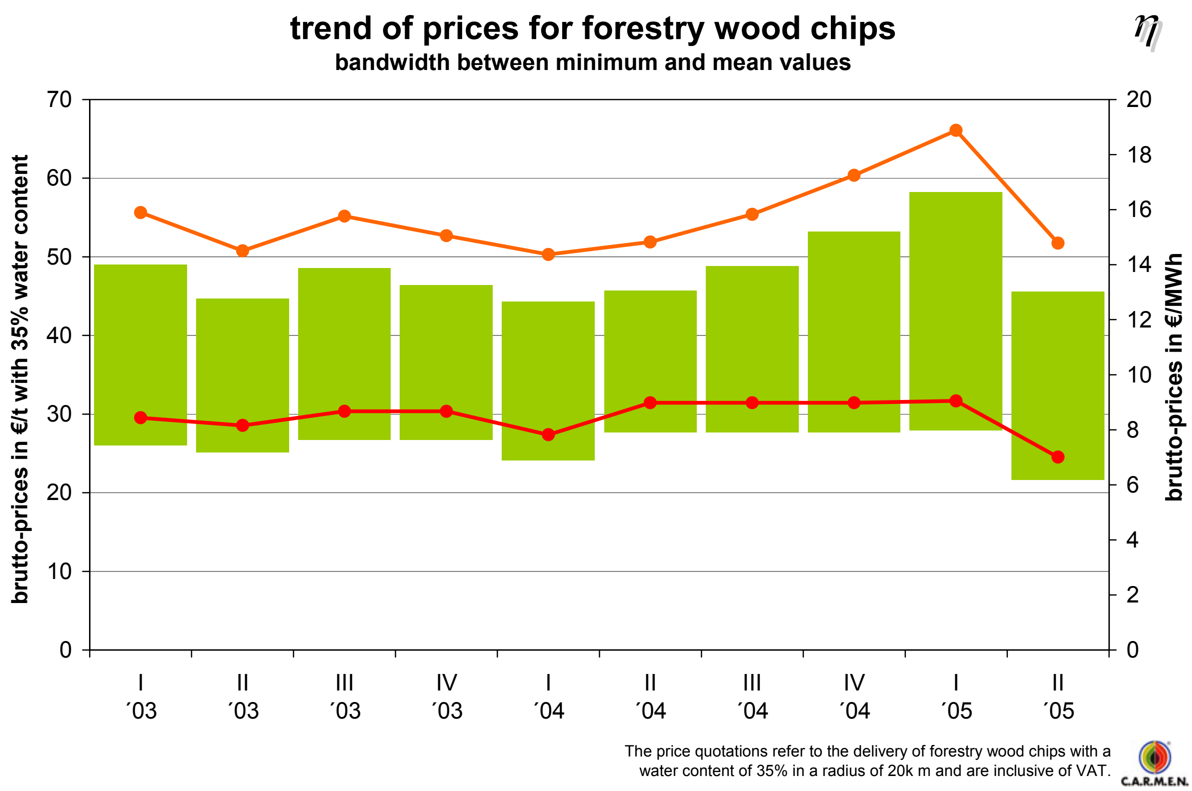
3 Price trends

Increasing productivity due to mechanization and automation while keeping an eye on cost efficiency and profitability are typically for modern forest management and silviculture. But sensitivity to local circumstances, owner structures, logistical and technical preconditions will be essential. The balance between the different overall objectives of forest management including timber production, landscape enhancement, wildlife conservation and soil management has influences on prices as well. Thus, there are often huge differences between offers for forest wood chips. Chipping capacities vary between 5 to 250 cubic meter (bulk) per hour and the corresponding working load is only one example for reasons concerning the wide price range.

Minimum prices describe the handling of larger volumes with a constant flow – market actors are in the situation to optimize logistical processes and increase productivity. A high demand all the year leads to stable prices in Bavaria/Germany around 8 €/MWh (excl. VAT). Slightly increasing prices are expected, due to the influence of the oil market on process steps like chipping or transport.

Particularly in Bavaria, lot’s of projects have been supported by the Bavarian government. Thus, there is a good or better situation for comparing prices and activities than in other parts of Germany. The price trend considers the prices of listed suppliers. Prices are based on trans porting forest wood chips within a distance of 20 km with a moisture content of 35%, incl. VAT. The illustrated price range between minimum and maximum is related to plants with a constant fuel demand all the year.

The following picture shows the trend of prices for wood chips in Bavaria/Germany.



small scale biomass logistics: Characteristically for wood chip logistics set up for smaller scaled heating installations is to provide the required quality of the wood fuel at the right time. The specification is determined chiefly by the technology used for energy production, which will carry tight guidelines on what fuel can be used within equipment guarantees. Requirements vary according to the size and nature of the smaller installation, but specifications are likely to determine the particle size, moisture content and cleanliness of the fuel. Standards to describe wood fuels quality used in smaller boilers are essential to avoid problems. Pre drying and a clean intermediate storage is important to guarantee a constant fuel quality.

In most cases, some material will be stored in the forest for a period of time. Often a moisture content of 30% is the upper limit for stable storage conditions, because wet chips are prone to fungal attack and composting will occur. Volumes and capacity limits have less influence concerning the logistic chain for small scale installations. Universal equipment used mainly for agricultural purposes is often a suitable solution for preparing and transporting the fuel (chipper, tractor and trailer). Often hand held tools (felling) and manual labor are common instead of large automated harvesting and transporting machinery.

Fuel preparation
- drum chipper
- shredder
- hammer mill
- screw chipper

Fuel requirements boiler
- particle size
- moisture content
- ash content
- ingredients

Fuel source
- climate
- wood species
- treatment

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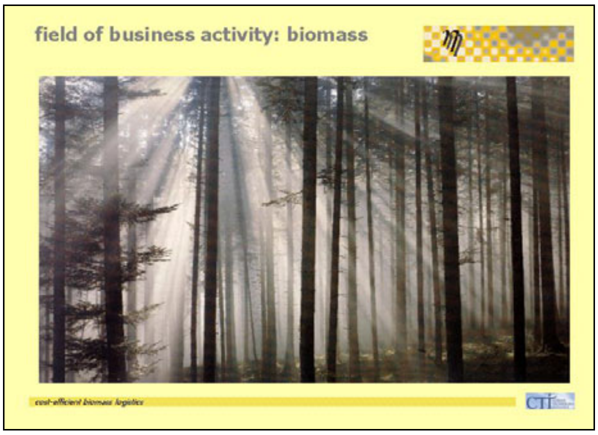

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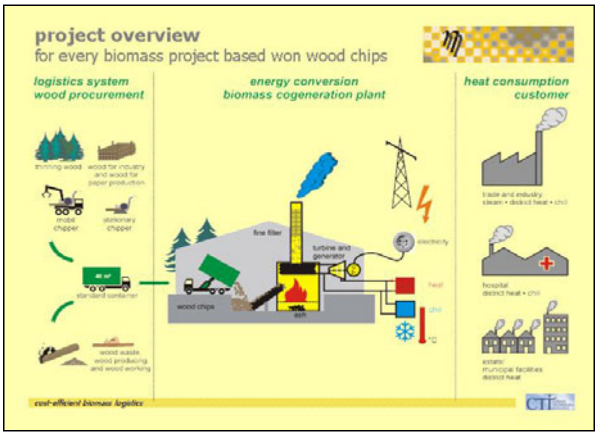

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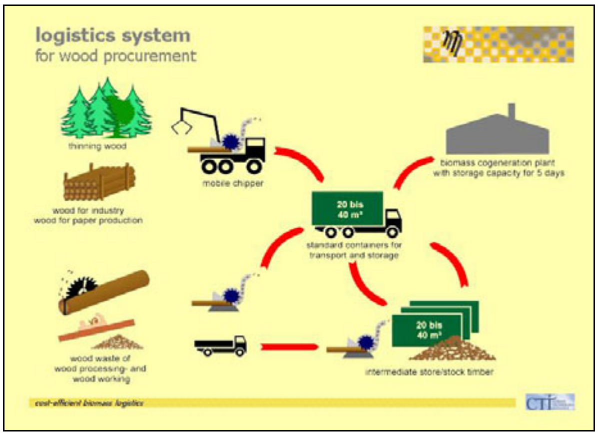

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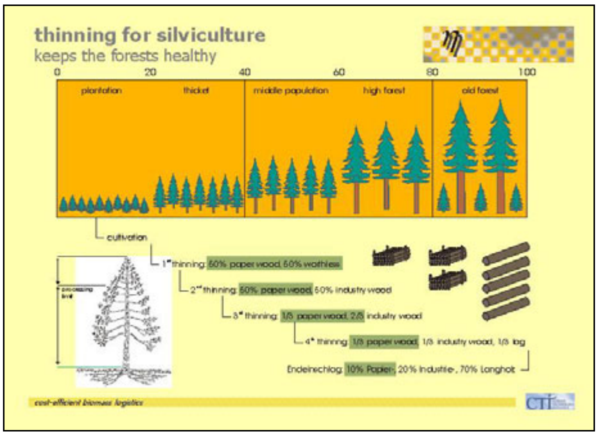

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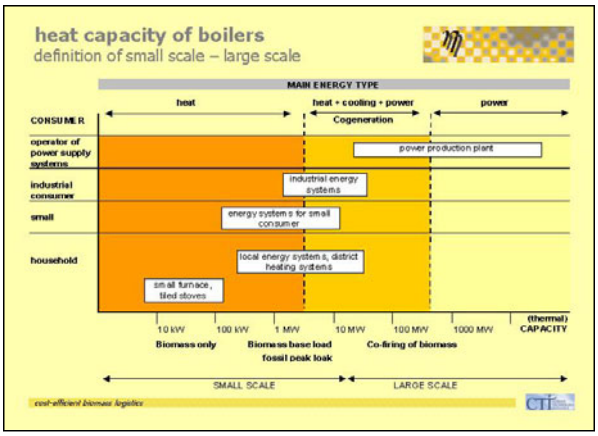

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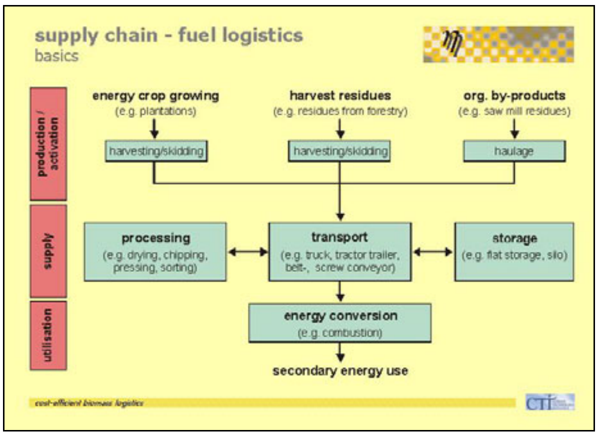

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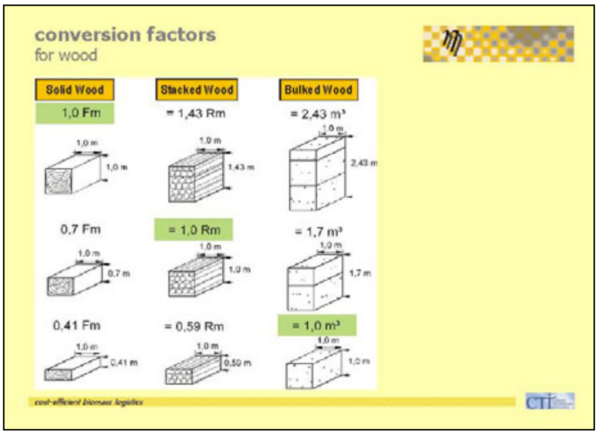

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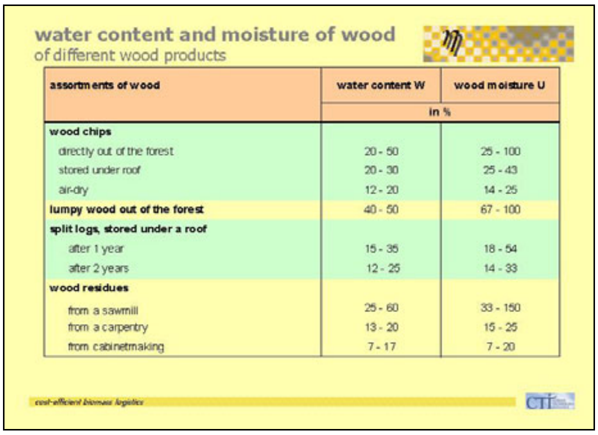

assortments of wood	water content W	wood moisture U
	in %	
wood chips		
directly out of the forest	20 - 50	25 - 100
stored under roof	20 - 30	25 - 43
air-dry	12 - 20	14 - 25
lumpy wood out of the forest	40 - 50	67 - 100
split logs, stored under a roof		
after 1 year	15 - 35	18 - 54
after 2 years	12 - 25	14 - 33
wood residues		
from a sawmill	25 - 60	33 - 150
from a carpentry	13 - 20	15 - 25
from cabinetmaking	7 - 17	7 - 20

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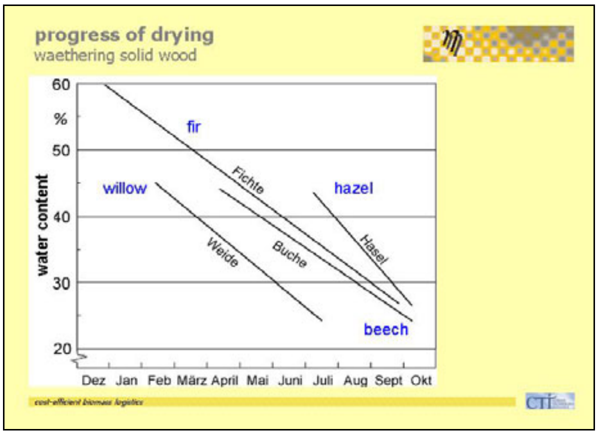

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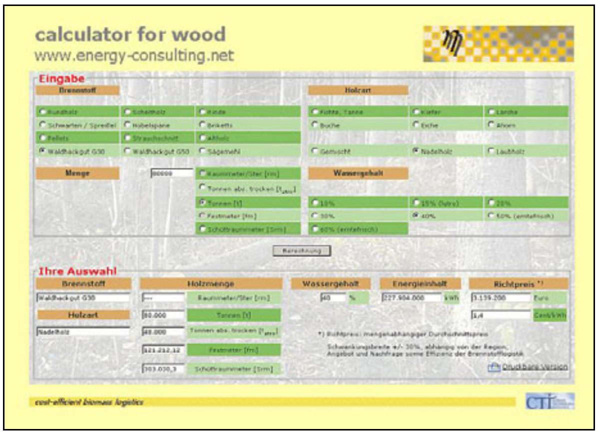

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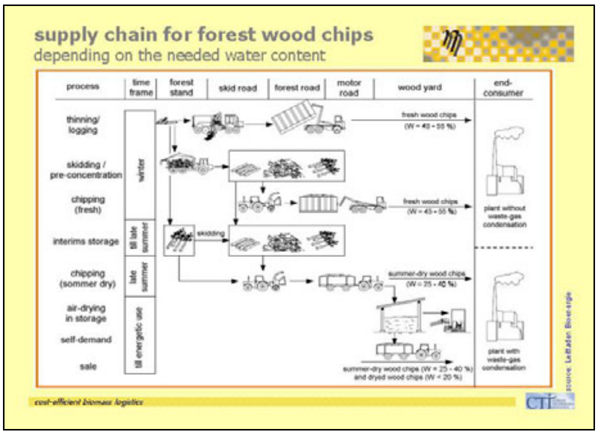

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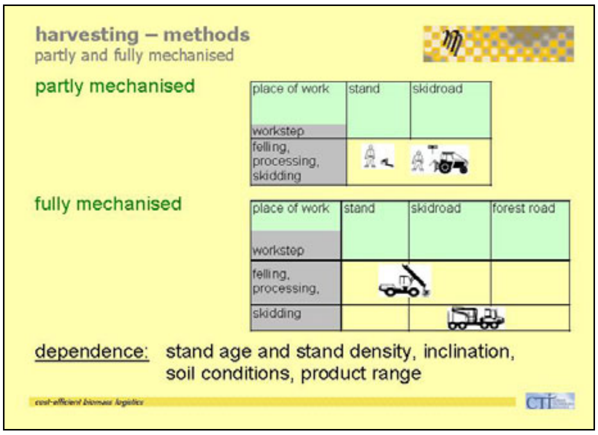

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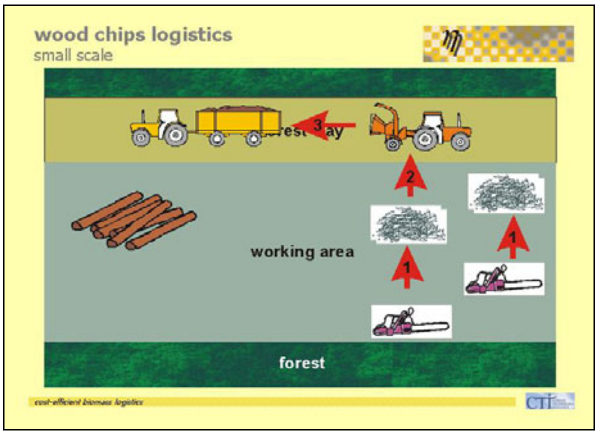

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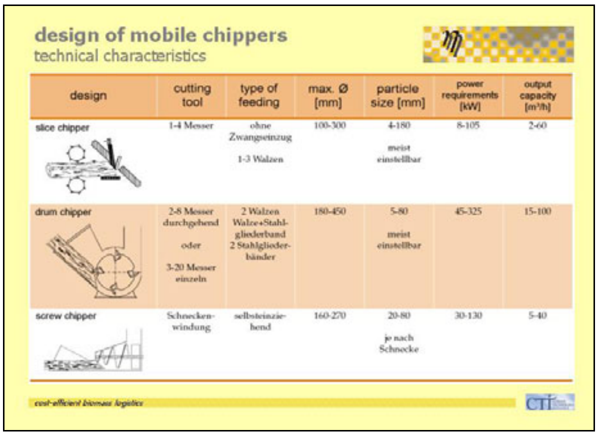
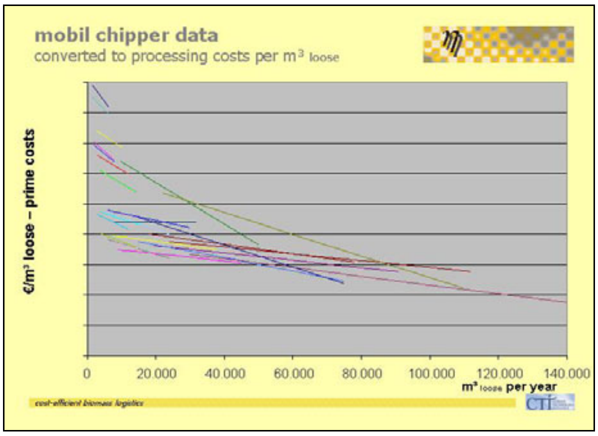


design	cutting tool	type of feeding	max. Ø [mm]	particle size [mm]	power requirements [kW]	output capacity [m³/h]
slice chipper	1-4 Messer	ohne Zwangseinzug 1-3 Walzen	100-300	4-180 meist einstellbar	8-105	2-60
drum chipper	2-8 Messer durchgehend oder 3-20 Messer einzeln	2 Walzen Walze+Stahlgliederband 2 Stahlgliederbänder	180-450	5-80 meist einstellbar	45-325	15-100
screw chipper	Schneckenwindung	selbsteinziehend	160-270	20-80 je nach Schnecke	30-130	5-40

Slide 19



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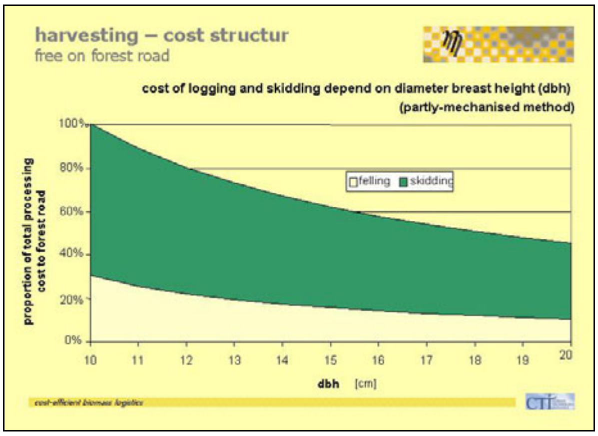

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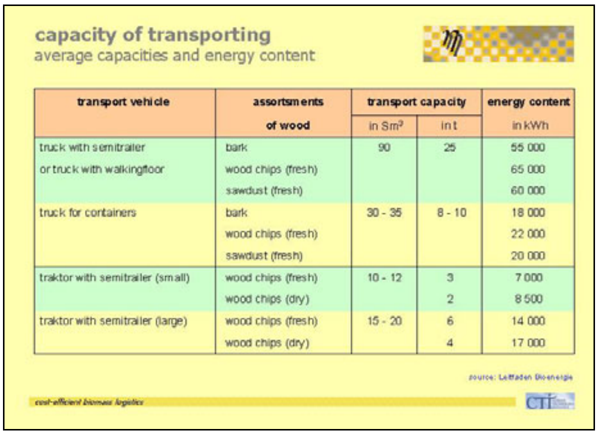


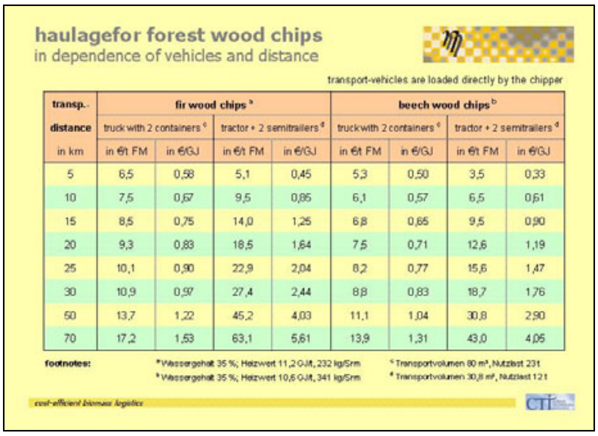
capacity of transporting
average capacities and energy content

transport vehicle	assortments of wood	transport capacity in Sm³	transport capacity in t	energy content in kWh
truck with semitrailer or truck with walkingfloor	bark	90	25	55 000
	wood chips (fresh)			65 000
	sawdust (fresh)			60 000
truck for containers	bark	30 - 35	8 - 10	18 000
	wood chips (fresh)			22 000
	sawdust (fresh)			20 000
traktor with semitrailer (small)	wood chips (fresh)	10 - 12	3	7 000
	wood chips (dry)		2	8 500
traktor with semitrailer (large)	wood chips (fresh)	15 - 20	6	14 000
	wood chips (dry)		4	17 000

source: Leitfaden Bioenergie

cost-efficient biomass logistics

Slide 26



haulagefor forest wood chips
in dependence of vehicles and distance

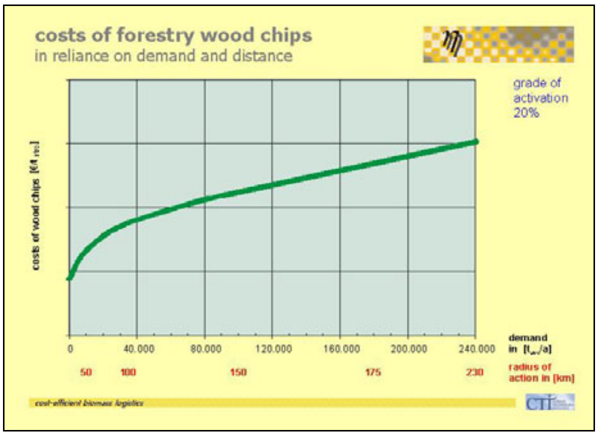
transport-vehicles are loaded directly by the chipper

transp.-distance	fir wood chips [a]				beech wood chips [b]			
	truck with 2 containers [c]		tractor + 2 semitrailers [d]		truck with 2 containers [c]		tractor + 2 semitrailers [d]	
in km	in €/t FM	in €/GJ	in €/t FM	in €/GJ	in €/t FM	in €/GJ	in €/t FM	in €/GJ
5	6,5	0,58	5,1	0,45	5,3	0,50	3,5	0,33
10	7,5	0,67	9,5	0,85	6,1	0,57	6,5	0,61
15	8,5	0,75	14,0	1,25	6,8	0,65	9,5	0,90
20	9,3	0,83	18,5	1,64	7,5	0,71	12,6	1,19
25	10,1	0,90	22,9	2,04	8,2	0,77	15,6	1,47
30	10,9	0,97	27,4	2,44	8,8	0,83	18,7	1,76
50	13,7	1,22	45,2	4,03	11,1	1,04	30,8	2,90
70	17,2	1,53	63,1	5,61	13,9	1,31	43,0	4,05

footnotes:
[a] Wassergehalt 35 %; Heizwert 11,2 GJ/t, 232 kg/Srm
[b] Wassergehalt 35 %; Heizwert 10,6 GJ/t, 341 kg/Srm
[c] Transportvolumen 80 m³, Nutzlast 23 t
[d] Transportvolumen 30,8 m³, Nutzlast 12 t

cost-efficient biomass logistics

Slide 27



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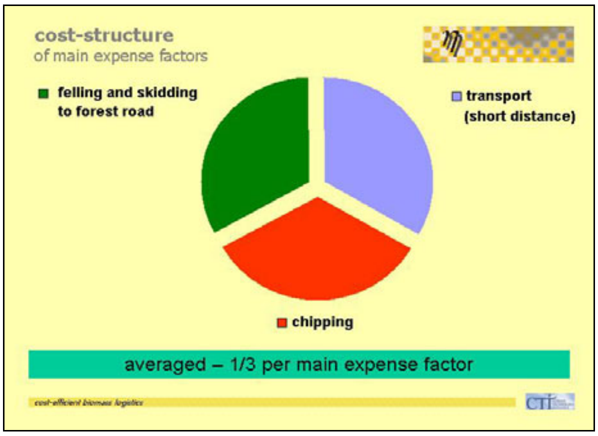

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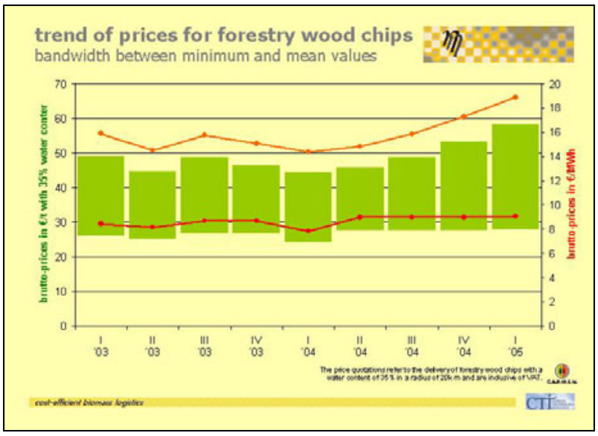

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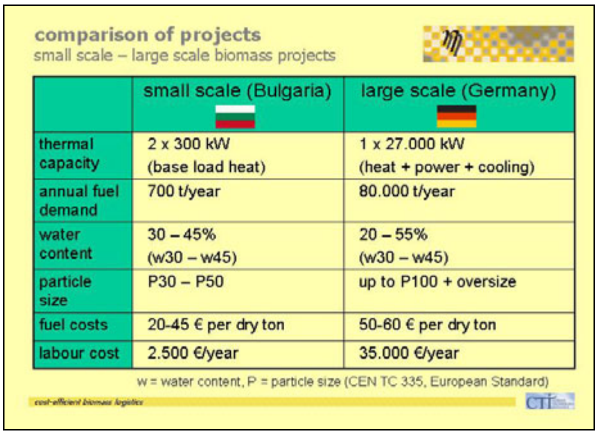

comparison of projects
small scale – large scale biomass projects

	small scale (Bulgaria)	large scale (Germany)
thermal capacity	2 x 300 kW (base load heat)	1 x 27.000 kW (heat + power + cooling)
annual fuel demand	700 t/year	80.000 t/year
water content	30 – 45% (w30 – w45)	20 – 55% (w30 – w45)
particle size	P30 – P50	up to P100 + oversize
fuel costs	20-45 € per dry ton	50-60 € per dry ton
labour cost	2.500 €/year	35.000 €/year

w = water content, P = particle size (CEN TC 335, European Standard)

cost-efficient biomass logistics

Slide 31

Slide 32

Biomass Supply and Utilization in District Heating in Poland

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1 Conclusion

Based on its natural resources Poland has a high potential of biomass for energy production. Nevertheless biomass has traditionally a settled position in the energy supply system in Poland as renewable and cost effective source of energy. Actually it is seen more and more as an alternative for modernization of existing energy supply plants. Thus, the number of plants for district heating fired with wood increases today continuously. Based on this development and the increasing use of the existing potentials raising prices for biomass can be recognized. But, at the same time an increase in prices for electricity from renewable sources can be seen and is further to be expected in near future. Thus, economy of biomass utilization depends strongly on market developments in Poland in the electricity market and in the biomass market. Other issues are the possibilities of regional biomass production and the tariff system based on decisions of the regulation Agency URE.

Actually – also seen on the basis of a number of existing biomass heating plants – the framework for feasible biomass projects improves though the prices for heat and electricity are comparably low in Europe.

2 Introduction

In Poland district heating systems have a long tradition and a very well distribution for heating of flats, public buildings and some industrial facilities. The polish district heating supply branch is characterized by relatively old plants and heat networks. Some modernization is really done but mostly an old and ineffective standard on the basis of hard coal is still in operation connected with high pollutions. High investments are necessary in future for reasons of guaranteeing heat supply, European environmental requirements and optimization of economical effectivity.

Necessary construction activities offer the chance to create cost-effective, environmentally sound and sustainable district heating systems fired with local biomass. This contributes to international requirements regarding reduction of greenhouse gases and increase in the energy production from renewable sources. Especially in Poland biomass plays a major role within the renewables sector. In big plants – as district heating plants – biomass contributes with in a cost efficient way to reduction of utilization of fossil fuels and carbon dioxide emissions. Furthermore, biomass utilization supports decentralized employment especially in rural areas.

In spite of high potentials of biomass in Poland there are a lot of obstacles for biomass utilization. Some of them are subsidies for fossil fuels, lack of incentives for investment, low economical feasibility of biomass solutions under the existing framework (what gets better at the moment). Additionally there are a lot of activities of activists but still there is a substantial lack of knowledge in the energy companies and investment sector as well a lack of logistics for efficient biomass supply for energy plants.

3 District heating in Poland

District heating in Poland is realized with about 1.850 heating units. 1.550 of them supplies low tempered heat. For more than 100.000 customer more than 22.000 MW heat and 2.000 MW hot water is supplied annually (Regulski 2004). The structure of the district heating sector is shown in Figure 1. Based on answers from a questionnaire from 240 energy companies the technical conditions of the heating plants are good – very good. But at the same time about 25 % of operators see a need for modernization of their plants, what offers the chance to implement biomass based solutions (Figure 2).

Fig. 1: Structure of district heating plants in Poland (Regulski 2004)

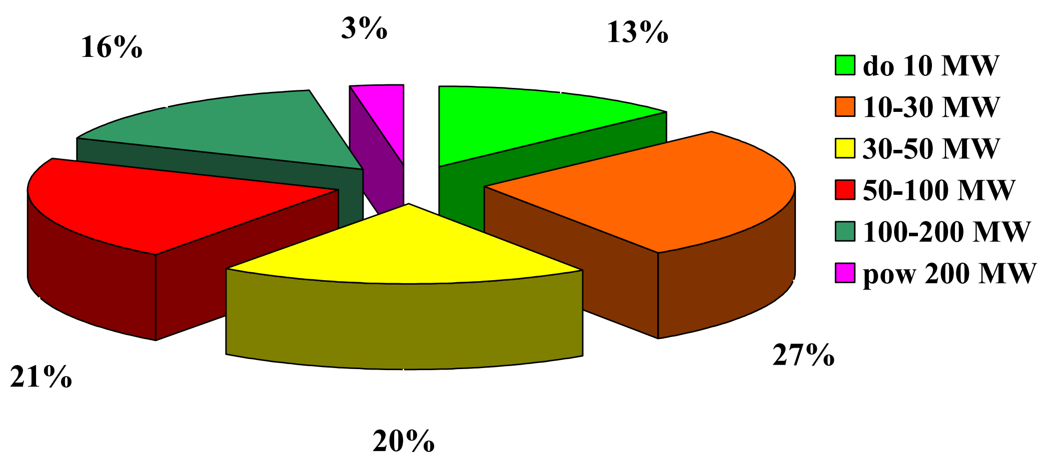
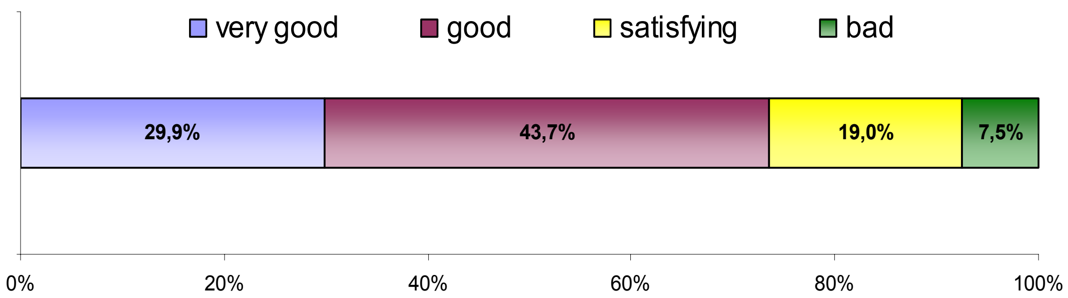
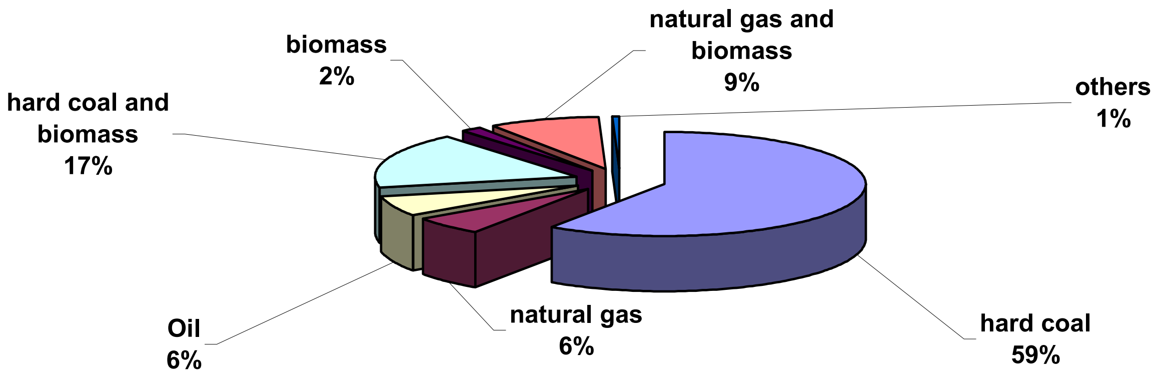


Fig. 2: Technical situation of the plants (survey within 240 plant operators)



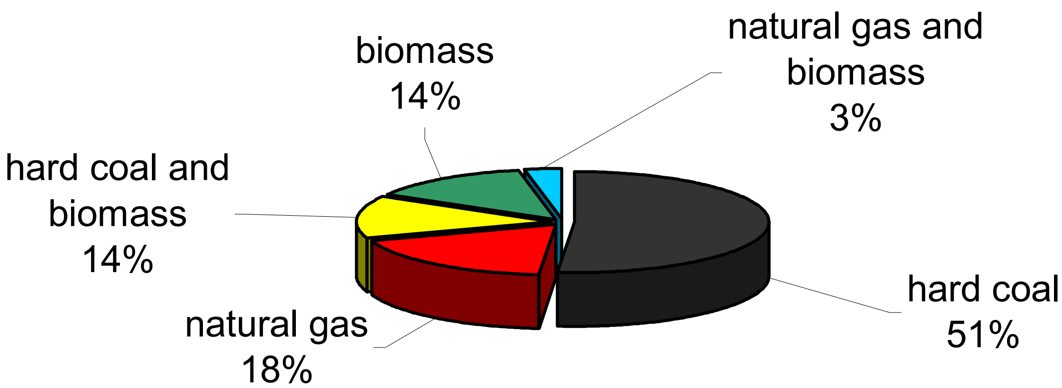
Within these heat production plants mainly coal and with a small part also natural gas and oil are fired. Additionally there are some few plant which use biomass as fuel actually (see figure 3)

Fig. 3: Fuels for district heating plants (survey within 240 plant operators)



With kind support of the polish chamber of district heating 240 operators of district heating plants were asked for their perspectives regarding fuel utilization. The result shows a clear tendency to interest in biomass utilization. 75 % of the operators think about the possibilities of biomass as fuel for their plants, partly as co-firing with fossil fuels. At about 8 % of companies biomass utilization is realized or under realization until today. Based on answers from the heating companies the following structure of heat production could be reality in future.

Fig. 4: Fuel utilization in future for district heating (survey within 240 plant operators)



4 Potentials and use of biomass for energy production

Last not least the high interest in utilization of biomass results from the high available biomass potentials – from wood and energy crops from agriculture. Based on data surveys on the level of voivodships by the Institute for Energy and Environment the today usable potentials of biomass for energy supply shown in table 1 were calculated.

Table 1: Technical potentials of solid biomass in Poland (potentials: own calculations, use: IEA 2003, EC BREC 2002)

Solid Biomass	Potential		Use2002/2003	
	PJ/a	%	PJ/a	%
Straw	114	21	1,5	0,9
Hey	10	2	0	0,0
Natural wood	203	37	104	65,0
Industrial waste wood	29	5	24	15,0
Used wood	43	8	29	18,1
Wood from fruit plantages	15	3	1	0,6
Wood from landscape care	1	0	0,1	0,1
Energy crops	130	24	0,3	0,2
Total	545	100	160	100

In comparison with the primary energy demand in Poland (about 3.760 PJ/a) and the energy use in the district heating sector (about 564 PJ/a) utilization of biomass could substitute serious amounts of fossil carbon dioxide emissions and fossil fuels. Today about 25 % of the available biomass potentials are in use, corresponding to about 90 % of all renewable energy produced in Poland (2002) (Wiśniewski 2004). With about 400 PJ/a not used potentials the utilization of biomass could expand continuously as it is to recognize at the moment. Data about the dynamics are included in table 2. The tendency to co-firing of biomass in existing power plants will have a visible influence on this development.

Table 2: Dynamics of expanding utilization of biomass without households, furniture, pulp and paper industries (Wiśniewski 2004)

Type of	Capacity MW (1999)	Capacity MW (2002)	Increase of Capacity in MW	Dynamic in %/year
Wood based heating	350	450	100	8,7
Straw based heating	13	92	79	92,0
Straw	7	23	16	48,7

Beneath pure heat production an increase in electricity production and combined heat and power plants in the district heating sector is to be expected. The basis for this development are on the one hand reliable frame conditions (chapter 5.1) and on the other hand raising energy prices for renewables following from the quota system, the now introduced certificate trading system and raising demand for renewable energies. The known tendencies shows table 3.

Table 3: Share of renewable electricity production (IEA 2003)

Year	1990	1995	1997	1998	1999	2000	2001
Share in %	1.1	1.4	1.5	1.8	1.7	1.6	1.9

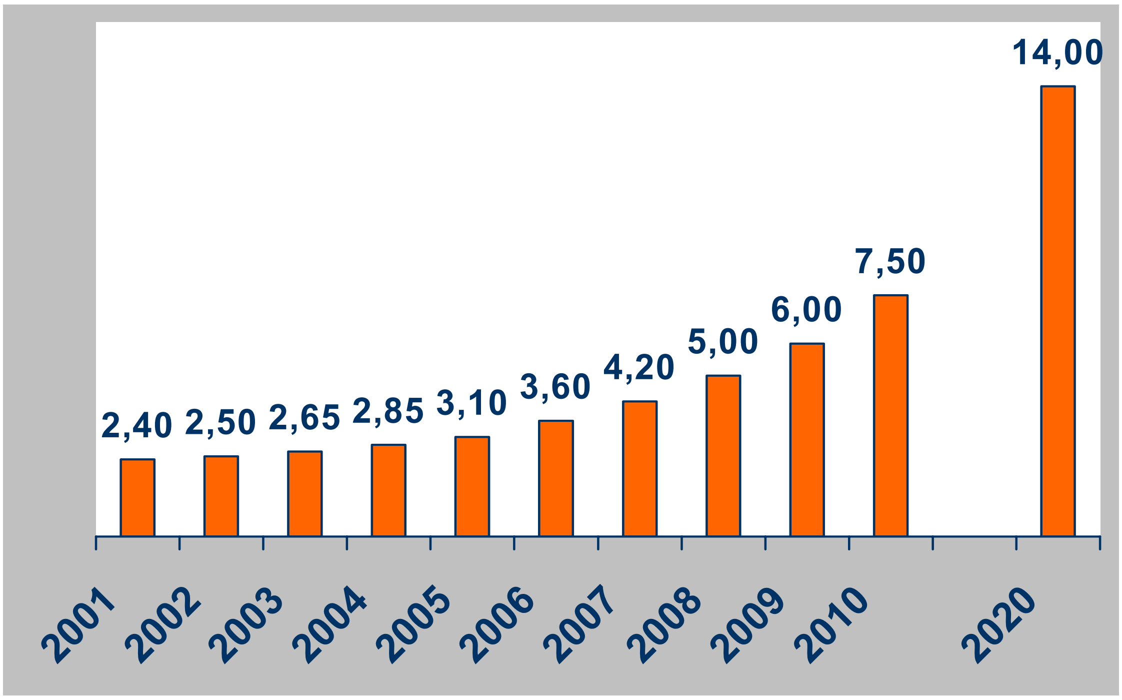
5 Framework for biomass utilization for energy production

In Poland energy production from biomass is influenced by a huge amount of different regulations and practical issues. Based on the broad range only the most important information regarding administration, laws and economy are described in the following. It shall give an insight into the practice. For more information the author can be asked for.

5.1 Administration and rights

Biomass utilization for energy production is influenced mainly by the laws regarding energy production. 2000 the continuously valid quota model was introduced. It shall realize a dynamic market system for renewable energy. The system requires from any energy production company clear figures regarding the share of renewable energy of the total energy supply. The quotas are shown in figure 5.

Fig. 5: Quota for renewable energy supply based on the total energy supply of any company



In the past the quota could not be reached based on an inadequate realization of the system by the administration, mainly the regulation agency URE. Thus a clear change of this situation has to be expected since in 2004 an effective punishment system was introduced and since October 2005 a certificate trading system within Poland has started. Additionally in the energy law from 2003 an calculation method was introduced (coming into force July 2004) for calculation of the share of renewable energy in co-firing plants leading to an increasing co-firing practice. But with co-firing an strong negative influence on decentralized and regional bio energy projects is to be expected due to regional availability of wood. Based on the quota system the prices for renewable energies have to be dealt with the electricity companies before starting any biomass project what includes mainly relatively short lasting contracts.

For the heating sector any district heating company is bound to buy heat from renewable sources due to the ordinance for the energy law from May 2003. The only obstacle is that the prices for heat from the company should not raise to much (more than the inflation rate). This includes that there will be no upper limit for renewable heat production. The decision about the final price will be at the regulation agency.

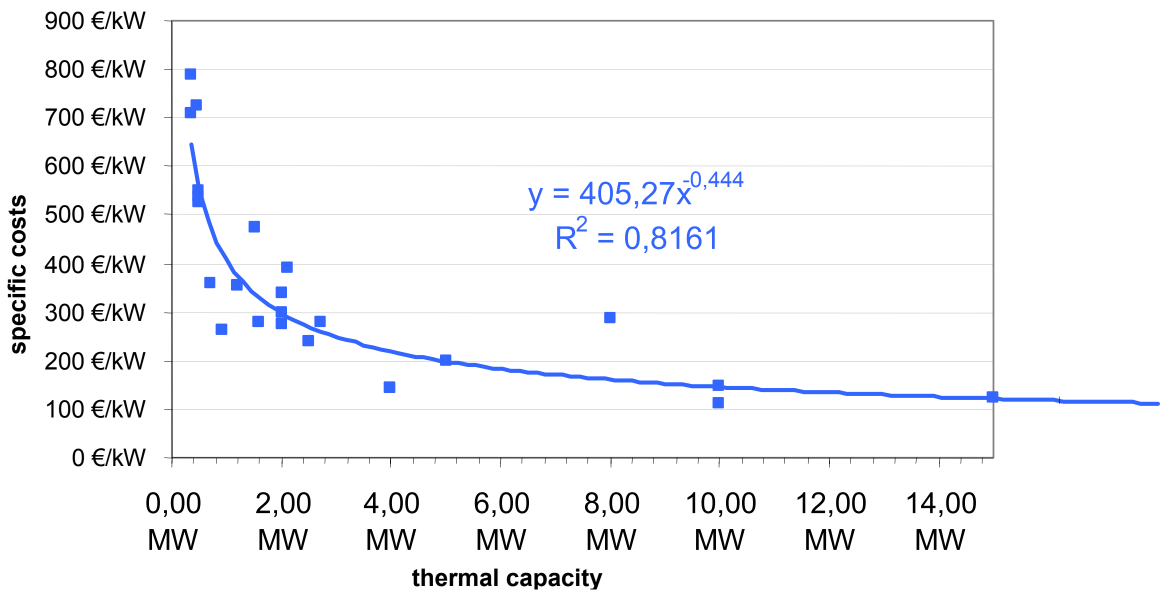
In opposite to the electricity market there are no quota systems or regulations of renewable energy amounts as well as any energy prices regulation foreseen.

From an administrative point of view energy production of heat and electricity are advised by the regulation agency URE. The main task is regulation of prices and tariffs. Due to the energy law the tariff for heat is a combination of prices, taxes and regulations its use. If a company is active out of any competition the president of URE can release a company from these regulations but today no company got this opportunity. The regulations by URE are valid for companies with an installed heat capacity of more than 1 MW. For most plants based on biomass in the district heating sector it results the necessity to get the allowance from URE for their operation and their prices. Thus, prices have to be oriented at the prices before installing the biomass based heating plant what leads sometimes to serious difficulties.

5.2 Economy

Also the economical framework can be discussed only in a very short way. The most important influences on economy of biomass fired heating plants are investment costs, operation costs (including costs for the fuel biomass), maintenance costs and personnel costs. From analysis of heating plants based on wood chips the investment costs are shown in Figure 6. It shows the typical decreasing costs with raising installed capacity.

Fig. 6: Specific costs of wood chips based heating plants in Poland (2004)



As second most important factor the costs for biomass provision have to be recognized in the calculations. Table 4 contains 2004 surveyed data for different solid biomasses

Table 4: Costs for biomass including delivery to the heating plant

Fuel	Price
Natural wood chips	Average: 50 €/Srm
Wood chips from saw mill	20 - 34 €/Srm (Average 25 €/Srm)
Wood chips from energy crops	45 - 60 €/Srm (GFA 2004)
Straw	27 - 34 €/t (Average 29 €/t) at 20 % Humidity

For financing the plant the following assumptions were taken:

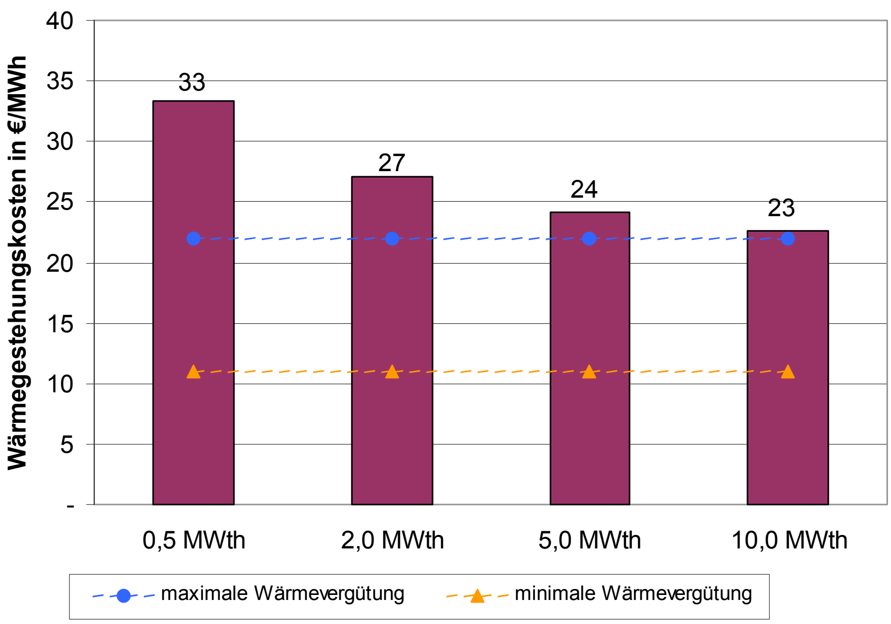
- Own funds: 30 %; 15 % interest, based on typical bank requirements
- Borrowed capital: 70 %; 3 % interest, based on the bank of environment

For further operation and personnel costs are assumed:

- Personnel: 0,5 / 2 / 3 / 4 workers for 0,5 / 2 / 5 / 10 MW plants
- Maintenance: 1 % of investment cost for constructions and 2 % for technical components
- Administration and insurance: 1 - 2,8 % of investment costs

Figure 7 shows the results of the calculation based on these assumptions for 4 different classes of capacity. The dotted lines show the typical prices for heat in district heating areas 2004. Costs vary very much with the size of the heat plants, generally are they higher than costs of heat in existing heating systems. Thus, an economical operation of a biomass fired heating plant today requires very good conditions.

Fig. 7: Heat production costs for biomass based new heating plants in comparison with maximum and minimum heat prices 2004



For Assessment of these data has to be recognized that they depend on the chosen assumptions. They depend very much on the local real situation. In the case of comparison of a new biomass based plant with a new fossil fuel (gas or coal) based plant the differences in heat production costs are negligible. That means that in the case that a heating plant has to be constructed biomass could be at least an equivalent option.

In the case of a combined heat and power generation at the moment the frame conditions are so that in most cases the single heat production seems to be more feasible, but the development shows a tendency that combined plants based on biomass will have perspectives.

As most important factor the decision about the allowance of the envisaged heat and electricity prices by the regulation agency will influence the feasibility of the different options of heat production. Therefore this stage seems to be taken most care about. Nevertheless, generally it is to conclude that the conditions for biomass based heat production facilities are good in Poland so that thinking about the possibilities is reasonable.

6 Perspectives of biomass utilization

On the background of the world wide raising use and promotion of renewable energies also in Poland a raising utilization of biomass for energy production is expected. High importance for a further development has the reduction of existing obstacles. These are mainly:

- costly approval procedures
- practice of market regulation and price approval
- tradition of hard coal utilization and connected lobbying
- possibilities of co-combustion in big power plants
- long lasting energy contracts in the conventional energy sector
- surpluses in conventional power plants
- inconsistency of political instruments
- quota-model and technology-definition
- short-timed contracts for energy feeding in and fuel supply
- language barriers

In spite of these obstacles the interest in biomass solutions is high in Poland and in foreign countries. Realized plants show that all obstacles can be overcome. Moreover the participation of Po-land in the emission certificate trading market will give all technologies of renewable energy production a considerable support. It is to be expected that the international interests in the polish biomass market will raise.

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15. November 2005 www.ie-leipzig.de

Institut für Energetik und Umwelt
Institute for Energy and Environment

Forschung, Entwicklung, Dienstleistung für
- Energie
- Wasser
- Umwelt

Biomass supply and utilization in district heating in Poland

Dr. Frank Scholwin
Institute for Energy and Environment gGmbH; Leipzig

Results of a project supported by Deutsche Bundesstiftung Umwelt

DBU

Institut für Energetik und Umwelt gGmbH, Torgauer Str. 116, D-04347 Leipzig, info@ie-leipzig.de

Slide 1

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Contents

2

Slide 2

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The Institute for Energy and Environment

The Institute for Energy and Environment (IE), arisen from the 1953 founded „Institute for Energy“, is an **interdisciplinary research company working on all topics in the fields energy, environment and water** both theoretically and practically. This contains **feasibility studies, reports, surveys, impact assessment referring to technology, economy and environment as well as scenario analyses and life cycle assessments**. Further topics are shaping and simulations as well as experimental examinations from the laboratory level to pilot projects.

Slide 3

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Introduction

- about 40 Mio inhabitants
- rural character
- 35 % of inhabitants life in rural areas
- 25 % of inhabitants work in agriculture
- Area corresponds to Germany
- 60 % of the area are used agriculturally
- 30 % of the area are wood

4

Slide 4

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Prerequisites for biomass utilisation

- existing biomass and areas for biomass production
- -> high potentials
- straw- and hey-surpluses
- high heat demand in district heating systems
- long tradition of biomass utilisation for heating
- political intention for strenghening rural areas
- liberalisation of the energy sector
- high environmental taxes
- research and activities within the energy plant sector

5

Slide 5

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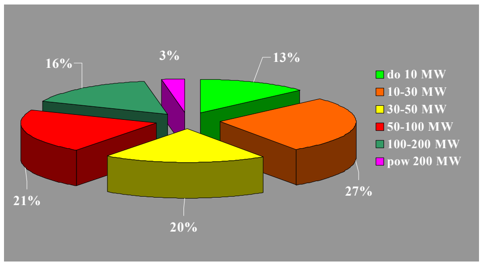
District heating systems in Poland
structure of dimensions of companies



Source: Polish chamber of district heating 2004

6

Slide 6

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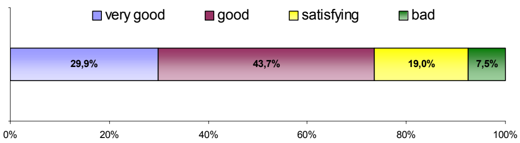
District heating suppy in Poland
technical status of energy production plants



Source: survey within 240 companies 2004

7

Slide 7

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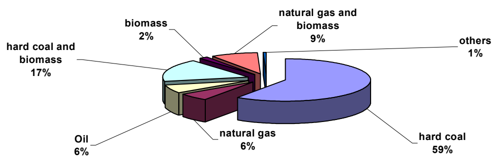
District heating suppy in Poland
Fuels



Source: survey within 240 companies 2004

8

Slide 8

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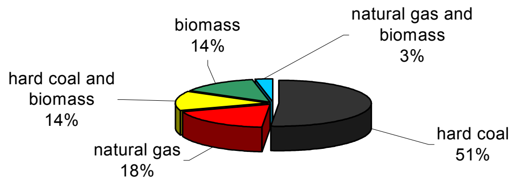
District heating suppy in Poland
fuels in future



Source: survey within 240 companies 2004

9

Slide 9

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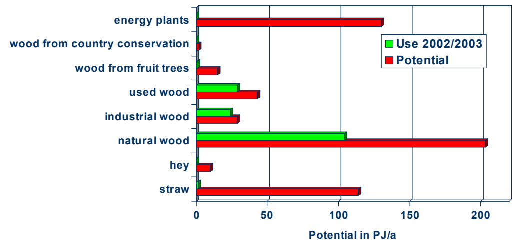
Potentials and use of biomass for energy



Utilisation total: 25 %
Potentials: own calculations, use: IEA 2003, EC BREC 2002

10

Slide 10

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Use of biomass for energy
dynamics

Type of plant	capacity in MW (1999)	capacity in MW (2002)	Increase of capacity in MW	dynamics in %/year
wood based heating plants	350	450	100	8,7
straw based heating plants	13	92	79	92
straw boilers	7	23	16	48,7

without households, wood and paper processing industries

Source: Wiśniewski 2004

11

Slide 11

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Framework for biomass utilisation

- bylaw for energy act 05/2003:
  duty for heating companies for bying heat from renewables
- district heating connection has to be available
- consumer price may not increase unreasonable
  - no upper limit for renewables are defined
  - conditions of contracts have to be negotiated individually
  - prices have to be approved by the regulation authority URE
  - for new plants are prices recognisable which allow a return of investment wihtin 6 years or more at limited price increase
  - no clear statements regarding recognisable capital costs

12

Slide 12

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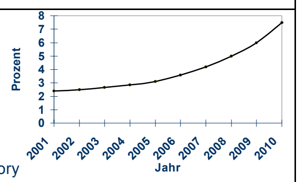
Framework vor combined heat and power plants based on biomass

- Quota-model since 2000:



- function of the model depends on reliability of punishments
- Punishments until now not obligatory
  - it is in discretion of URE
  (EnG Art. 56 I1a / III / V)
- Punishment can be up to 15% of income of the last tax-year (EnG Art. 56 Abs. 3)
- personal sanctions against managing directors up to 300% of the monthly income (EnG Art. 56 Abs. 5)

13

Slide 13

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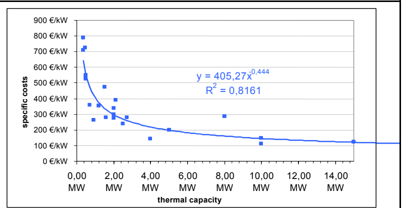
Feasibility of biomass heating plants

specific costs of
biomass heating plants,
own survey and calculations



fuel prices with transport
to biomass heating plant

fuel	price
natural woodchips	medium: 50 €/Srm
woodchips from industrial processing	20 - 34 €/Srm (medium 25 €/Srm)
short rotation energy woodchips	45 - 60 €/Srm (GFA 2004)
straw	27 - 34 €/t (medium 29 €/t) at 20 % water content

14

Slide 14

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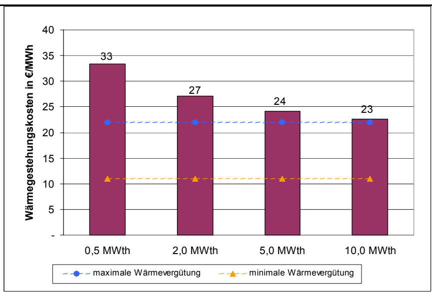
Feasibility of biomass heating plants



Heat production costs in newly build plants based on natural wood chips
in comparision to minimum and maximum heat prices

15

Slide 15

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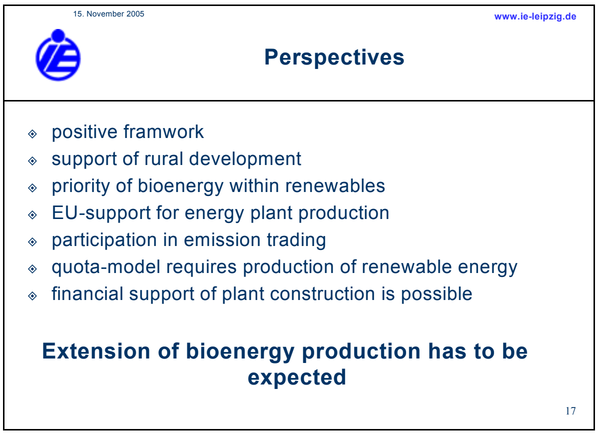
Obstacles for bioenergy

- costly approval procedure
- practice of market regulation and price approval
- tradition of hard coal utilisation and connected lobbying
- possibilities of co-combustion in big power plants
- long lasting energy contracts in conventional energy sector
- sourpluses in conventional power plants
- inconsistency of political instruments
- quota-model without certificates and technology-definition
- short-timed contracts for energy feeding in and fuel supply
- language barriers

16

Slide 16



Slide 17

Slide 18

Workshop 1: Innovative Biomass Logistics

Rapporteur: Dr. Julije Domac

Energy Institute "Hrvoje Požar", Zagreb

Socio-economic dividends of climate change mitigation projects: Job creation and regional development and innovation

WS1: Innovative biomass logistics

Rapporteur: Julije Domac

CTI Seminar, Leipzig, October 23, 2005

Slide 1

Reasons (challenges) for innovative biomass logistics

- To make biomass available
- To ensure sustainability
- To keep biomass utilization environmentally friendly
- To enable competitiveness and lower the production & supply costs
- To make transition from 'poor man's fuel' to modern energy source possible!

Slide 2

Key factors

- National strategy & (supportive) legislation
- Pilot and demonstration projects to identify the needs and available technology
- Economics still a challenge!
- Clear local and regional effects (jobs, income generation, wealth retention,…)

Slide 3

Some important issues

- Small scale vs. Large scale
- Partly mechanised vs. Fully mechanised
- Available mechanisation
- Labour intensivity (Labour costs)
- Water content
- Radius of action (Transport costs)
- Maximum load on road
- …

Slide 4

Perspectives

- Still numerous barriers, can be overcome
- Efficient and integrated logistics for better competitivness
- Importance of private&public, town&country partnerships
- Considerable support from emission certificate trading market expected
- Socioeconomics an important driver in the future

Slide 5

Biomass is forever! (Prof David Hall)

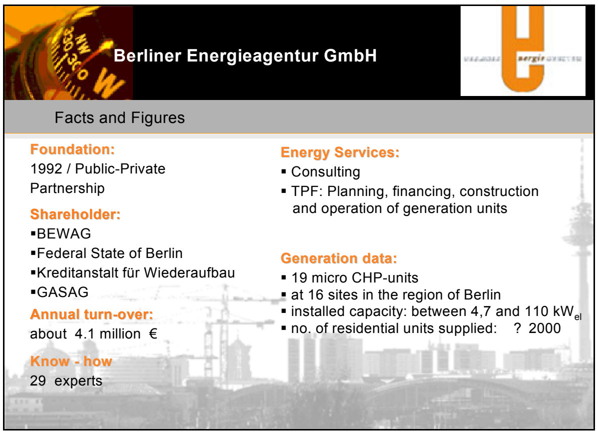
Slide 6

Developing Contracting Businesses and ESCO Industries in CEE Countries

Ralf Goldmann

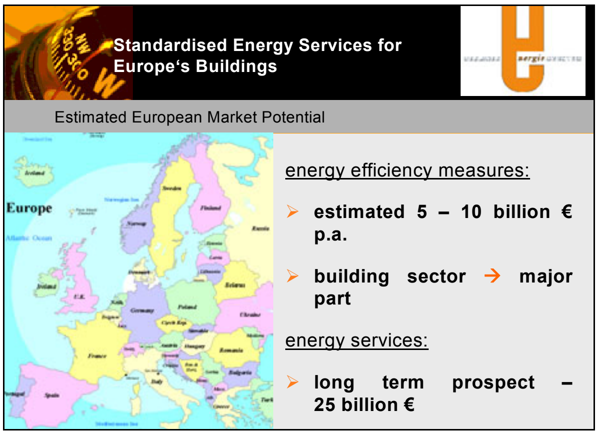
Berliner Energieagentur

Slide 1



Slide 2

Slide 3



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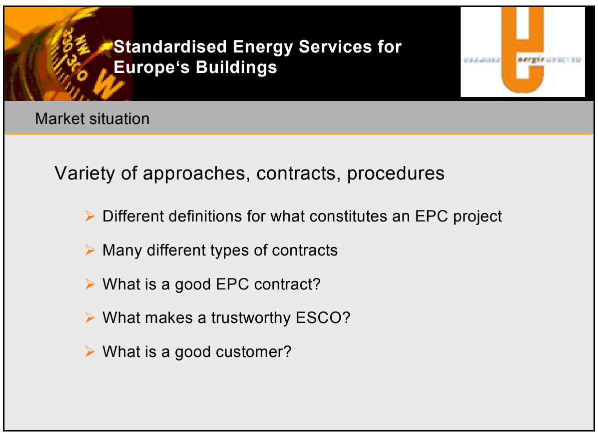
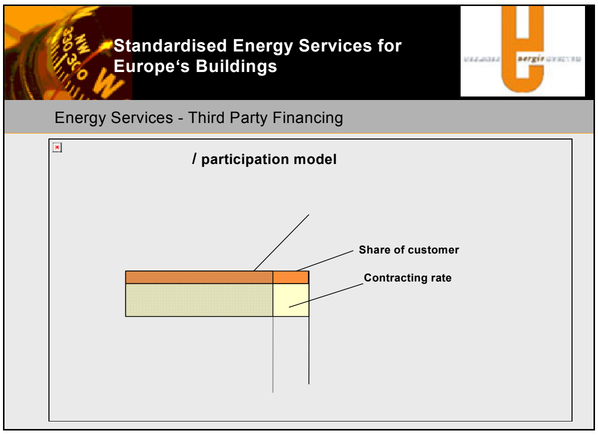
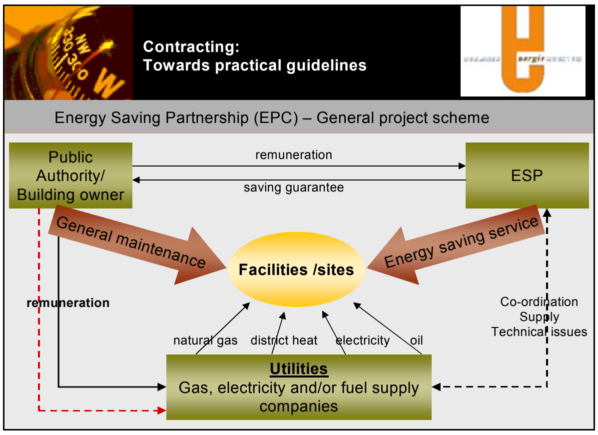


Slide 5

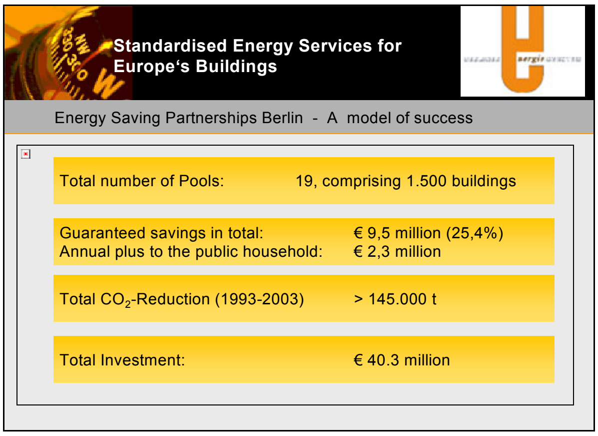
Slide 6



Slide 7



Slide 8



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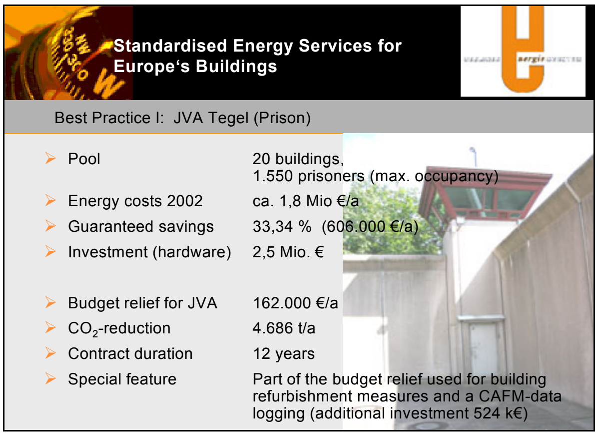

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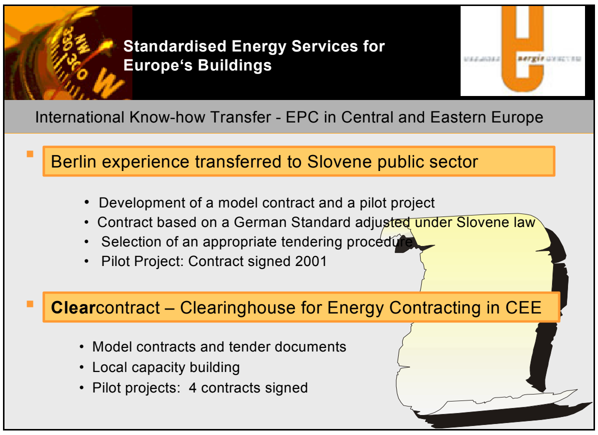
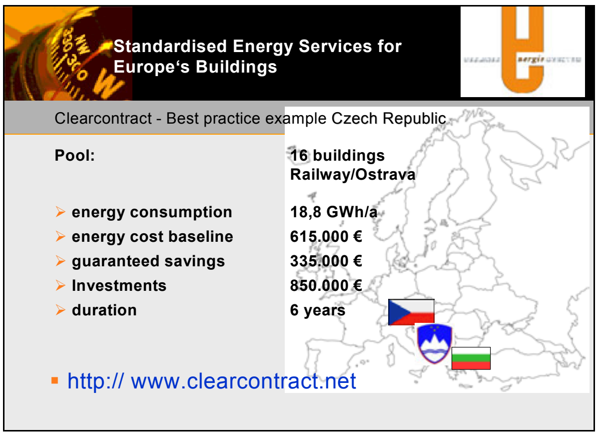


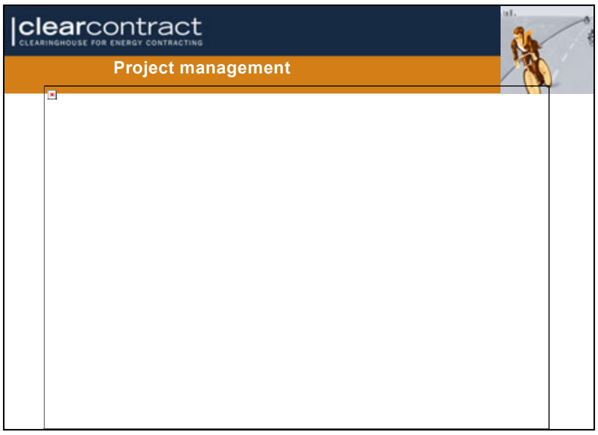
Slide 11

Slide 12

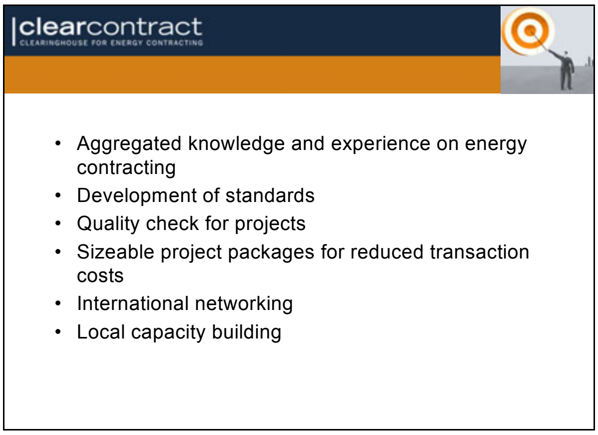


Slide 13

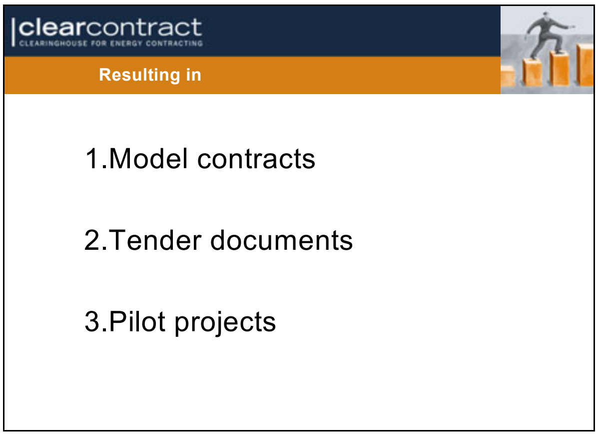
Slide 14



Slide 15



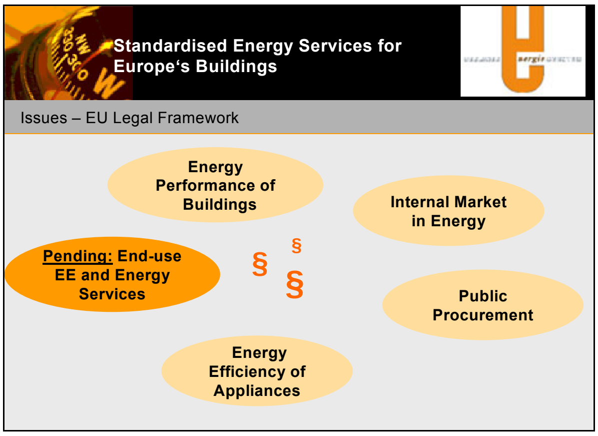
Slide 16



Slide 17

Slide 18

Slide 19

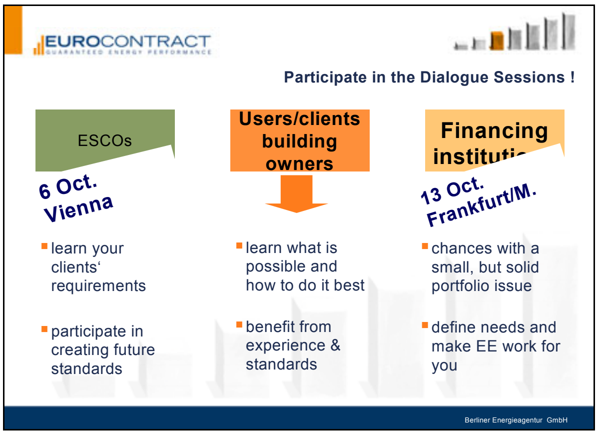


Slide 20

Slide 21

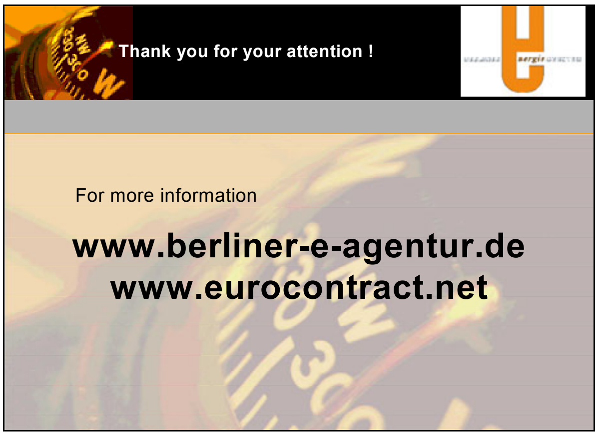
Slide 22

Slide 23



Slide 24

Slide 25



Slide 26

Housing Renovation Initiative for Energy Saving: Lessons Learned and Opportunities in the Future

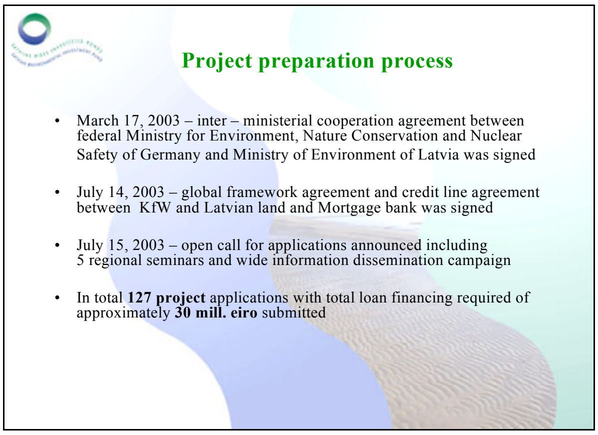
Ilze Puriņa

Environment Investment Fund, Latvia

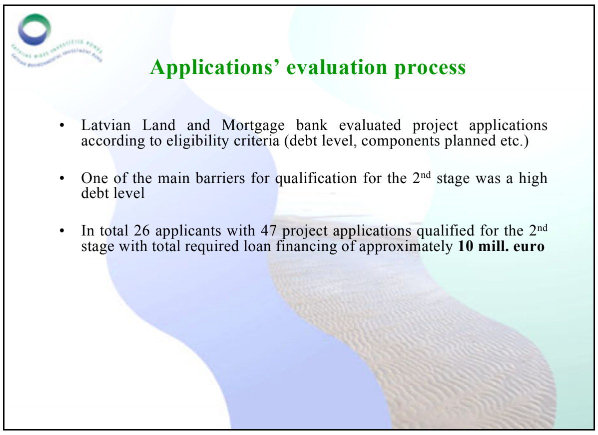
Slide 1

Slide 2

Slide 3



Slide 4



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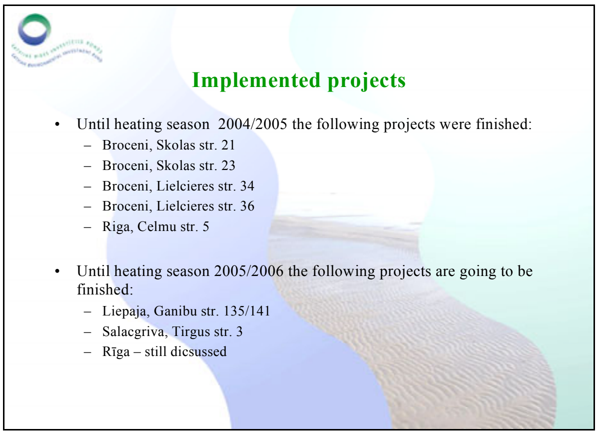
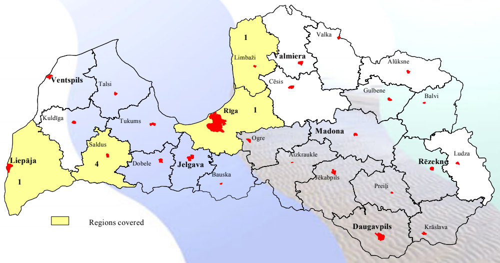


Slide 6

Regional distribution of projects



Slide 7

Riga, Celmu str. 5

Slide 8

Riga, Celmu str. 5

- Main parameters of the building :
  - Number of floors – 5
  - Number of apartments – 60
  - Number of tenants – 151
  - Heating area – 2972 m²
  - Hot water – provided all year around
- Measures implemented :
  - Windows changed, m² – 541
  - Walls insulated, m² – 2023
  - Top floor ceiling insulated, m² – 780
  - Thermoregulation installed on each radiator, pieces– 190
  - Thermal energy meters installed on each radiator, pieces– 190
- Total investments – **148 560 €**
  - including grant – **60 000 €** as to the first finished private project

Slide 9

Broceni, Skolas str. 21

Slide 10

Broceni, Skolas str. 21 (similar Skolas str. 23)

- Main parameters of the building:
  - Number of floors – 5
  - Number of apartments – 70
  - Number of tenants – 200
  - Heating area – 3820 m²
  - Hot water – provided all year around
- Measures implemented :
  - Windows changed, m² – 620
  - Walls insulated, m² – 2264
  - Top floor ceiling insulated, m² – 650
  - Thermoregulation installed on each radiator
  - Thermal energy meters installed on each radiator, pieces
  - Basement ceiling insulated, m² – 975
- Total investments – **297 420 €** for each project
  - project on Skolas str. 23 received also grant of – **70 000 €** as the first finished municipal project

Slide 11

Broceni, Lielcieres str. 34

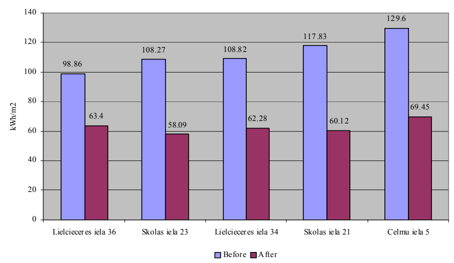
Slide 12

Broceni, Lielcieres str. 34 (similar Lielcieres str. 36)

- Main parameters of the building:
  - Number of floors – 5
  - Number of apartments – 42
  - Number of tenants – 110
  - Heating area – 2200 m²
  - Hot water – provided all year around
- Measures implemented:
  - Windows changed , m² – 470
  - Walls insulated, m² – 1730
  - Thermoregulation installed on each radiator
  - Thermal energy meters installed on each radiator
  - Basement ceiling insulated, m² – 522
- Total investments – **180 150 €** for each project

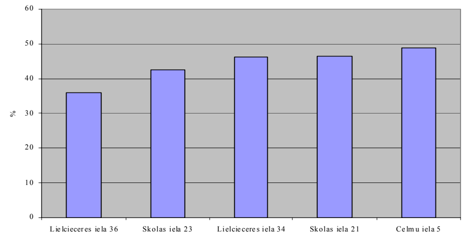
Slide 13

Relative heat consumption



Slide 14

Reduction of CO_2 emissions



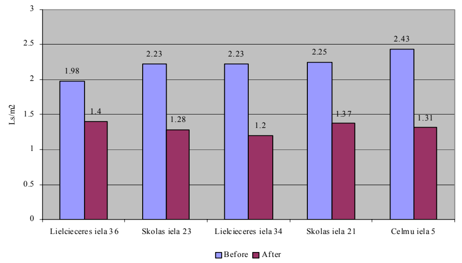
Slide 15

Results

- In total 5 projects with total investments of **1.2 mill. eiro**, including grant of 130 00 eiro had already the first heating season
- Approximately **770 inhabitants** have more comfortable living conditions and market value of their apartments increased substantially
- Total CO_2 emission reductions reached in the first heating season by the first 5 projects – **293 t**
- Technical feasibility of measures demonstrated – relative heat consumption in all projects is **bellow 70 kWh/m² per year** similar as in the pilot project on Ozolciema str. 46/3
- It is planed that the next heating season will be the first for 3 more renovated buildings

Slide 16

Costs for heat



Slide 17

Main problems and challenges

- Project applicants faced a problem to reach at least 75% apartment owners agreement to take loan and to start whole renovation of dwelling (it is required by the bank in case there is no any additional security provided)
- It is very difficult for inhabitants to agree to take loan for investments in common property. There are very different people that are living in the same house – for some of the planned payments are acceptable but for some are too high
- Inhabitants are not ready to invest in common property and still do not realize that it is their common obligation
- Program required complex renovation of dwellings. That is correct from technical point of view but it requires also very high investments. Not all inhabitants are ready for so big credit payments that are necessary to finance complex renovation
- Inhabitants don't have collective borrowing experience therefore are very sceptic to participate and to take loan
- It is a time consuming process – from project idea to real implementation

Slide 18

Opportunities

- Housing sector has a great potential for reduction of heat energy consumption and GHG emissions in the future
- Pilot projects proved that it is technically possible to reduce heat consumption by 50% implementing complex panel building renovation project
- Green investment schemes could be very good financing mechanism for this sector:
  - many projects with similar packages of measures planed and simple calculation models for calculation of GHG emissions reduction potential
  - success will be very much dependent on creation of the overall project financing system for renovation of panel buildings that will have enough motivation for inhabitants to take loans and to implement measures

Slide 19

From project idea to its realization together with Environmental Investment Fund!

Ģetrudes str. 10/12
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Fax: 7845222
E-mail: pasts@lvif.gov.lv
http:\\www.lvif.gov.lv

(more detailed information on project results is available)

Slide 20

Adapting District Heating Networks to Reduced Demand

Dimitar Doukov

CEE EnEffect, Bulgaria

Preface

This report is a summary of the experience accumulated in Bulgaria in the field of restructuring of the district heating sector and its alignment to operation under the conditions of a market-based economy. The report presents the major legal framework and structural reforms, which have allowed the district heating sector to continue operating on the market despite the dramatic increase of heat energy prices and at the background of gradual curtailing and abolishment of subsidies. The most generally applied technical measures for adaptation of district heating companies to the end-users' requirements for higher supply-side flexibility are based on the example of "Toplofikatsiya Gabrovo" (Gabrovo District Heating Company), which is a typical representative of medium-sized district heating companies featuring a significant drop in heat energy consumption in the residential sector and industry.

The demonstration project "Energy Efficiency Renovation of District Heating and Heating End-Use in the City of Gabrovo" was implemented in the framework of the project "Energy Efficiency Strategy to Mitigate Greenhouse Gas Emissions. Energy Efficiency Demonstration Zone in the city of Gabrovo, Republic of Bulgaria", financed by the Global Environment Facility (GEF) through the United Nations Development Program. The project was implemented under the guidance of the Center for Energy Efficiency EnEffect in collaboration with the management of Toplofikatsiya Gabrovo EAD (District Heating Gabrovo - Sole Proprietor Stock Company, SPSCo) in the period 1998-2003. The technical measures of the project were financed by GEF/UNDP, Toplofikatsiya Gabrovo and the district heating end users.

Introduction

The past decade was characterized by implementation of institutional, regulatory and structural reforms in the energy sector. The focus was on market liberalization – their expansion and gradual opening to a growing number of consumers as an integral part of the general concept of modernization of the national economies and promotion of free movement of goods and services; deregulation – replacement of regulation by competition aimed at improvement of the efficiency of production and the quality of services; protection of consumers with respect to their fundamental consumer interests – health, security, economic interests, the right of access to information and training in order to be able to safeguard their rights. The successful implementation of energy sector reforms in a number of countries had produced significant economic and social benefits in terms of reduced costs and re-orientation of the achieved savings in favor of the end users.

In recent years Bulgaria was faced with grave challenges related to the transfer to market-based mechanisms in the energy sector, caused by objective reasons and circumstances as well as by subjective delay of the reforms in the sector. In actual fact, until 1999 the reform in the energy sector has not started at all, which caused the formulation of quite ambitious tasks and time limits for its implementation in the following years. With due account of the state and specifics of the Bulgarian energy market these actions had to be aligned to the requirement for stepwise implementation of the reforms in order to allow for adaptation of the energy enterprises and consumers to the changing conditions.

1 Why reduced demand of heat energy?

1.1 Energy sector reform and gradual abolishment of subsidies for heat energy for residential consumers

As early as in 2002 the National Strategy for Development of the Energy Sector and Energy Efficiency by 2010 (SG, Vol. 25/1999), approved by the Council of Ministers and adopted by the National Assembly in principle in 1999; was evaluated as being as a strategy, which promulgates too general and conceptually permanent objectives – security of energy supply, energy efficiency, protection of the environment, nuclear safety – scheduled to be achieved by too generally formulated mechanisms – regulatory framework aligned to the European one, market orientation, competition and privatization. The Energy and Energy Efficiency Act (EEEA), approved in the same year, aimed at creating a basis for sustainable regulatory framework for long-term development of the processes in the energy sector, including development of a competitive energy market. Although this Act was stamped as a failure because of the lack of compliance between objectives, tools and actions and although the active phase of the negotiations for Bulgaria's accession to the European Union imposed the need of approval in November 2003 of a new Energy Act, the 1999 Act still marks the first step towards implementation of the energy sector reforms. A State Energy Regulation Commission (SERC) was set up, thus meeting the requirement of Directive 96/92/EC "On the internal electricity market" concerning the availability of an independent regulatory body. The Energy Act grants the SERC competences, which are relatively adequate to the European ones in the field of licensing of energy enterprises, control on the implementation of the terms and conditions of the license and regulation of energy prices.

The new Energy Act reproduces some of the shortcomings of the old law, however at the same time contains the major prerequisites for implementation of the objectives laid down in the Energy Strategy, including development of a competitive energy market in Bulgaria. The "Single Buyer" model in the power sector and the natural gas sector was replaced by a model of bilateral contracts and a balanced market. It is envisaged that the SERC should approve the required documents related to the introduction and operation of a market for electricity, heat energy and natural gas.

Gradual deregulation of the potentially competitive activities – generation and supply – is envisaged to run simultaneously with the advance in the development of market-based relationships.

Another important circumstance is that the Bulgarian energy sector is poorly prepared for deregulation, since economic regulation as a form of management of monopolist sectors has been introduced in Bulgaria only recently. Besides, the majority of the energy enterprises are still financially unstable, the energy prices for the residential sector used to be subsidized till the current year 2005 and the change of ownership has not been completed as yet. This situation confronts Bulgaria with the challenge to compensate within only several years the lagging behind in the implementation of the reforms and to get closer to the EU member-states in terms of the level of development of market-based conditions in the energy sector.

All this places before the SERC the difficult task to stroke a balance among multiple and diverse interests in the process of structural and price reform in the energy sector.

1.2 Heat energy market

Heat energy consumption accounts for about 22 percent of the end-use energy balance. Heat energy generation is based mainly on combustion of natural gas and is the main form of space heating in the densely populated urban areas with high-rise build-up. Heat energy consumption in recent years is characterized by significant ebb of consumers, which leads to reduction of the heat loads and increased system losses (the negative consequences from which are for the account of the DH-connected consumers and the tax-payers) and insolvency of connected end-users – mainly households and budgetary public entities.

Table 1 shows the change of heat energy consumption by heat carriers – hot water and steam – and by district heating companies in percentage. The diminishing trend is common for both heat carriers. Hot water consumption varies within broad limits, whereat its drop is more significant in the small cities.

Local space heating and direct combustion of natural gas are serious alternatives to district heating, however the development of new gas distribution networks is not competitive as compared to the already existing DH supply networks. The investments in replacing low-pressure gas distribution networks and their maintenance costs raise the price per unit heat energy significantly above the costs of the existing DH supply networks provided the latter are upgraded. In addition, the costs of the natural-gas-fired appliances are estimated at some BGN 1,000-2,000 per flat.

Till the end of the previous heating season electricity used to be an acceptable alternative for the DH subscribers who had resigned from the DH services because the price of electricity for the residential sector and for small business was indirectly (cross) subsidized. This subsidy, however, will be dismantled through the increase of electricity prices in force as of 1 October 2005. Electricity is not suitable for space heating because of the low level of utilization of primary resources (< 25 per cent), the high investment requirements for construction of new power plants and distribution networks, which in turn will lead to increase of the production costs and hence of the corresponding retail prices.

Table 1: Changes in heat energy consumption by heat carriers in percentage

District heating companies	Hot water			Steam		
	Report 2001	Report 2002	Forecast 2003	Report 2001	Report 2002	Forecast 2003
Sofia	100.0 %	78.0 %	77.5 %	100.0 %	56.9 %	63.9 %
Plovdiv	100.0 %	117.0 %	127.4 %	100.0 %	66.2 %	54.1 %
Pleven	100.0 %	89.1 %	94.2 %	100.0 %	82.0 %	78.3 %
Shumen	100.0 %	73.3 %	74.6 %	-	100.0 %	500.0 %
Pravets	100.0 %	50.3 %	74.3 %	-	-	-
Pernik	100.0 %	100.4 %	99.9 %	100.0 %	711.2 %	2293.6 %
Sliven	100.0 %	75.6 %	93.1 %	100.0 %	71.1 %	36.8 %
Gabrovo	100.0 %	84.5 %	101.5 %	100.0 %	74.1 %	72.1 %
Rousse	100.0 %	95.6 %	89.5 %	100.0 %	106.4 %	104.8 %
Kazanlik	100.0 %	97.5 %	95.4 %	100.0 %	91.0 %	96.0 %
Bourgas	100.0 %	89.1 %	99.2 %	100.0 %	0.0 %	77.9 %
Varna	100.0 %	84.3 %	91.4 %	-	-	-
Vratsa	100.0 %	96.4 %	96.8 %	-	-	-
Razgrad	100.0 %	97.1 %	95.8 %	100.0 %	95.1 %	32.4 %
Lovech	100.0 %	42.4 %	24.5 %	-	-	-
V. Tirnovo	100.0 %	88.9 %	89.2 %	-	-	-
Yambol	*	*	7373 MWh		775 MWh	1710 MWh
Loznitsa	*	100.0 %	150.4 %	-	100.0 %	220.6 %
Total	100.0 %	81.8 %	82.7 %	100.0 %	81.0 %	79.8 %

* not operating

Irrespective of the absolute increase of the prices of heat energy during the past two years, district heating remains the cheapest and environmentally the most acceptable option in densely populated urban areas. To this end, however, district heating should be provided by modern, flexible and cost-effective systems, which is far from being the case with the currently operating systems. The introduction of individual regulation of heat consumption at the end-users and its share-based building-level distribution is expected to result in stabilization of consumption.

In a long-term horizon one cannot expect a substantial increase of heat energy consumption either in industry or in the residential sector. The reasons for that are to be found in the expected restructuring of the GDP through reduction of the share of mining and processing industries for the account of an increase of the share of services, which are less energy-intensive, of privatization, accompanied by closure of inefficient and energy-intensive technologies and production facilities, reduction of energy costs with the aim to raise the competitive capacity of the production output, introduction of heat conservation measures at end-users aligned to their needs and solvency level and of individual devices for regulation and accounting of heat consumption and improvement of the heat performance of buildings.

Development of a low-pressure natural gas market for space heating through local boiler plants and introduction of gas supply for direct combustion in households is a competitive and highly efficient alternative to electricity and to certain extent to the district heating. The use of natural gas in households has been a pronounced priority of the energy policy for many years, however a certain advance in this respect has been noted only after 2002. The reasons for that are rooted in the general investment climate in our country and in some specific shortcomings of the energy sector, such as subsidizing of competitive energy sources (heat and power), the delay in the passing of the appropriate law and other regulatory acts and the pending introduction of regional tariffs for natural gas differentiated by groups of consumers.

1.3 Pricing policy for heat energy

The 1998 Action Plan envisaged annual increases of the prices of heat energy for the residential sector, so that subsidization of heat producers could be abolished in 2001.

According to the Energy Act the Ministry of Energy and Energy Resources had to set a bottom limit for the retail price of heat energy for households, applicable for district heating companies receiving subsidies from the state budget. A district heating company was entitled to subsidy from the state budget as long as the price of the heat supplied by that company as endorsed by the SERC was higher than the retail price for the residential sector set by the Council of Ministers.

The implementation of a schedule for increase of the prices of heat energy for the population was launched in 2002 with the aim to abolish subsidization of producers by the end of 2004. The rates are increased by 10 percent on an annual basis, effective after the end of the heating season. In compliance with Paragraph 24 of the Transitional and Final Provisions of the Energy Act the period of setting of heat energy prices by the Government expired with the price increase at the end of the 2004-2005 heating season and the regulation of prices was transferred entirely to the State Energy Regulation Commission.

Upon termination of producer subsidizing practices (as of July 2005) all consumers shall have to pay for their heat consumption at the regional prices endorsed by the SERC. Currently these prices apply only for industrial enterprises and budgetary entities. The differences between the unified national prices for the residential sector, set by the Council of Ministers, and the regional prices of the individual district heating companies vary since they are due above all to the prices of the fuels used and the volume of consumption in the respective region. As a consequence, the consumers from the residential sector in the different regions will be faced by different rates of increase of the prices for heat paid in 2005-2006 heating season. DH companies having the highest retail prices (those operating masut-fired plants and those having the smallest production output because of significant shrinkage of consumption in recent years) will probably make their best to reduce as much as possible their costs for the purposes of retaining their consumers from the residential sector.

Table 2 shows the heat energy prices endorsed by the SERC by heat carriers – steam and hot water – and by price components for the years 2002 and 2003 as an illustration of the differences between the different producers of heat energy.

Table 2: Heat prices (full-cost) for non-residential energy consumers (less V.A.T.)

District heating companies	2002			2003			
	Steam	Hot water		Steam	Hot water		
		Energy price	Capacity price		Energy price	Capacity price	
	BGN/ MWh	BGN/ MWh	BGN/ m^3	BGN/ MWh	BGN/ MWh	BGN/ m^3/month	BGN/kWh /month
Sofia	62.76	39.48	0.064	61.85	38.17	0.0567	0.93
Plovdiv	69.68	39.35	0.066	67.39	37.84	0.1059	1.61
Pleven	63.81	45.10	0.062	59.82	40.46	0.0680	1.08
Shumen		46.30	0.085	48.61	52.32	0.1359	1.96
Pravets		34.05	0.050		37.82	0.1306	2.17
Pernik	54.74	31.37	0.090				
Sliven	52.63	32.21	0.062	67.58	45.49	0.1287	2.11
Gabrovo	70.81	39.46	0.099	78.24	45.70	0.1175	1.32
Kazanlik	71.66	69.79	0.075	66.06	72.35	0.1145	2.08
Rousse	41.14	25.35	0.144	48.82	28.39	0.1030	1.71
Bourgas	56.56	39.18	0.084	53.67	37.52	0.0743	1.88
Varna		41.41	0.078		40.97	0.0823	2.06
Vratsa		43.46	0.060		40.41	0.0946	1.32
Razgrad		42.21	0.071	50.26	39.73	0.0937	1.84
Lovetch		57.30	0.205		61.00	0.3559	8.23
V. Tirnovo		64.32	0.078		77.33	0.0774	2.03
Samokov		46.98	0.072	-	-	-	-
Iskrets	115.65	33.33	1.021	-	-	-	-
Bedek		72.50	BGN 481 MWh/month				
Yambol	-	-	-	75.94	40.12	0.0881	1.77

2 Adapting district heating networks to reduced energy demand

2.1 Rehabilitation of district heating an ecological solution

The rehabilitation of district heating is a proven, effective and ecological solution for heating and hot water supply to high-density urban areas. Alternative heating systems result in considerably higher cost to the customers and require larger amount of investments. The technical and technological preconditions are available, which enable residential and public consumers to regulate and reduce their consumption through installation of modern substations and metering of the consumed energy.

The operational and heat transmission costs can be considerably reduced through reasonable investments in rehabilitation and modernization of the heat supply systems. The implementation of many well prepared investment programs created a real opportunity currently to phase out subsidies. The social assistance for households with low income can be improved through redirection of the subsidies from the producers to the consumers; this will have a favorable impact on demand and on heat suppliers.

The joint effect of the above key measures results in affordable heating cost and the conversion of the Bulgarian heat supply companies into modern, flexible and viable heating systems; these allow heat supply to correspond to the individual needs and requirements of the consumer.

2.2 Development possibilities for district heating

The development possibilities for district heating are based on two main approaches:

- restrictive, without additional investments over the accrued depreciation resulting in maintaining the already established trends;
- positive, directed to re-connect part of the customers (90 percent) through reasonable investments targeted to reduce the costs for supplier and heat bills, and phasing out of the direct operational subsidies.

Applying the positive approach and with World Bank assistance, Investment projects were developed for 8 companies to undergo major restructuring and to receive significant investments beginning from early 2001, thus restoring their commercial viability during the next 4 years, including debt service on loans received. These DH/CHPs receive about 80 percent of the operating subsidies for the sector; undertaking investments in conformity with the developed investment projects will allow them to supply heat at least cost.

3 Energy efficiency retrofit of Toplofikatsiya Gabrovo JSCo

3.1 Project objectives

The main objective of the project was to reduce the costs for heat energy generation, distribution and end-use - through application of energy efficiency measures and to overcome the barriers to energy efficiency improvement in the district heating sector. The project contributed as well to the formulation of sustainable energy policy and programs in the municipalities. It demonstrated the entire process of design and implementation of an energy efficiency project in the district heating system of a city and thus created a model for the implementation of such projects by other heating supply companies in Bulgaria.

3.2 Toplofikatsiya Gabrovo JSCo - short presentation

Until 1996, the sole proprietor of the Gabrovo HPP (later registered as Toplofikatsiya Gabrovo SPSCo) was the state, in the person of the Committee of Energy. The subject of activity of the district heating company was generation, transportation and sale of heat and electricity, produced under co-generation principle. The existing DH supply system in Gabrovo comprised:

- the Gabrovo HPP;
- two water mainlines with a common transit section at the outlet from the HPP, which makes them hydraulically interdependent, as well as their distribution networks;
- 204 substations, connecting end users to the water-based heat transportation network;
- three steam mains, named South, East and North, and their respective distribution networks.

In 1996, the company possessed 4 steam generators with energy generation parameters – 2 coal-fired boilers (type CKD) and 2 mazut-fired boilers (type BKZ), as well as 2 auxiliary mazut-fired boilers (type KM). In order to achieve lower production costs of the generated energy, coal was predominantly used as fuel. The power generation capacities comprised three steam turbines with back pressure and nominal capacity of 6 kWel. The generated electricity was sold to the National Electric Company (NEK SPSCo) at prices, which provided no incentives for combined heat and power generation. Steam output from turbines and auxiliary boilers was supplied to end users from industry and to the boiler system for production of hot water for water-based heat transportation network.

Some of the generation capacities featured obsolete design type and were heavily depreciated. A new steam boiler of 25t/h capacity was commissioned in 1998. During the next year, a new boiler replaced one of the auxiliary boilers. The company had considerable reserve in terms of generating capacities and heat transportation network, because of the grave drop in industrial loads (steam) and the stop in further expansion of the water-based heat transportation network.

During the selected baseline year 1996, the heat load for space heating was 47.1 MW, while the heat supplied to end users amounted to 67 494 MWh. Steam delivered to industrial customers had reached 86 056 MWh. The Gabrovo HPP used to supply heat to 6 678 dwellings, 31 public buildings and 29 industrial enterprises. The space heating in 1 538 dwellings (23% of the total number of subscribers) had been entirely disconnected, and in about 17% of the subscribers it was partially disconnected. Domestic hot water was supplied only during the heating season. Since the spring of 1994, in relation to the introduced water rationing, the district heating company had entirely cancelled DHW supply.

The missing automation of the basic technological processes in the plant resulted in lower efficiency of the energy supply, as compared to the HPP generation output – 73.3%. Centralized quality control of the heat supply was in place - based on constant flow of primary heat carrier and variable supply temperature. The share of electricity consumption for the HPP's own needs was quite high – 47%.

The length of the water-based heat transportation network was 19 400 m. It included 1 505 m pre-insulated pipelines. 56% of the pipeline length comprised pipes aged 10 to 20 years. The transportation losses in the water network (inclusive at substations) amounted to 16.6%. The losses in primary heat carrier were also high – the topping up of the network used to reach as much as 16 times a year, at six months duration of the heating season.

Most of the substations were of obsolete design type, and the available automatic controls were in poor condition. Until 1998, only some 25% of the substations were equipped with heat meters. The length of the steam and condense mainlines was 22 535 m. A considerable portion of those was aged above 30 years. Heat losses in steam transportation were also high - 28.7%. Because of reduced steam consumption by industrial customers, by the year 2000 the utilization length of the steam network had dropped to about 2 500 m [5].

3.3 Energy efficiency measures in the district heating network

The project for energy efficiency retrofit of the district heating company formulated the possible measures for upgrading of the components of the system – heat source, heat transportation network, substations and indoor heating installations. On the basis of pre-set criteria, by technical and economic analysis a list of three groups of measures was compiled, which may be viewed as separate investment packages.

Investment package "Heat transportation network"

- replacement of 680 m depreciated trench pipelines (laid in foam concrete) of the water-based heat transportation network by new, pre-insulated pipelines;
- replacement of the existing expansion compensators (gland compensators) of the water-based heat transportation network by new lens compensators (66 units);
- upgrading of a section of the steam main South - from the Belorussia Square to the Railway Bridge (replacement of the pipelines laid inside an unpassable channel, by new ones laid above the ground);
- installing a frequency regulator at the HPP - for the operation of the winter networking pump at variable speed. Since the beginning of 2002, the district heating company has commissioned into operation a new networking circulation pump. The new pump is driven by a 380 V electric motor with a possibility for frequency control.

Part of the industrial consumers of steam with hot water as heat carrier, declined the service. Under these conditions, the use and maintenance of the section of the steam transportation pipeline network, as envisaged in the rehabilitation project, turned out to be inefficient, so in the summer of 1999 that section was disconnected from the system and was deleted from the project scope. That circumstance entailed the update of the preliminary study. In March 2001, a project was developed for replacement of four expansion compensators in the water-based heat transportation network by new lens compensators.

The significant changes in the peak heat load and heat consumption during the recent years have imposed the need of changes in the characteristics of the heat transportation network. Adjustment of the supplied quantity of heat is effected by controlling the heat discharge rate. In order to reduce electricity consumption for transportation of the heat carrier, in 1998 the DH company had initiated undercutting of the pump wheel blades.

Since the beginning of 2002, the company has commissioned into regular operation a new networking circulation pump. The optimized performance characteristics of the network, at the background of the reduced heat load, allowed operation of the pump at 260 kW capacity, which was by about 100 kW less than the operating parameters of the main winter circulation pump after the undercutting of the blades. The electric motor of the new pump, fed by 380 V, creates pre-conditions for application of frequency control.

The main obstacle to the application of frequency control of the winter circulation pump was the technological requirement that such control should be applied after completion of the reconstruction of the existing indirect substations and replacement of the direct ones. The technical pre-condition for the application of frequency control, was the availability of only indirect substations equipped with a regulating valve for the maintaining of a pressure difference between the supply and return main of the primary carrier. The technical obstacle, provoked by the supply of the winter circulation pump rated for medium voltage of 6 kV, instead of 380 V low voltage, was removed at the end of 2001.

Investment package "Substations"

- replacement of 64 direct substations by modern automated indirect substations;
- introducing automatic control systems in the rest 140 existing indirect substations.
- In the framework of a target credit line from the World Bank, heat meters for measurement of the substations' heat consumption were delivered in 1998.
- Investment package "Buildings"
- fitting of heat allocators for all end users in the residential sector;
- fitting of thermostatic valves at the radiators in the flats.

By the end of 2002, in the course of processing the preliminary results, a serious decrease was identified in the number of connected subscribers. A question emerged: whether and to what extent the application of measures in heat distribution and heat end use was effective, under the existing configuration of the generation capacities of the HPP and its current operation cycle. The opportunities for attraction of new subscribers had to be evaluated - to take into account the emergence of a gas distribution company and its activity, as well as the commitments undertaken with respect to implementation of the Directive 2001/80/EC of the European Union. All these circumstances required the conducting of a new study over the district heating company in 2003, in order to try to design an optimized technological scheme and operation cycle of the district heating system.

3.4 Project results

Replacement of heat transportation network and compensators with the aim to diminish the losses of primary heat carrier.

As a consequence from the implementation of the repair programs in the heat transportation network and the replacement of the compensators a reduction of more than 2.5 times of the losses of heat carrier in the water-based heat transportation network has been achieved. The losses in transportation for the Household District Heating Division have diminished in absolute figures by 2.8 GWh/year, however in terms of proportion they show a relative increase from 16.6% in 1996 to 23.1% in 2002.

Table 3: Losses in heat transportation

Indicator	Unit	1996	1998	1999	2000	2001	2002
Losses of heat carrier	m^3/year	55536	57070	43582	33101	22264	20877
Heat losses due to heat carrier losses	GWh/year	3.6	3.7	2.8	2.2	1.4	1.4
Heat output total-hot water	GWh/year	80.9	64.5	61.2	53.7	52.5	46.0
Losses in transportation	GWh/year	13.4	11.3	11.2	10.0	10.6	10.6
Losses in heat transportation as a share of the heat output total	%	16.6	17.5	18.3	18.7	20.2	23.1

New networking circulation pump was commissioned into regular operation at the end of 2001.

The electricity savings for the year 2002 as a result of this change were estimated at 388 MWh. Despite the so far achieved electricity savings, the full potential of the measure may be realized only upon the comprehensive reconstruction and equipment with control systems of all the existing indirect substations and the replacement of all direct substations.

Modernization of substations through application of precision control depending on the meteorological conditions and the occupants' behavior

12 indirect substations were reconstructed, which comprised installation of control and monitoring devices. 9 direct substations were replaced by new indirect ones, equipped with devices for automatic control. The effect of this replacement, in terms of avoided loss of primary heat carrier, is estimated at 225 m^3/year or approximately 14.6 MWh/year.

The dynamics of the heated space during the first year had a strong influence on the effect of the energy conservation measures, while during the second year a stable trend of maintaining of the rate of savings had been observed in the reconstructed and replaced substations. The aggregate savings of these substations, placed under identical climatic conditions, amounted to 419 MWh for a period of two years or an average of 23.3 MWh/year for one substation. These savings have been achieved at the end users as a result from the measures applied in the buildings and substations alone. The theoretical extrapolation of this result with respect to all the 160 substations in residential buildings in Gabrovo under the same assumptions would produce annual savings to the amount of 3 728 MWh. The applying of an amendment of 20% transportation losses and 40% losses during the combustion at the heat source (on the average), leads to savings in fuel equivalent at the inlet of the combustion device, rated at 6 263 MWh/year.

Environmental benefits from the point of view of climate change

The long-term monitoring of the operating results of the Household District Heating Division in Gabrovo by the end of 2002 shows that the achieved heat savings in comparison with the baseline 1996 amount to 10% for 1999, 15% for 2002, 14% for 2001 and 15% for 2002, which makes a total of (cumulative for a period of 4 years) 37.9 GWh of heat, 388 MWh of electricity, or, as a value, more than USD 1482 thousand. This comparison was performed with a due account of the set of influencing factors, for which the necessary correction was made – dynamics in the connected heated space, meteorological factors, including the length of the heating season, efficiency of the system of heat generation, transportation and distribution. The effect expressed in terms of avoided GHG emissions (cumulative for four years) amounts to 14 887 t CO_2 equivalent or a mean average of 3 719 t/year.

Table 4: Summarized project results

Results	Unit	Project estimate	Dec. 2002 1)
Annual savings	USD/year	367 400	370 543
Energy savings	heat MWh/year electricity MWh/year	24 300 748.2	9457 388.8 2)
Project life cycle	years	15	
Payback period	years	4.1	1.16
Investments total	USD thousand	1 519	431.9 3)
Host-party financing	USD thousand	304	229.8
Emissions reduction:			
SO_2	t/year	148	63.8
NO_x	t/year	29	10.9
CO_2	t/year	9797	3510.9
CO	t/year	2.7	1.02
Dust	t/year	9.6	3.8
CH_4	kg/year	1030	400
N_2O	kg/year	1895	645
NMVOC	kg/year	1030	400
CO_2 equivalent	t/year	10 406	3719
Price per 1 t avoided CO_2 equivalent for the project life cycle	USD/t CO_2 equivalent.	9.7	7.7

1) As compared to 1996 as a baseline
2) Electricity savings were realized only in 2002.
3) The investments were accounted only until September 2003, while the technical and economic results of the company refer to the period ending 31 December 2002.

3.5 Problems not solved yet

The drop of consumption in the residential sector is above all the result of the drastic self-imposed restrictions of consumers and the significant number of subscribers, who have resigned from the services of the company for inability to pay their bills for space heating. This has a negative impact on both the volume of sales of Toplofikatsiya Gabrovo and the production cost of generated heat. On the other hand, this reflects on the quality of the service, since in many cases a compromise has to be made with the norm requirements for indoor temperature. The effect is very negative when the disconnected heated volume in the framework of one substation exceeds 40%. This leads to higher bills for the rest of the subscribers in the building and generates public discontent.

The results from the operation of the district heating company during the recent years demonstrate a drop in the heat production output to the amount of four times the 1996 figure. As far as heat sales by the Household District Heating Division are concerned, the drop is twofold. The peak load for end users of domestic hot water has dropped by 6.6 MW. A significant change has been noted also in the structure of heat sales – in 1996 heat for the water-based heat transportation network accounted for 45% of the sales, while in 2002 it accounted for as much as 86%. The forced by the current circumstances operation cycle for heat consumption above all for the needs of district heating limits the opportunities for electricity generation under the co-generation method, which would have allowed improvement of the efficiency of production and reduction of the production cost of heat.

Due to these grave changes in the volume and structure of the heat load Toplofikatsiya Gabrovo operates inefficiently, at high loss, and therefore is supposed to possess potential for improvement of its economic parameters and reduction of emissions. Preservation of the volume of heat production output was an important condition for curtailing of the trend towards constant increase of indirect costs in the production costs per unit of energy output. Under the current minimum load for steam consumers and the negligible probability for its increase in the coming years, it is necessary to review the energy balance of the plant and to identify opportunities for changes in the configuration of the equipment and the plant's operation cycle. The current operation cycle is inefficient from both energy and economic point of view, it leads to high production cost of heat and high level of emissions. The opportunities for winning back resigned consumers and the eventual attraction of new ones border above all to the ability to produce heat at a competitive price.

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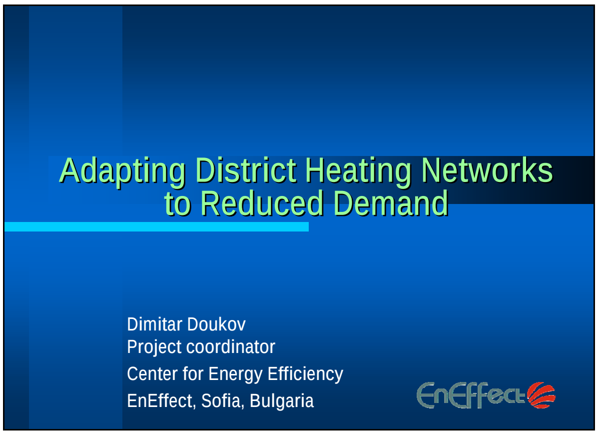
Study on opportunities for reconstruction of the district heating system in the city of Gabrovo, Energy Institute JsC, developed for the Center for Energy Efficiency EnEffect under Contract No. EE 03-07/10.4.2003, Sofia, July 2003

Decision No 582 of 23 August 2000 of the Council of Ministers on approval of the Strategy for Development of District Heating in the Period 2000-2005 and a Plan of Action for restructuring of district heating companies and setting up of a Working Group on implementation of the Plan of Action (Unpromulgated)



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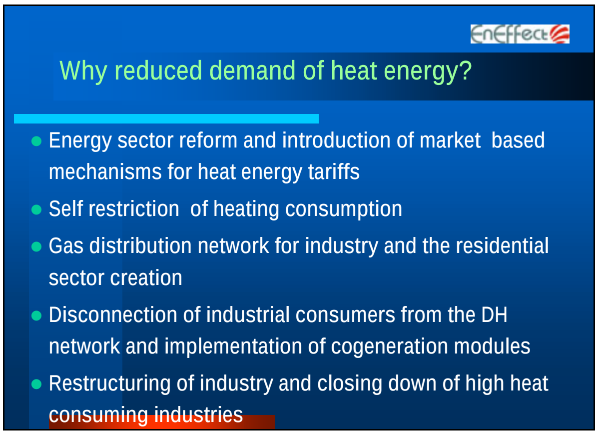

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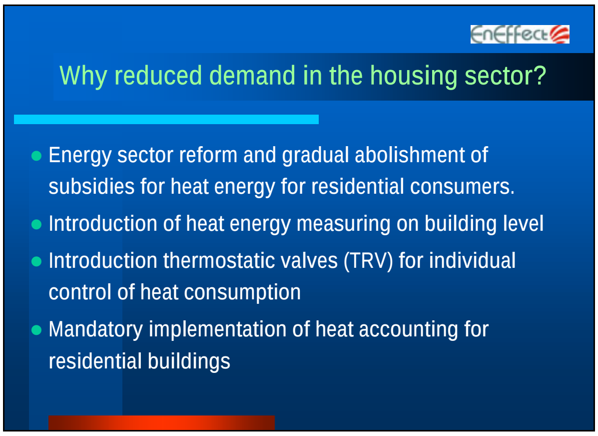

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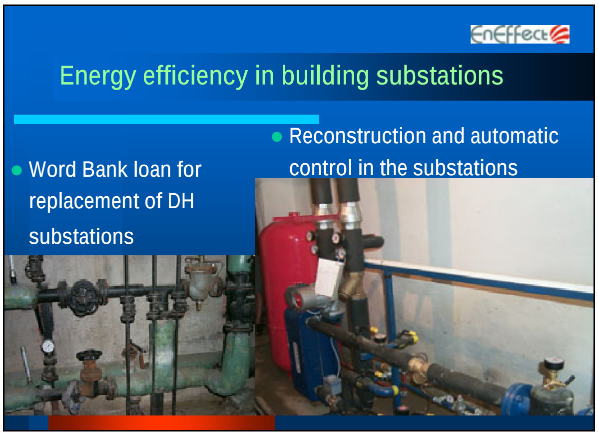

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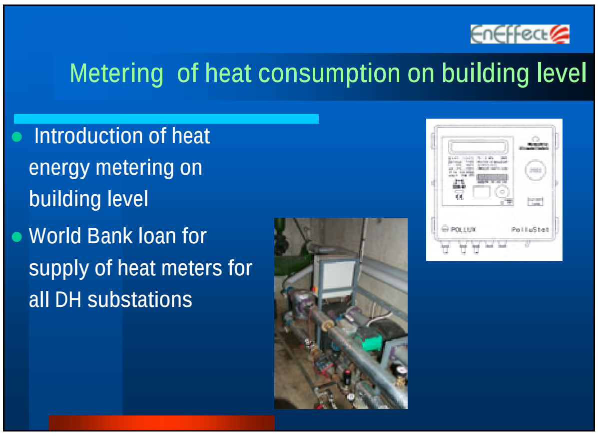

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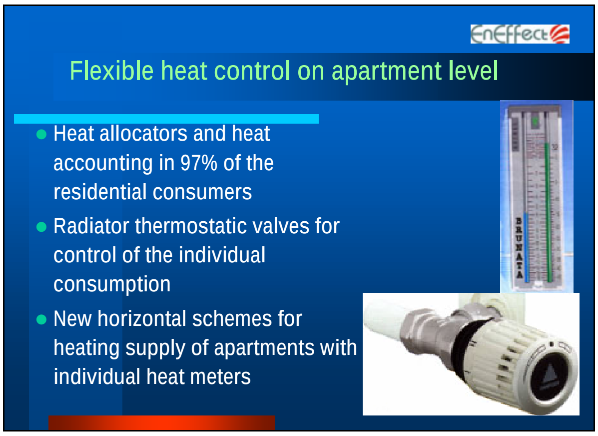

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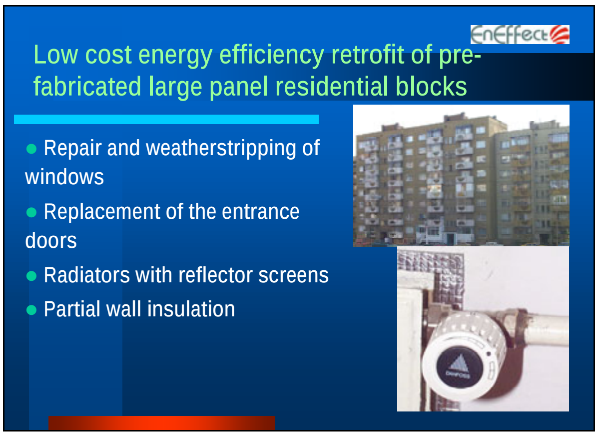

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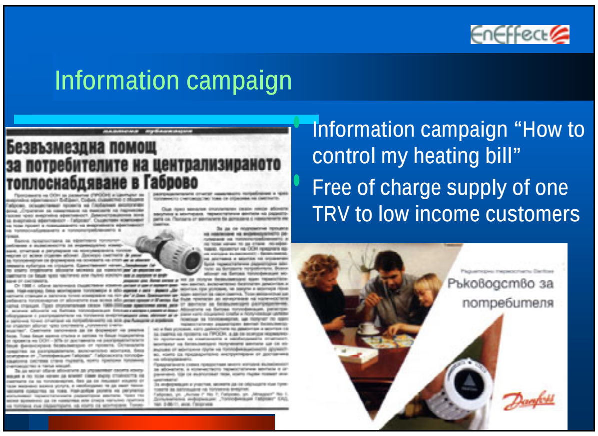

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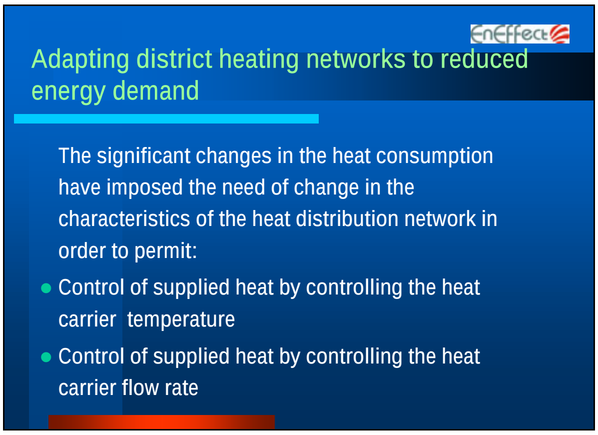

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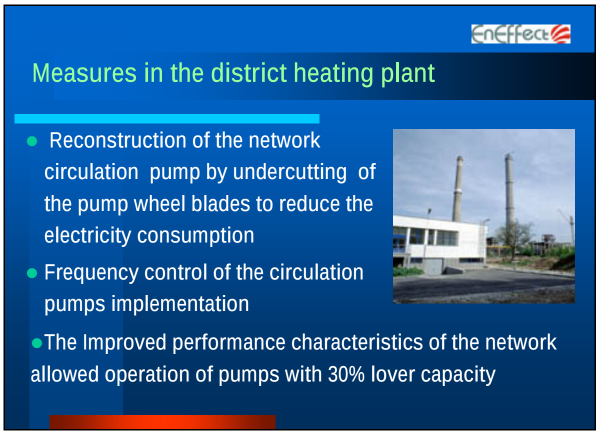

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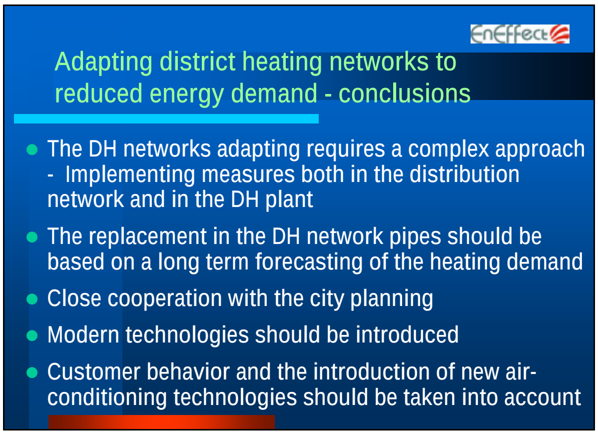

Slide 13

Slide 14

Information Technology for Climate Protection: A Dialogue-based Campaign

Dr. Johannes D. Hengstenberg

CO2online gGmbH, Berlin

Dialogue based Campaign

To motivate tenants, house owners and small businesses to protect the climate by saving energy and money, their individual situation needs to be addressed: Their specific building and its heating energy consumption is at the centre of the dialogue, instead of general (one-way) messages on energy conservation. Most cost-effective are structured online-dialogues, but to reach entire population they must be combined by phone-hotlines and written expertises for people without internet.

Tools: Online Advisers & written Heating Expertises

Written Heating Expertises (12 pages incl. addresses of local energy consultants and builders) can be ordered by readers of the "Heating Survey" flyer who conclude from its tables that their building's energy consumption or costs are above the average of their area. The 6 Online Advisers

1. rate a given building's heating energy consumption and costs, [1]
2. compare heating systems for new buildings by total costs and CO_2,
3. check heating and circulation pumps, [2]
4. estimate payoff from modernization over 20 years, including subsidies,
5. show locally available subsidy programs,
6. show successfully modernized buildings. [3]

Results: Evaluation of Tools

Over 500 partner websites present our online advisors, each with the partner's logo and colors, i.e. "co-branded". 2/3 of all advisor usage comes through them. Total usage is over 500,000 in 18 months (7/2004-12/2005), over 50,000 per month currently (11/2005). Counted are only users who reach a first result! 25% of users of the online modernization adviser confirm in an evaluation that they were to invest in major home improvement measures, on average 55,000 Euro per project (incl. multi-family houses), generating local employment for builders and avoiding 7 tons CO_2 per year.

Perspective: Ideas for Cooperation

Online Advisors can be adapted to other countries' regulatory, economic, and climatic conditions and translated into their languages. That is more cost-effective than developing everything anew because the initial development cost has been paid by the German taxpayer.

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[1] Heating http://heizcheck.sec2-server.de/index.php?portal_id=europa_en

[2] Pumps http://pumpenrat.sec2-server.de/index.php?portal_id=co2online_en

[3] Best Practice http://www.co2online.de/bestpracticearchiv.0.html

Information Technology for Climate Protection – a dialogue based Campaign

CTI Leipzig, October 2005
Dr. Johannes D. Hengstenberg
co2online gGmbH, Berlin

Slide 1

Agenda

Agenda

1. Introduction: Campaign's Approach and Task
2. Tools: Online Advisers
3. Results: Monitoring and Emission Reduction
4. Perspective: Ideas for Cooperation

Information Technology for Climate Protection

Slide 2

Intro

Approach

Aim: Reduction in CO_2 emissions from housing

Central approach: Dialogue on climate protection through energy saving, using

- Online Advisers,
- municipal heating surveys,
- portal partners from business, media, and politics.

The projects of the campaign motivate private households and small businesses to save money and energy, protecting the climate.

Side effect: creating a persistent network and cooperation between government, industry, tenants, and houseowners.

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Slide 3

Intro

Philosophy

The problem

- 120 mill. t CO_2 emission p.a. from residential buildings with no or little tendency to decline
- 36 mill. actors (house owners and tenants) with no or little knowledge about their energy consumption level and saving potentials
- 300,000 contractors and tradesmen with no or little marketing expertise and power

The task

- significantly more modernisation of buildings to comply with Kyoto goals

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Slide 4

Intro

Philosophy

The solution

- goal-oriented methods for the reduction of CO_2 emissions
- low-budget and highly-efficient methods and tools
- web-based and dialogue oriented approach

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Slide 5

Intro

Web based + dialogue oriented approach

- accessible for everybody
- useful and easy to understand for experts and laypeople
- adaptable to everybody's business needs and to local conditions (portability)
- creating chains of action:
  from Radio-/TV-broadcasting to
  - media website with Online Advisers to
  - energy consultants to
  - craftsmen/builders

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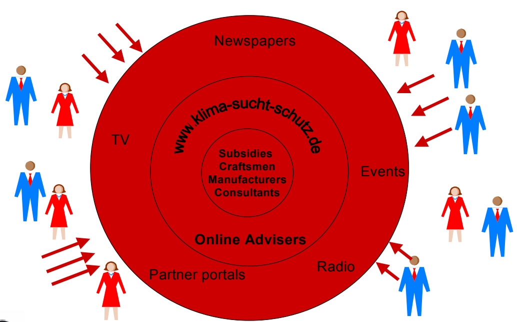
Slide 6

Intro



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Slide 7

Tools

Municipal Heating Surveys

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Slide 8

Tools

Municipal Heating Surveys

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Slide 9

Tools

Energy Saving Online Advisers

All Online Advisers offer quick and specific advice on various aspects of residential heating, energy saving modernisation, and subsidies.

They help home owners and tenants to evaluate their residential energy consumption and to cut costs and CO_2 emissions.

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Slide 10

Tools

Energy Saving Online Advisers

1. Heating Check
2. Heating Systems Check
3. Pump Check
4. Modernisation Check
5. Subsidy Check
6. Good Practice Archive

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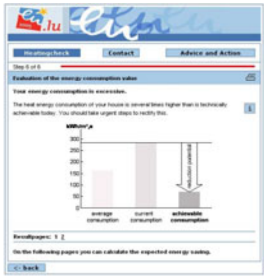
Slide 11

Tools

Heating Check

This benchmarker allows to evaluate one's own energy consumption and costs.

The Heating Check also estimates the energy saving potential and provides contact addresses to implement energy saving measures.



Diagrammed result of a "Heating Check" – Step 6/6

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Slide 12

Tools

Heating Check

Users are lead through six steps. Required inputs are size and age of the building, fuel type and consumption for at least one year, and whether water heating is integrated or separate.

Test the Heating Check in English (use postal code 1234)!

Input mask – Step 1/6

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Slide 13

Tools

Pump Check

Households use two types of pumps: one pumps water through heating pipes to radiators and back, the other circulates the drinking water. Old pumps are often unnecessarily large and inefficient.

The Pump Check shows the energy saving potential of adjusting or replacing pumps. It compares current energy cost with cost estimates for adjusted or new pumps as well as the payback period.

Input mask "Pump Check" – step 1/11

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Slide 14

Tools

Pump Check

The data base contains most pump types used in Europe. The Pump Check is useful for laypeople and for craftsmen.

Test the Pump Check in English (use postal code 1234)!

Input mask "Pump Check" – step 8/11

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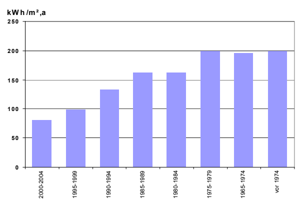
Slide 15

Results

Monitoring: Energy Saving Online Advisers

More than 500 partners have integrated the Online Advisers into their own websites.

These tools give useful and costfree advice to home owners and tenants. At the same time they provide valuable data to politics for CO_2 emissions and energy consumption monitoring in buildings.



Energy consumption of residential buildings and year of construction

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Slide 16

Results

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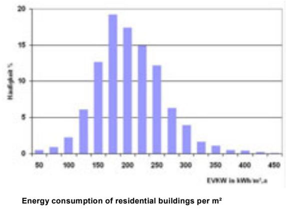

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Slide 17

Results

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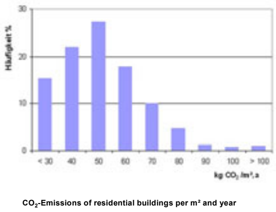

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Slide 18

Results

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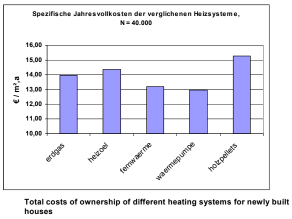

Total costs of ownership of different heating systems for newly built houses

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Slide 19

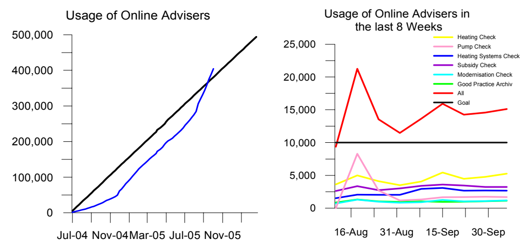
Results

Co-operation Partners

Slide 20

Results

Reporting: Usage of Online Advisers



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Slide 21

Results

Costs and Savings

- 416,000 online consultations since July 2004
- if successful, one consultation generates EUR 55,000 (USD 63,255) of turnover for tradesmen and helps to avoid 7 t of CO_2 emissions by year
- one consultation costs EUR 3-4 for development of advisers, EUR 1-2 for system and partner administration
- users identified a total of EUR 18 bill. of turnover potential for builders, corresponding to an employment potential of 240,000 men years since the beginning of the campaign in July 2004
- 25 % of our visitors say: „Using the online advisor has increased our motivation to take steps (investment measures) towards energy conservation."

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Slide 22

Cooperation

Perspective: Ideas for Cooperation

Integration of Online Advisers on your web site

- adapt tools to national needs & conditions
- provide local climate data, addresses of consultants & engineers
- translate into national language(s)

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Slide 23

Thank You!

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Berlin, Germany

www.co2online.de

Slide 24