


Energy Recovery from Biodegradable Waste in Grain Processing Industry



ERSCP

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The Institute of Environmental Engineering

Kaunas University of Technology



The Institute of Environmental Engineering (APINI) was established in 1991 as an independent interdisciplinary research institute affiliated with Kaunas University of Technology

Research areas:

- Cleaner production and financing
- Cleaner products
- Environmental management
- Chemicals control
- Preventive waste management
- Environmental systems
- Resource management

The Institute of Environmental Engineering

Kaunas University of Technology

In 1995 APINI together with other Lithuanian universities initiated scientific quarterly journal

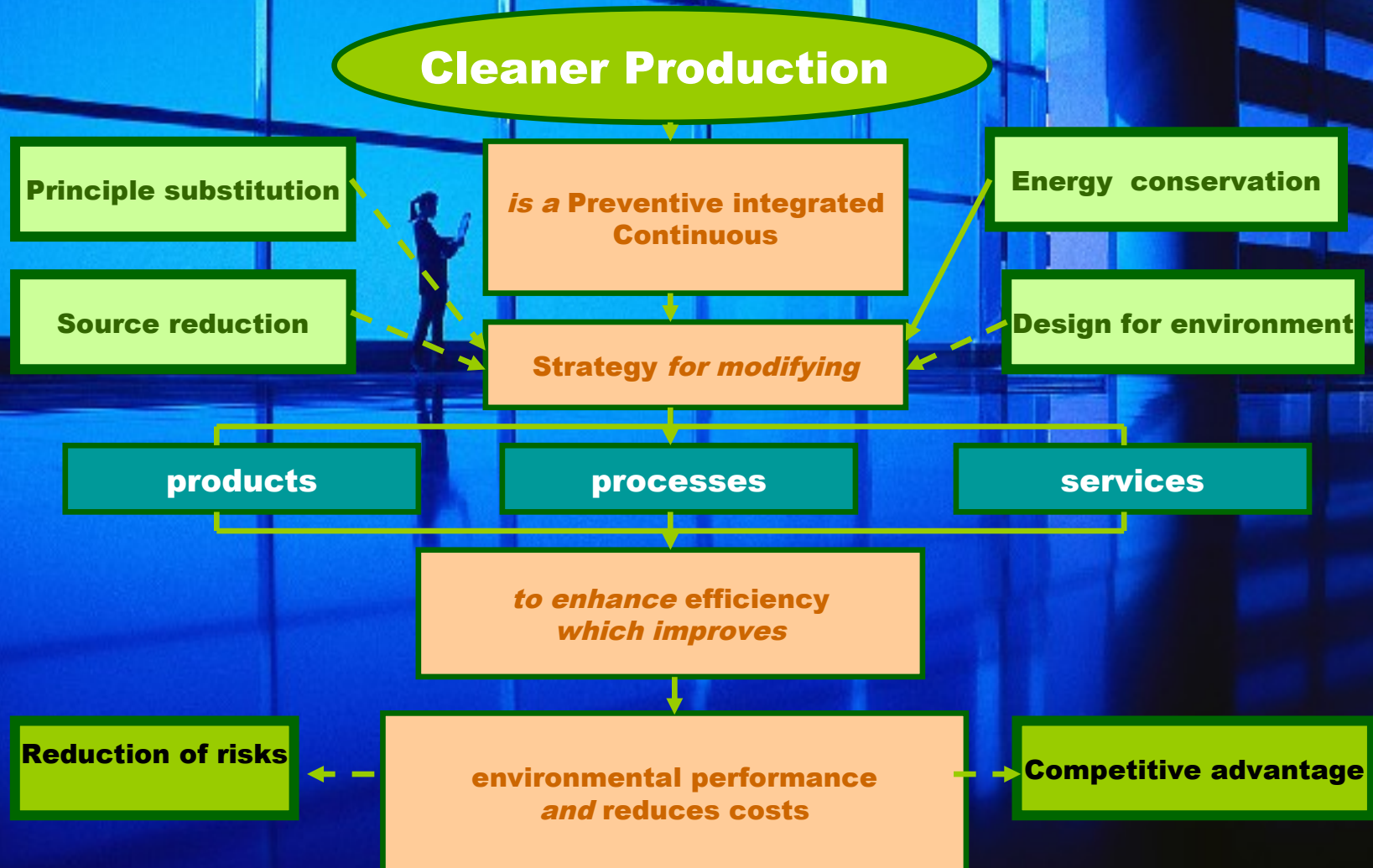
“Environmental Research, Engineering and Management”
in Lithuanian and English languages.

APINI staff :

- actively takes part in international and national conferences
- has published more than 140 publications, including 7 monographs and 9 Ph.D. theses
- is taking part in educational program at the MSc and PhD level

APINI is coordinator of **“MSc programme in Environmental Management and Cleaner Production”** for Baltic Countries.

Cleaner Production Definition

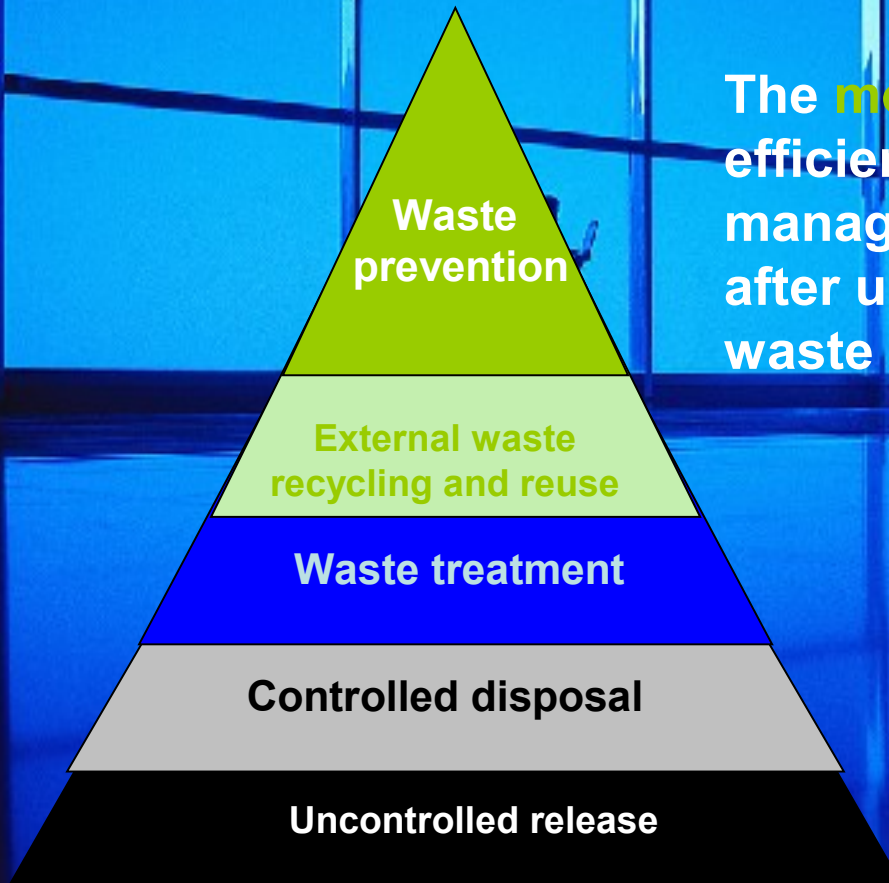


CP definition

Cleaner production means a continuous application of an integrated preventive environmental strategy to processes, products and services to increase overall efficiency. This leads to improved environmental performance, cost savings, and the reduction of risks to humans and the environment.

- ***For production processes***, CP includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and waste before they leave the process.
- ***For products***, CP focuses on reducing impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product.
- ***For services***, using a preventive approach involves design issues, housekeeping improvement, and a better selection of material inputs (in the form of products).

Waste management hierarchy



The **most important tool** for resource efficiency, as well as sustainable waste management, is **waste prevention**. Only after understanding the causes of waste generation we can prevent it

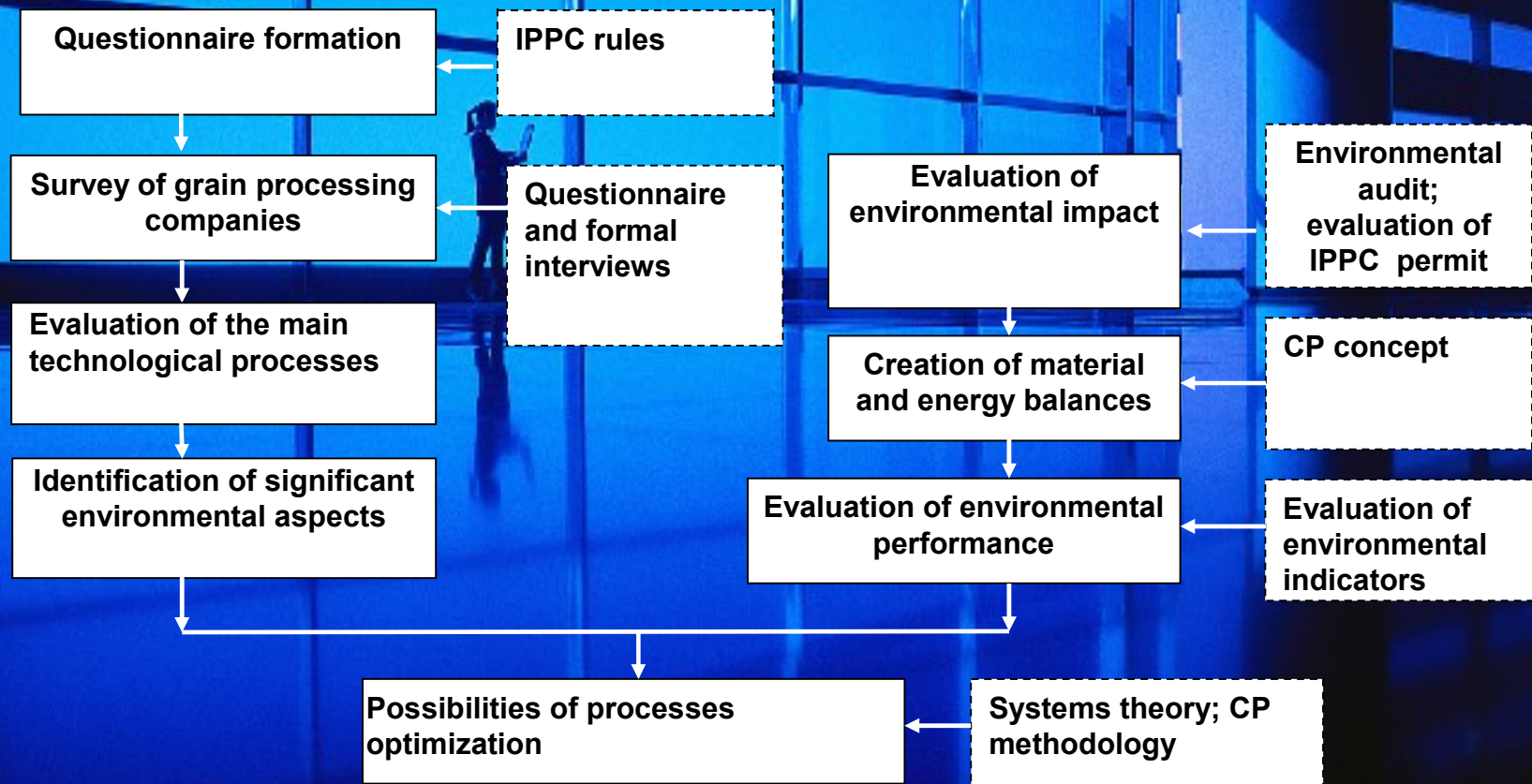
Several strategic documents on preventive waste management, including National Programme on Sustainable Industrial Development have been **developed by APINI experts**

Material and BD Waste Flows in a Selected GP Company

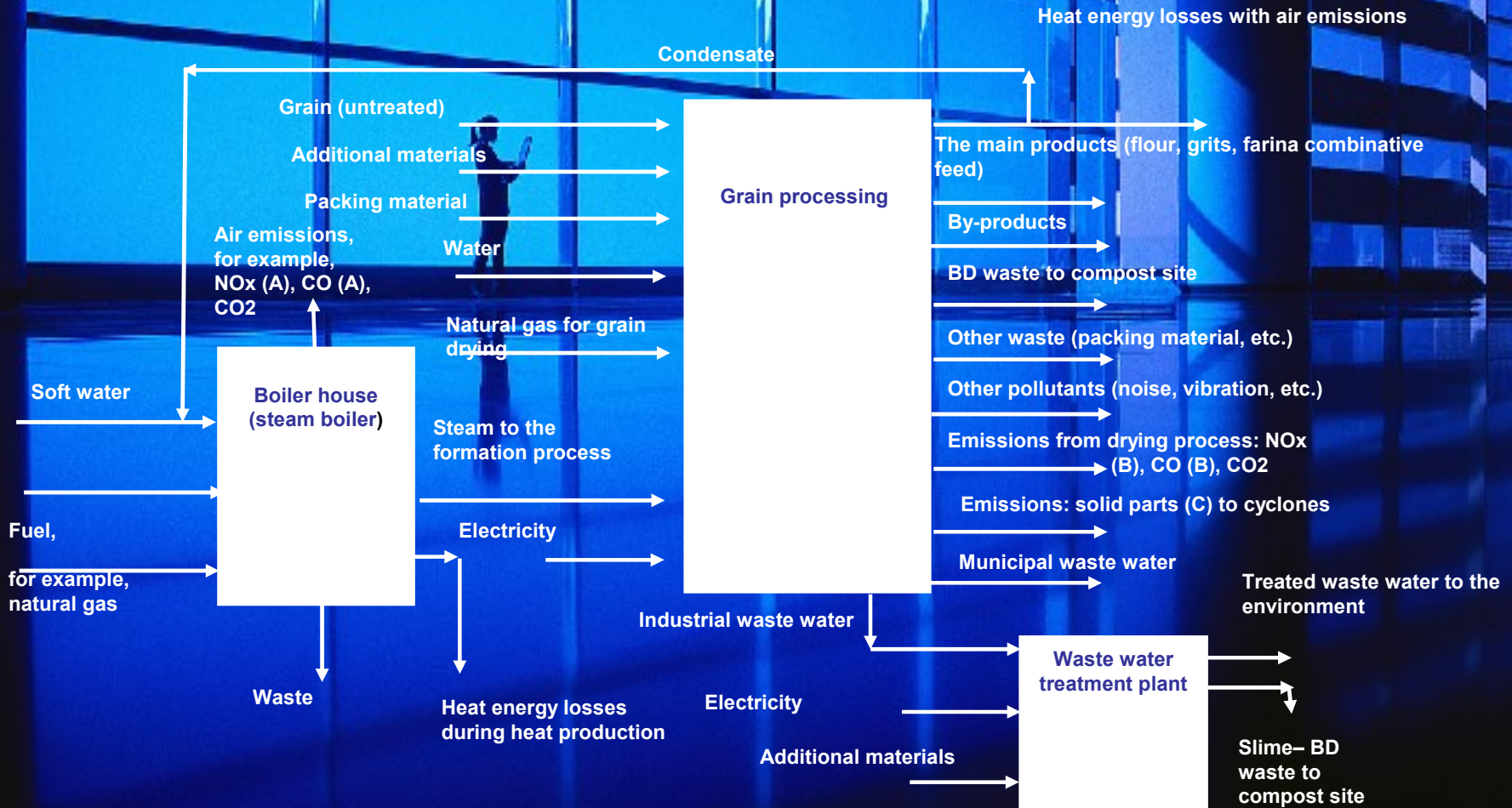
(primary evaluation)

| Inputs and outputs materials of the grain processing processes | 2008 (t/year) |
|---|--------------------------|
| Input materials: | 109770,09 |
| Grain | 62 000 |
| Additional raw materials | 45769,89 |
| Protein raw materials | 2000,2 |
| Output materials: | 108575,00 |
| Manufactured products: | 107796 |
| Highest and first quality flour | 12000 |
| Mixed fodder: | 87000 |
| Protein vitamins and supplements | 2000 |
| Farina | 2500 |
| Bran (by-products with about 70% of nutrient) | 4256 |
| Other products | 40 |
| Waste volume indicated in yearly statistic waste report for 2008 | 779 |
| Difference between inputs and outputs | 1195,09 |

Methodology for the evaluation of environmental aspects and impacts and possibilities to increase environmental efficiency in grain processing company



Flowchart of typical grain processing company



Standardization of produced solid recovered fuel according to the classification system of solid recovered fuels (CEN/TC 343)

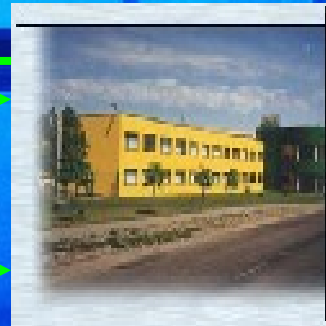
| BD waste of GP company | Conformity to a certain class of recovered fuel in accordance with below presented fuel characteristics | | | |
|---|---|------------------------------|--------------------------------------|--------------------------------------|
| | Net calorific value (ar), MJ/kg | chlorine (Cl) content (d), % | Mercury (Hg) content, mg/MJ (median) | Mercury (Hg) content, mg/MJ (in 80%) |
| Pellets from composite solid BD waste of GP | 4th class (≥ 10) | 1st class ($\leq 0,2$) | 1st class ($\leq 0,02$) | 1st class ($\leq 0,04$) |
| Pellets from bran | 4th class (≥ 10) | 1st class ($\leq 0,2$) | 1st class ($\leq 0,02$) | 1st class ($\leq 0,04$) |

CP financing scheme APINI - NEFCO

**CP PROJECT
DEVELOPMENT**



COMPANY



**CP PROJECT
IMPLEMENTATION**



Environmental benefit

Total environmental benefit

(in absolute value):

- reduction of company's organic waste by 1050 t/year (without bran);
- production of alternative energy (4 562 MWh/year);
- reduction of natural gas consumption by 530 thousand nm³/year;
- direct and indirect reduction of air emissions by 821.667 t/year.

Economic assessment

The energy recovery of BD waste in selected GP company will enable to minimize direct processes' costs **up to 117.12 thousand EUR/year**

Estimated income from recovered fuel sold – **229 670 EUR/year**

Project investment – **347 540 EUR**

Payback period – **1 year.**

Conclusions

1. It was determined that **the generation of biodegradable waste in grain processing** (up to 18.3 kg/t of manufactured production) and large volume of energy consumption (up to 108.3 kWh/t of production) **are currently the most significant environmental aspects of this industry.**
2. The use of biodegradable waste for the production of alternative fuel **would reduce the amount of biodegradable waste up to 8.51 kg/t** of grain processing products in the selected GP company. Consumption of natural gas would **reduce by 62.87%** due to the burning of the part of produced recovered fuel for heat energy production. Combustion products' emissions to the air **will be reduced by 7.17 kg/t** of the manufactured production.
3. Partial substitution of produced recovered fuel for natural gas in grain processing industry **will allow producing up to 35 500 MWh/year of an alternative energy.** Therefore, environmental impact to the atmosphere during heat energy production **will be reduced by 5082 t/year** (including indirect negative effect due to electricity consumption).



Thank YOU!

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