- NextGenBioWaste -

Project objectives and overview

Picture: Courtesy of ASM, Brescia, Italy

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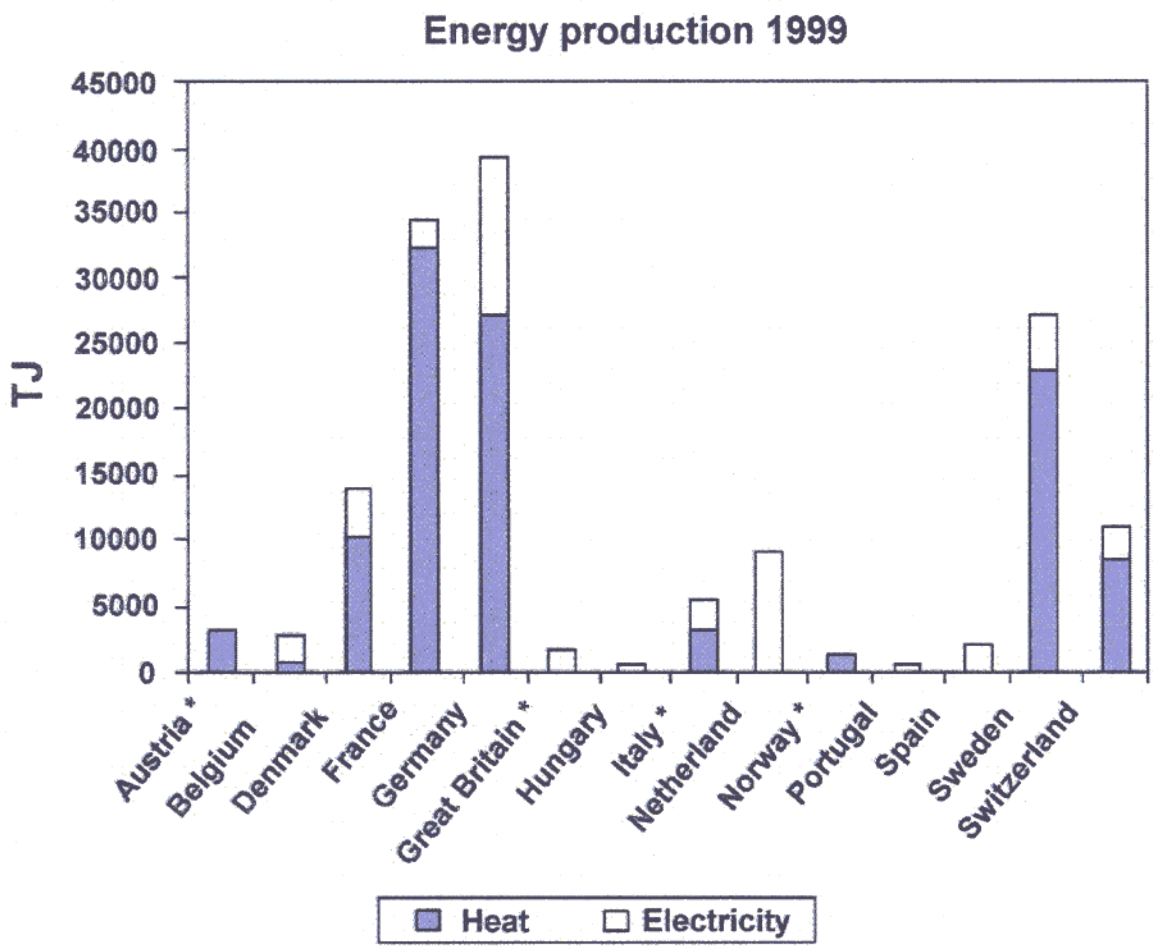
NextGenBioWaste in the ”big picture”

- Reducing greenhouse gases and pollutant emissions (Kyoto)
- Increasing the security of supply by increasing the share of renewable energy production from biomass and waste
- Enhancing the competitiveness of European industry (Capitalising from European research)
- Improving quality of life both within the EU and globally (Johannesburg follow-up)
- International collaboration
- Contributions to standards

Energy from MSW combustion in Europe



Estimated Investment Costs/Benefits by Sector

TYPE OF ENERGY	ADDITIONAL CAPACITY 1997-2010	UNIT COST 1997 ECU	UNIT COST 2010 ECU	AVERAGE UNIT COST ECU	TOTAL INVESTMENT 1997-2010 billion ECU	ADDITIONAL ANNUAL BUSINESS 2010 billion ECU	BENEFIT OF ANNUAL AVOIDED FUEL COSTS 2010 billion ECU	TOTAL BENEFIT OF AVOIDED FUEL COSTS 1997-2010 billion ECU	CO_2 REDUCTION milliom tn/year IN 2010
1. Wind	36 GW	1,000/KW	700/KW	800/KW	28.8	4	1.43	10	72
2. Hydro	13 GW	1,200/KW	1,000/KW	1,100/KW	14.3	2	0.91	6.4	48
3. Photovoltaics	3 GWp	5,000/KWp	2,500/KWp	3,000/KWp	9	1.5	0.06	0.4	3
4. Biomass	90Mtoe				84	24.1	-	-	255
5.Geothermal (+ heat pumps)	2.5 GW	2,500/KW	1,500/KW	2,000/KW	5	0.5	-	-	5
6.Solar Collectors	94 Mio m^2	400/m^2	200/m^2	250/m^2	24	4.5	0.6	4.2	19
Total for EU market					165.1	36.6	3	21	402

Source: Energy for the future: Renewable sources of energy, COM(97)599 final (26/11/1997)

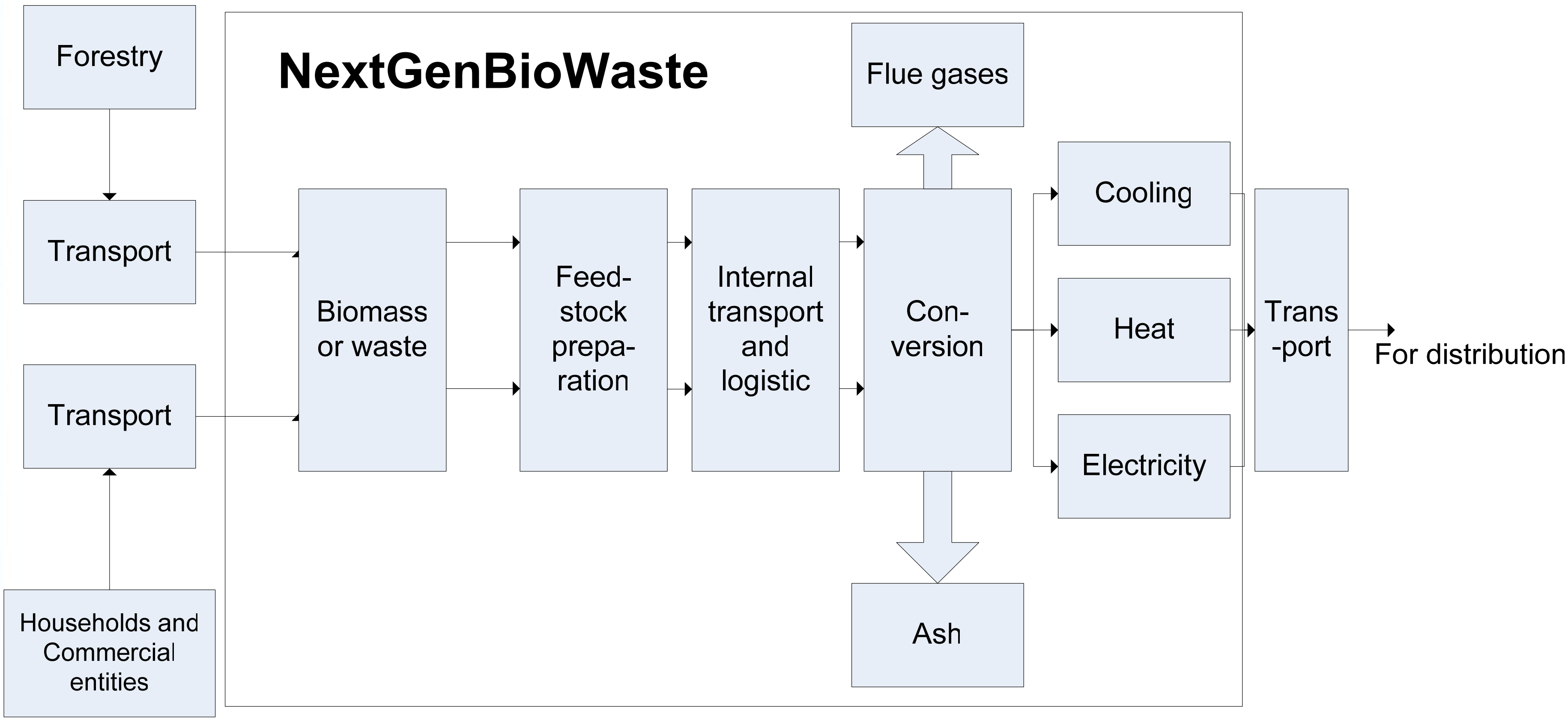
State-of–the-art

- Challenging fuels
  - High chlorine/sulphur ratio
  - High content of alkali metals
  - High content of heavy metals (waste)
  - The use of additives is not commercially proven
  - High fuel costs (biomass)
  - High ash content (waste)

State-of–the-art

- Conversion technology
  - Low electrical efficieny
  - Severe corrosion and fouling
  - High maintenance cost
  - Co-combustion of waste wood up to 50%
- Residue management
  - Poor utilisation of residues in general
  - Leaching of heavy metals and other pollutants

Scope of NextGenBioWaste



The objective

The objective of NextGenBioWaste is to demonstrate innovative ways of improving the energy conversion and renewable electricity production using municipal solid waste materials and biomass for large-scale supply of renewable electricity and heating/cooling to end-users - at a more competitive cost and improved environmental parameters.

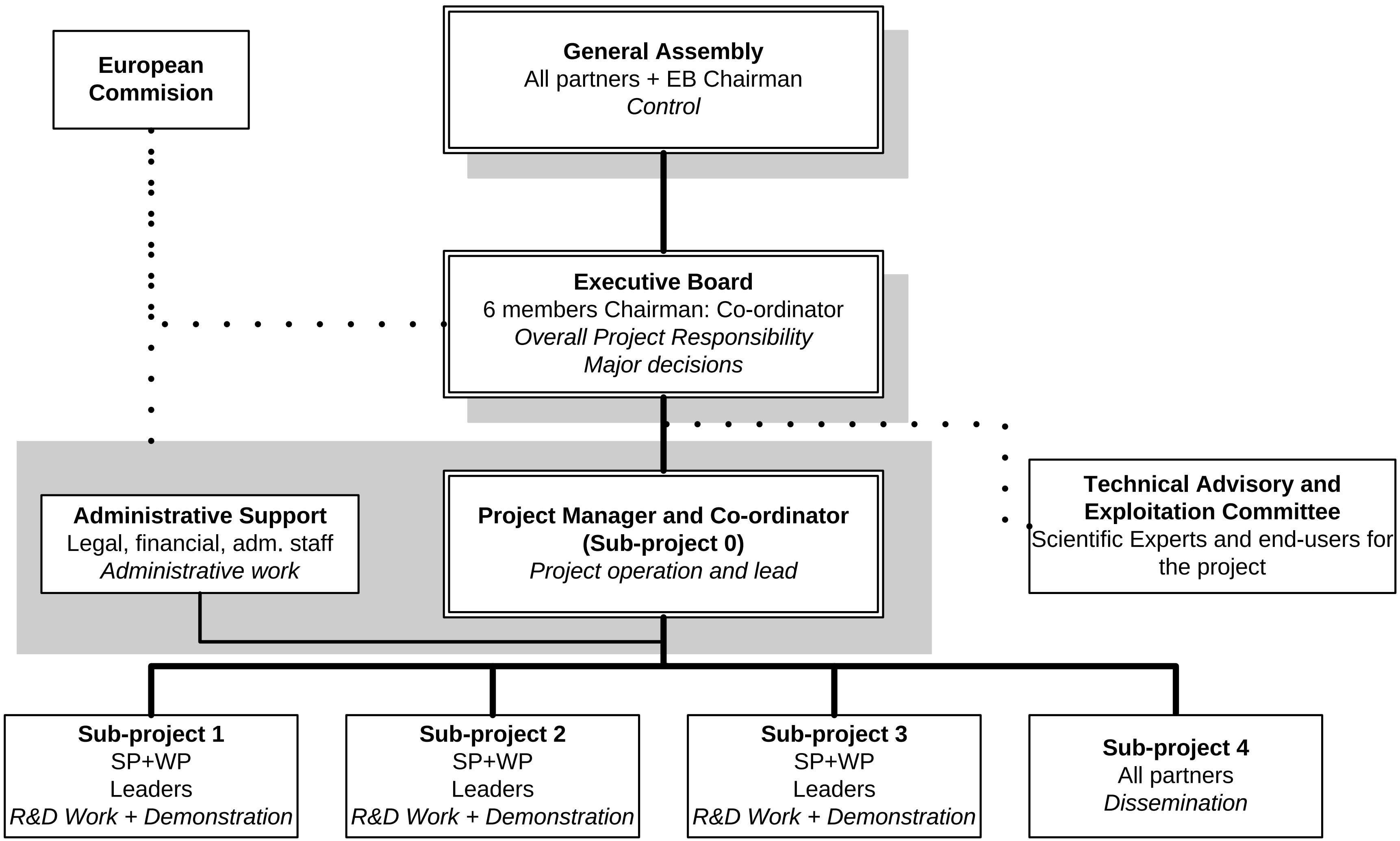
Targets

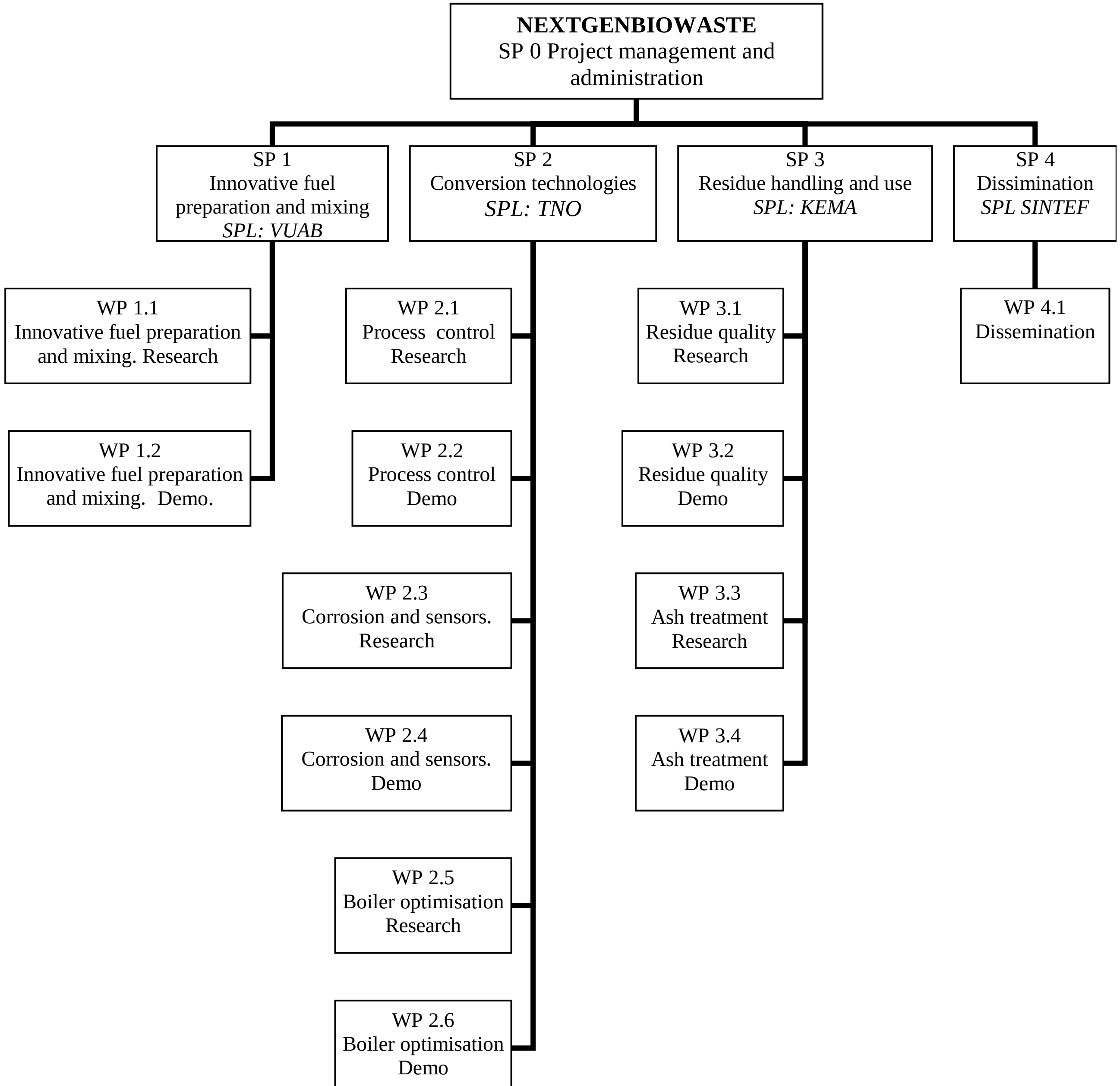
1. Increase the electric efficiency for waste to energy plants from 22% to 30% (gross generated).
2. Double the lifetime of heat exchanger components at existing steam temperatures
3. Increase the electric efficiency for biomass combustion plants from 33% to 35%, while making the systems more cost-effective by the use of more low-grade fuels
4. Lower the fuel cost at least 1 mill.€/year for a 100 MW_{th} biomass combustion plant while maintain the two former sub targets (2 and 3).
5. Enable technologies for upgrading of bottom ash, thus, enabling the utility companies to valorise from 70% of their bottom ashes for civil engineering purposes

Technology advancement

- A full-scale demonstration of a retrofit fluidised bed bottom design for combustion of 100% of waste wood fuel in a 100 MWth biomass boiler
- Large-scale demonstration of advanced control systems enabling plant operators to obtain more stable conditions and improved electrical efficiency
- Large-scale tests of advanced boiler materials and cladding of superheater surfaces to reduce maintenance costs
- Large-scale demonstration of advanced combustion techniques using low excess air enabling more compact and cost-effective systems with higher electrical efficiency
- Full-scale demonstration of high-dust selective catalytic reduction (SCR) of NOx for improved electrical efficiency and environmental performance
- Full-scale demonstrations on the use of additives in order to reduce operation costs because of decreased fouling and to reduce maintenance costs via an increased lifetime
- Demonstration of novel design and retrofitting of boilers for improved efficiency
- Full-scale demonstration of artificial aging of bottom ashes for improved leaching properties giving added value products

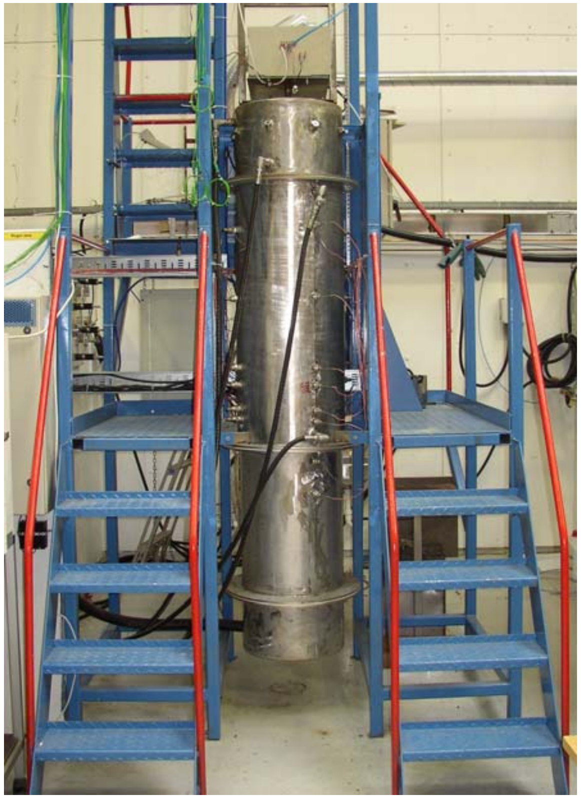
Project management




NEXTGENBIOWASTE
SP 0 Project management and administration
SP 1
Innovative fuel preparation and mixing
SPL: VUAB
SP 2
Conversion technologies
SPL: TNO
SP 3
Residue handling and use
SPL: KEMA
SP 4
Dissimination
SPL SINTEF
WP 1.1
Innovative fuel preparation and mixing. Research
WP 1.2
Innovative fuel preparation and mixing. Demo.
WP 2.1
Process control Research
WP 2.2
Process control Demo
WP 2.3
Corrosion and sensors. Research
WP 2.4
Corrosion and sensors. Demo
WP 2.5
Boiler optimisation Research
WP 2.6
Boiler optimisation Demo
WP 3.1
Residue quality Research
WP 3.2
Residue quality Demo
WP 3.3
Ash treatment Research
WP 3.4
Ash treatment Demo
WP 4.1
Dissemination

Progress report - SINTEF

WP 1.1 – Innovative fuel preparation and mixing - Research



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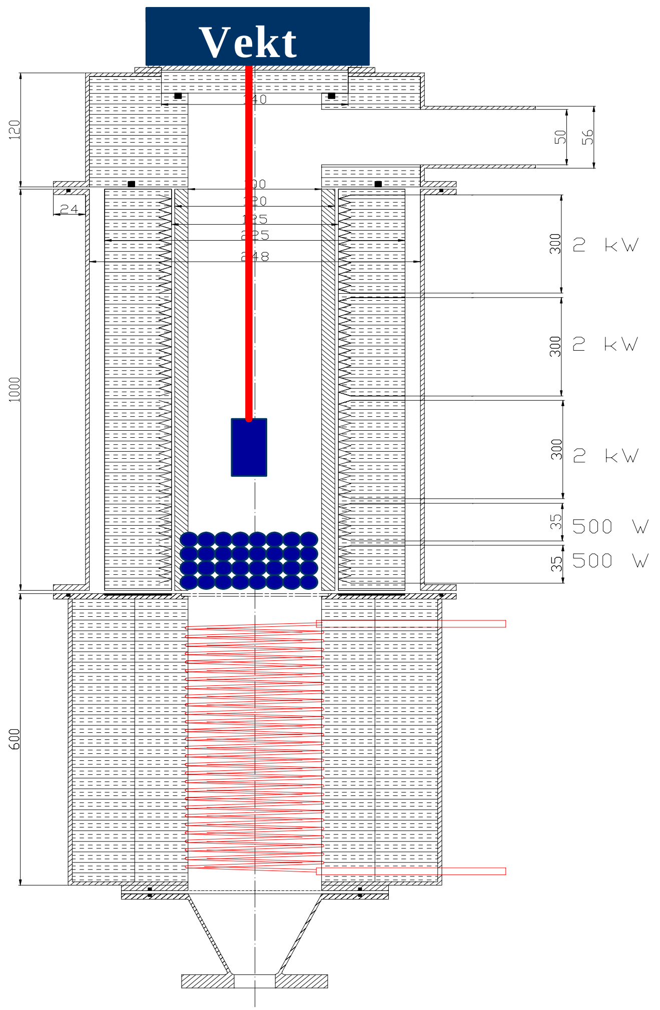
SINTEF Energy Research

Partner no. 1

Objectives of WP 1.1

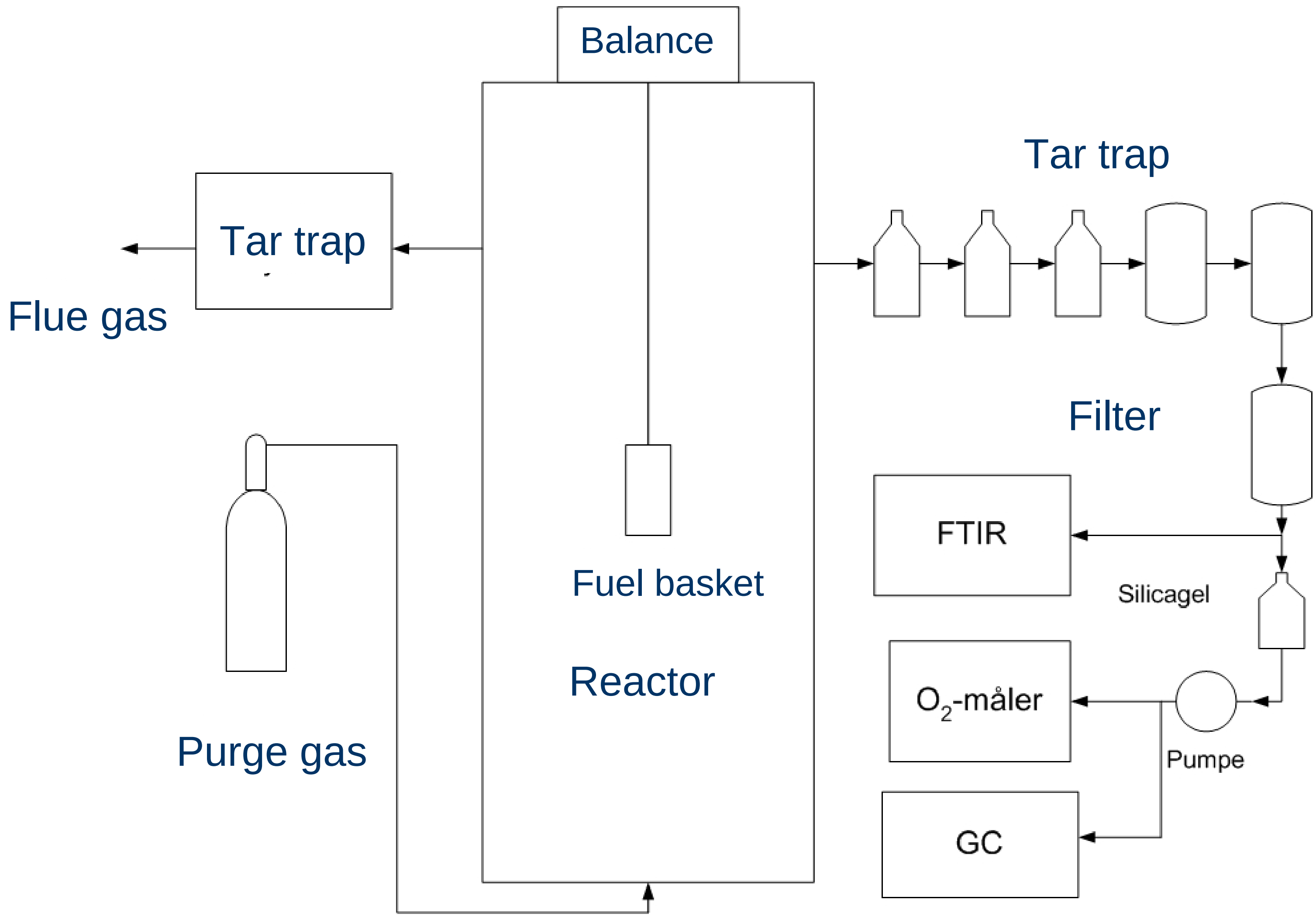
1. To study the importance of feedstock quality, preparation and mixing on flue gases and residues
2. To provide a basis for selecting fuels to be tested in large scale demonstration tests
3. To study previously published data on the effect of fuel additives and select additives for demonstration tests in boilers

The current multifuel reactor



- 5 independent heating elements within the reactor. Possible to control the vertical temperature profile
- Ceramic tube inside to prevent catalytic reactions. Length of reactor chamber: 1 m, diameter 100 mm.
- Max. temperature 900ºC
- Max. heatingrate 15ºC/min
- 4 flowcontrollers control the purge gas flow and composition

Current experimental set-up



Challenges and changes

- Providing conditions as close as possible to a large scale system
  - Comparison of different fuels under the same conditions
  - Batch feeding
    - Not realistic compared to continously operating reactors
  - Fixed bed or fluidised bed?
  - Sampling of fly ashes
    - Cooling/heating of flue gas line
    - Filter or cyclone?
    - Cut off size?
    - Particle size distribution

Rebuilding the multifuel reactor

Flue gas and ash measurements

- Gas analysis FTIR:
  - SO_2, HCl, NO, NO_2, N_2O, CO, NH_3, HF, H_2O, CO_2, HCN
- Gas analysis GC:
  - CH_4, C_2H_4 + C_2H_2, C_2H_6, H_2, O_2, N_2, CO, CO_2
- Ash analysis
  - Heavy metals: Cd, Hg, Pb, Cr, Cu, Mn, Ni, As, Ti, Sb, Co, V, Sn, Zn
  - Alkali metals: K, P, Na, Si,…

Hot filter

- Design with a flexible sampling temperature
- Flue gas temperatures ranging from 150 to 500^{o}C

Thank You For Your Attention!