CEDAR Ridge

Technical Environmental Solutions Slovakia s.r.o.

# Cedar Ridge CE and Technical Environmental Solutions Slovakia present Integration of a solid biomass fuelled CHP generator to wood pellet production technologies

# Introduction

- Context
- Requirement / Demand
- Solutions
- Micro-turbine Biomass Generators
- Application to Pellet Production
- Industrial applications in general
- Summary

# Context

- Slovak dependence on external energy:
  - Russian gas crisis in January 2009
- EU Energy Policy / SmartGrids
  - Decentralised alternative energy sources
- Slovak Act 309 of 19 June 2009
  - Promotion of renewable energy sources and high-efficiency cogeneration / URSO regulation
- ENEF 2010 results:
  - Slovak biomass can support production of 4 GW with agriculture and 4 GW with silvaculture

# Requirements

- Alternative energy must be carbon neutral, but also:
  - Efficient in small decentralised facilities
  - Minimise environmental impact
  - Use market-ready solutions
  - Sustainable locally through experience and expertise
  - Meet EU Standards

# Requirements: EU Standards

**For biomass fired generators under 300 kW, standard EN 303-5 applies for most of the member states in Europe, including Slovakia, with some exceptions:**

| Substance monitored | Emission Limit Value up to 300 kW (mg/MJ) | | | |
|---|---|---|---|---|
| | Czech Rep. | Austria | EU | Slovakia |
| Standard | CZ 352/2002 | EN 303-5 Annex A1 | EN 303-5 | EN 303-5 |
| PM | 167,5 | 60,0 | 74,0 | 74,0 |
| VOC/OGC | 33,5 | 40,0 | 39,0 | 39,0 |
| CO | 435,5 | 500,0 | 613,0 | 613,0 |
| NOx | 435,5 | 150,0 | - | - |
| $SO_2$ | 1675,0 | - | - | - |

**Up to 1MW, EU standards vary, but PM +/- 50, VPC/OGC +/- 20, CO +/- 340, NOx +/- 150 (mg/MJ)**

# Demand

- **Simple, economical and efficient biomass generation under 1MW:**
  - **Secure, reliable and cost-effective alternative energy**
  - **Remote power sources**
  - **Adapted to biomass sources**

# Solutions

- **Steam technology is inefficient and expensive below 1 MWe**
- **Existing smaller scale biomass power generation systems are both inefficient and/or unreliable**:
  - **Anaerobic digestion and gas engine**
  - **Gasifier and gas engine**
- **Modular micro-turbine biomass generators are efficient and clusters are secure**

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# BG50

# Micro-turbine Biomass Generators

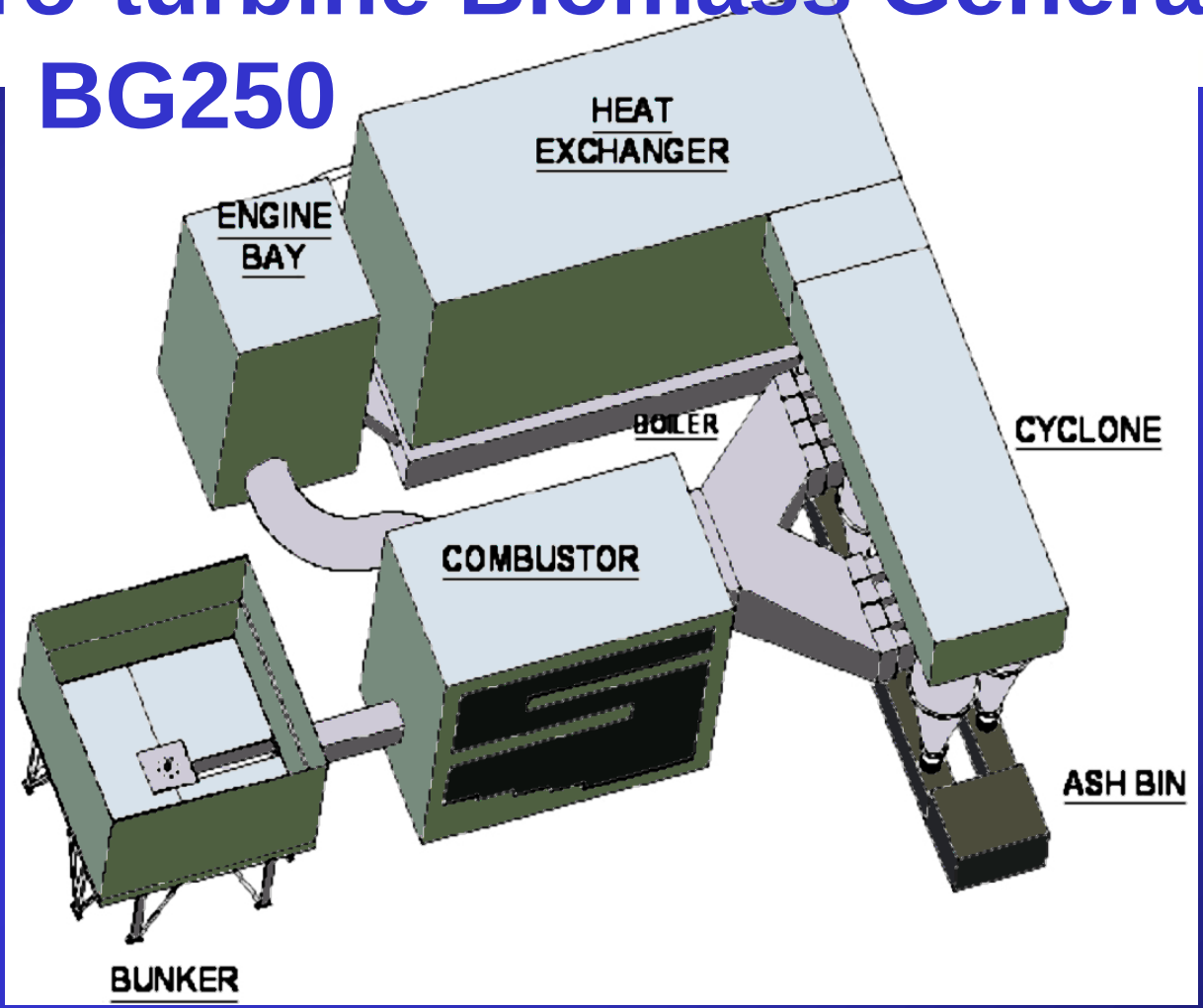
**FUNCTIONAL SCHEME**
**BG Series**
**Biomass Generators**




- Fuel supply
- Combustion
- Flue gas system
- Heating
- Heat-up Fresh Air
- Turbine process
- Power production
- De-Ashing

# Micro-turbine Biomass Generators

## BG250



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# Micro-turbine Biomass Generators

## Emissions monitoring results for BG25 and BG50 units (under 300 kW) conforms to EU standards:

| Substance monitored | BG25-BG50 Monitoring Result | | Conformity |
|---|---|---|---|
| | mg/m$^3$ 11% $O_2$ | mg/MJ* | Pass / Fail |
| PM | 54,7 & 60,4 | 38,6 (average) | Pass |
| VOC/OGC | 4,39 | 2,94 | Pass |
| CO | 204,4 | 137,0 | Pass |
| Formaldehyde** | <0,6 | <0,4 | Not required |
| NOx | Not tested | est. <150,0 | Not required |
| $SO_2$ | Not tested | est. not significant | Not required |

* Conversion from mg/m$^3$ to mg/MJ made according to table in Swiss Federal Environment Office (OFEV) publication G412-1063 of October 19th 2007

** For fuels containing adhesives used in multi-density fibreboard (MDF) and Chipboard

**And technology conforms to EU standards up to 1 MW (BG250)**

# Micro-turbine Biomass Generators

- **Fuel requirement**
  - Size

| EU G50 | % by weight of relevant chip size (mm) | | | | Extreme Values (mm) | |
|---|---|---|---|---|---|---|
| | 20% max | 60 – 100% | 20% max | 4% max | Cross section | Length |
| | >31,5 | 31,5 – 5,6 | 5,6 – 1,0 | <1,0 | 50 | 120 |

  - Non-polluting
  - Non-corrosive
  - Ash content <5%
  - Preferred MC <25% (start-up), maximum 40%

# Micro-turbine Biomass Generators

- Key factors in achieving energy conversion efficiency
  - **High temperature combustor**
  - **Heat exchangers**
  - **Micro turbine generator**
  - **Computer controlled combustion**

# Micro-turbine Biomass Generators

- Key factors in investment cost efficiency
  - **Compact design**
  - **Modular design**
  - **Integration of standard components**
  - **Series manufacturing**

(*Cost per W is foreseen to progressively approach that of large central facilities*)

# Micro-turbine Biomass Generators

- Key factors in operating cost efficiency
  - **Installation local to energy needs, particularly direct heat utilisation**
  - **Flexible fuel types**
  - **Fully automatic computer controls**
  - **Maintainability:**
    - Designed for easy cleaning
    - Low annual cost (+/- 2% of technology investment)
  - **EU energy policy**

# Micro-turbine Biomass Generators

- Reduction in annual carbon emissions
  - **BG25: 212 tonnes (8000 hours)**
  - **BG50: 375 tonnes (8000 hours)**
  - **BG250: 2650 tonnes (8500 hours)**
  - Based on :
    - 0,45kg CO2 produced per kW electricity for fossil fuel fired power station,
    - 0,19kg CO2 produced kW of heat generated by a gas-fired boiler.

# Application to Pellet Production

- Dual BG50 integration to pellet production line and domestic heat:
  - Pellet production line requirement of 180 kWe
    - Direct electrical supply to pellet line
    - Supply to grid when not operating
  - Domestic building heating network uses 95 kWth according to seasonal demand
  - During warm season heat is used the dry pellet production material to improve pellet line efficiency, but no evaluation of cost savings is made

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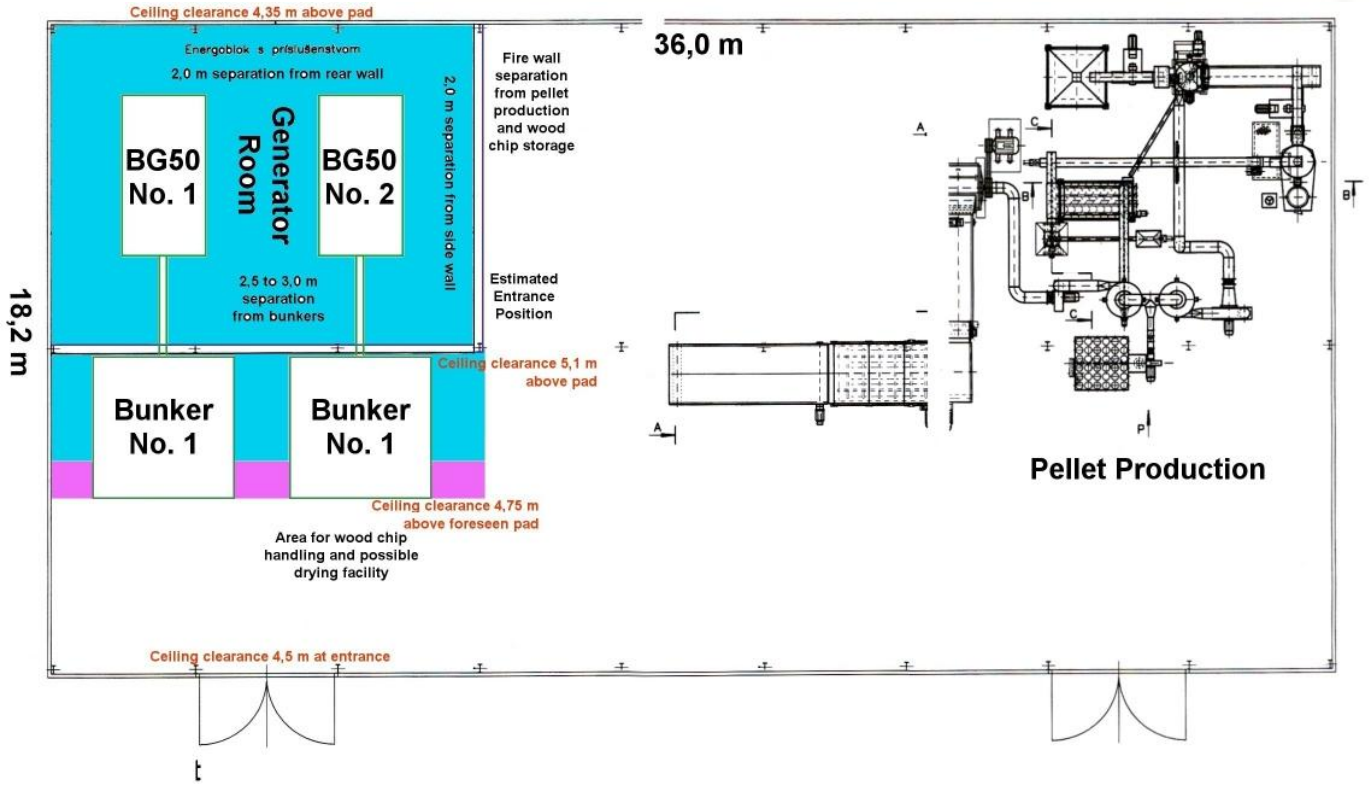
# Application to Pellet Production




| | | | | |
|---|---|---|---|---|
| Zodpov. projektant: T. Pankuch | Vypracoval: T. Pankuch | Kontroloval: | PROAGRO TOMÁŠ PANKUCH Šarišská Poruba 51 | Zákazka číslo: TP 0710 |
| Investor: BIMPEX, s.r.o. Prešov, Budovatelska 63 | | | Formát: 2xA4 | Soda číslo: |
| Obú: Prešov | OU: Prešov | Kraj: Prešovský | Dátum: 11.2010 | |
| Stavba: Zvýšenie kapacity výroby pelet, výstavbou novej peletizačnej linky s modernou technológiou areál firmy Bimpex– Budovatelska 63 | | | Stupeň: Štúdia | |
| | | | Mierka: 1:100 | |
| | | | Časť PD: TECHNOLOGICKÁ | |
| Obsah výkresu: Pôdorys | | | PREVÁDZKOVÉ SÚBORY | Výkres č.: T–3 |

# Application to Pellet Production

# Application to Pellet Production

# Application to Pellet Production

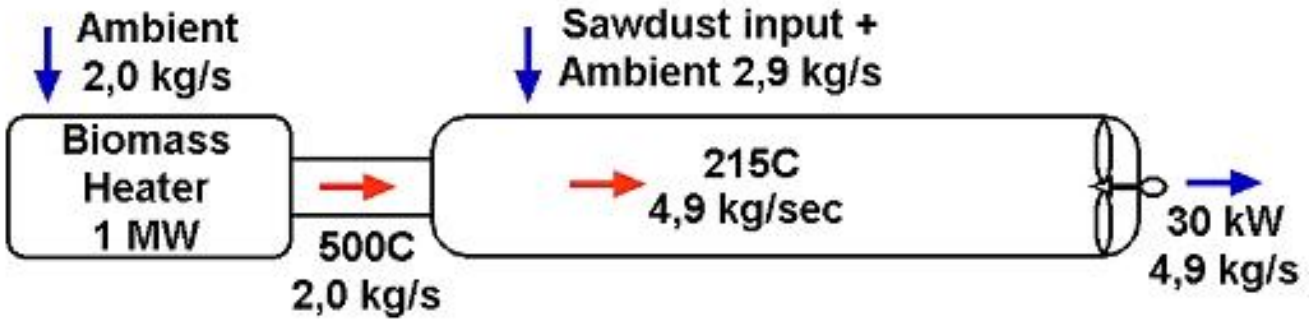
- Dual BG50 Investment and Operating Performance:
  - Installation cost: 1,0 €/W for total CHP energy production (within EU investment project)
  - Input: 2 x 650 tonnes wood chips at <40% m.c. (or equivalent)
  - Output: 2 x 50kWe + 95kWh (>8000 hours/year) (heat recovery foreseen to be increased to 120 kWth)
  - Operating cost:
    - Summer heat used to dry pellet material, but cost incidence is not evaluated
    - Winter heating with 50% heat usage including maintenance, depreciated over 15 years: 0,074 €/kWh

# Application to Pellet Production

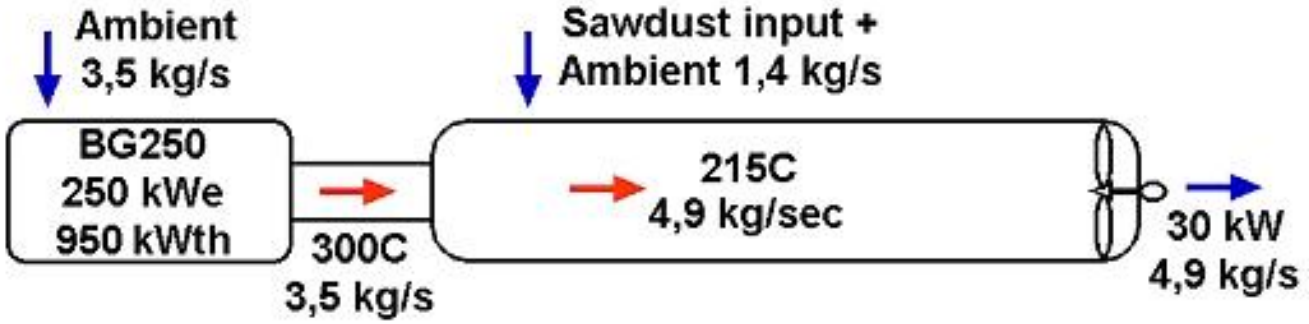
- BG250 Integration to pellet production lines:
  - Fuel is primarily sawdust from wood industry, but also woodchips as required
  - Each BG250 replaces existing 1 MW biomass heat production units
  - Electrical production for each BG250 is foreseen to be directly supplied to grid (250 kWe for 8500 hrs)
  - “Clean” exhaust gases at 300 C are directly used to dry pellet production material

# Application to Pellet Production

Current pellet production technology




Proposed Biomass Generator Solution



# Application to Pellet Production

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  - Fuel is primarily sawdust from wood industry, but also woodchips as required
  - Each BG250 replaces existing 1 MW biomass heat production units
  - Electrical production for each BG250 is foreseen to be directly supplied to grid (250 kWe for 8500 hrs)
  - “Clean” exhaust gases at 300 C are directly used to dry pellet production material
  - Efficiency can exceed 95%

# Industrial applications in general

- Clusters of 4 x BG250 units:
  - Secure energy supply where installation cost: <1,5 €/W
  - Input: 10 000 tonnes wood chips at <40% m.c. (or equivalent)
  - Output: 1MWe and 2 to 4 MWth (8500 hours/year)
  - Operating cost:
    - Industrial application with 100% heat usage including maintenance, depreciated over 15 years: 0,044 €/kWh
    - Winter heating with 50% heat usage including maintenance, depreciated over 15 years: 0,066 €/kWh

# Summary

- Micro-turbine Biomass Generators:
  - Market ready solutions for carbon neutral alternative energy
  - Compact with minimum environmental impact
  - Simple, economical and efficient biomass generation under 1MW
  - Experience and expertise providing standard modular sustainable solution
- Slovak production of biomass generators drawing on significant industry experience