

### Blue Bird – Concomitant generation of energy and chemicals from biomass waste streams

TKI-BBE project TEBE15001

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**Aim: To create an integrated and energy-efficient technology for gasification of biomass wastes**

```

    graph LR
      Biomass --> Gasification
      subgraph AvailableTechnologies [Available technologies]
        FuelFlexible[Fuel flexible]
      end
      Gasification --- FuelFlexible
      subgraph DropIn [Drop-in: fits existing processes and industry]
      end
      Gasification --- DropIn
      Gasification --> GasUpgrading[Gas upgrading]
      GasUpgrading --> Products[Ethylene, benzene  
Energy (bio-SNG)  
Optionally: bio-syn gas]
      subgraph VariousBiomass [Various biomass (humins & lignin)]
      end
      Gasification --- VariousBiomass
      subgraph Separation [Separation methods to produce valuable chemicals]
      end
      Gasification --- Separation
      subgraph Synergetic [Synergetic production of bio-energy and bio-based chemicals serves as accelerator]
      end
      Gasification --- Synergetic
  
```

### Blue Bird builds on “Green Birds”

- Humins gasification
- BTX removal
- Ethylene removal

- **BTX:**
  - Liquid BTX product: first liter in 2014
  - >95% separation
  - B/T/X = 90/9/1
  - Simplifies downstream process to SNG

### Challenges from previous work

- Feeding humins
- Continuous operation of the BTX scrubber
- Effect of water on ethylene removal
- Cyclic operation of the ethylene absorbent
- Long term stability of the system
- Steering the BTX yield via ethylene conversion

### Approach

```

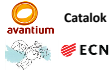
    graph LR
      Biomass --> PreTreatment[Pre-treatment]
      PreTreatment --> Lignin
      PreTreatment --> Humins
      Lignin --> Gasification
      Humins --> Gasification
      Gasification --> Separation
      Separation --> FinalConversion[Final conversion]
      FinalConversion --> MeOH[MeOH]
      FinalConversion --> Diesel[Diesel]
      FinalConversion --> SNG[SNG]
      FinalConversion --> HeatPower[Heat Power]
      Separation --> Converter[Converter]
      Converter --> Ethylene
      Separation --> Benzene
  
```

WP1 – Project management and reporting (ECN)  
 WP2 – Humins and lignins production and modification (Avantium)  
 WP3 – Integrated gasifier unit for gas clean-up, BTX production and Ethylene capture (ECN, Avantium, Catalog)  
 WP4 – Humins/Lignins for gasification to BTX and Ethylene (Avantium, ECN)  
 WP5 – Conceptual process design study and LCA (Kodak, Avantium, Catalog, ECN)

### Results

- Create an outlet for the waste of the 2nd generation YXY process of Avantium (humins)
- Create valuable by-products from gasification
  1. BTX absorption technology (ECN)
  2. Ethylene absorption technology (Avantium)
  3. Catalytic conversion of ethylene (Catalog/ECN)
  4. Process design, LCA, market introduction roadmap

Thank you for your attention!



ECN 800 kW<sub>th</sub>  
MILENA gasifier



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