Overcoming Technical Barriers Related to Biomass Co-combustion in Large-Scale Power Plants

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BIO-ENERGY
ENLARGED PERSPECTIVES

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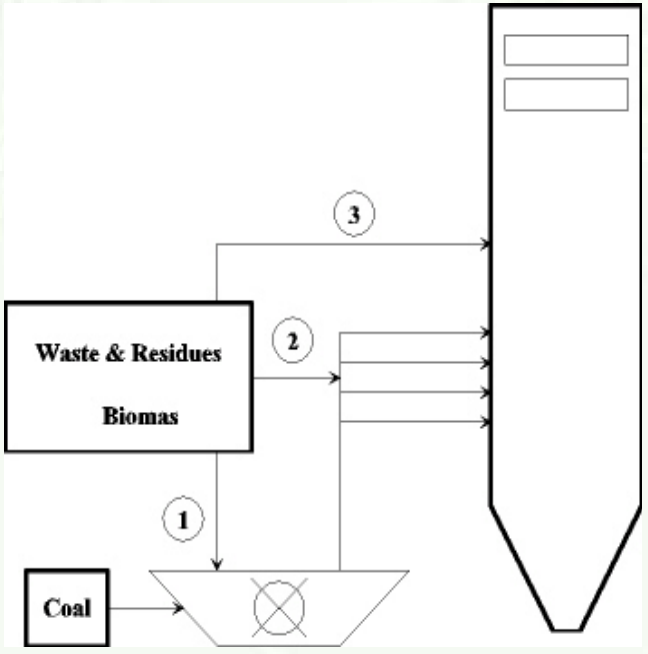
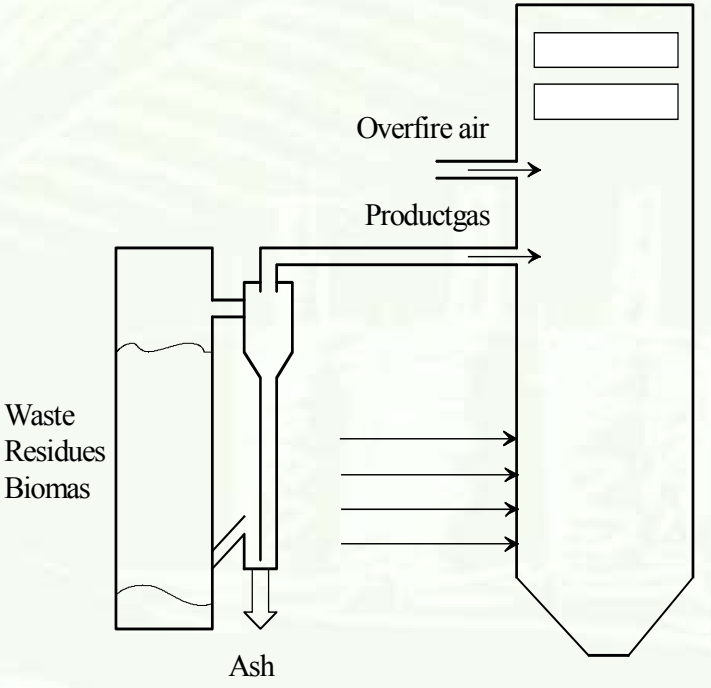
Why Biomass Co-Combustion?

- Large, already existing capacities
- Comparable low investment costs
- High (electric) efficiency, low emissions
- Low operational effects at low biomass shares
- Seasonal fluctuations of biomass can be minimised
- Substitution of coal for CO_2 reduction

Co-Combustion Techniques



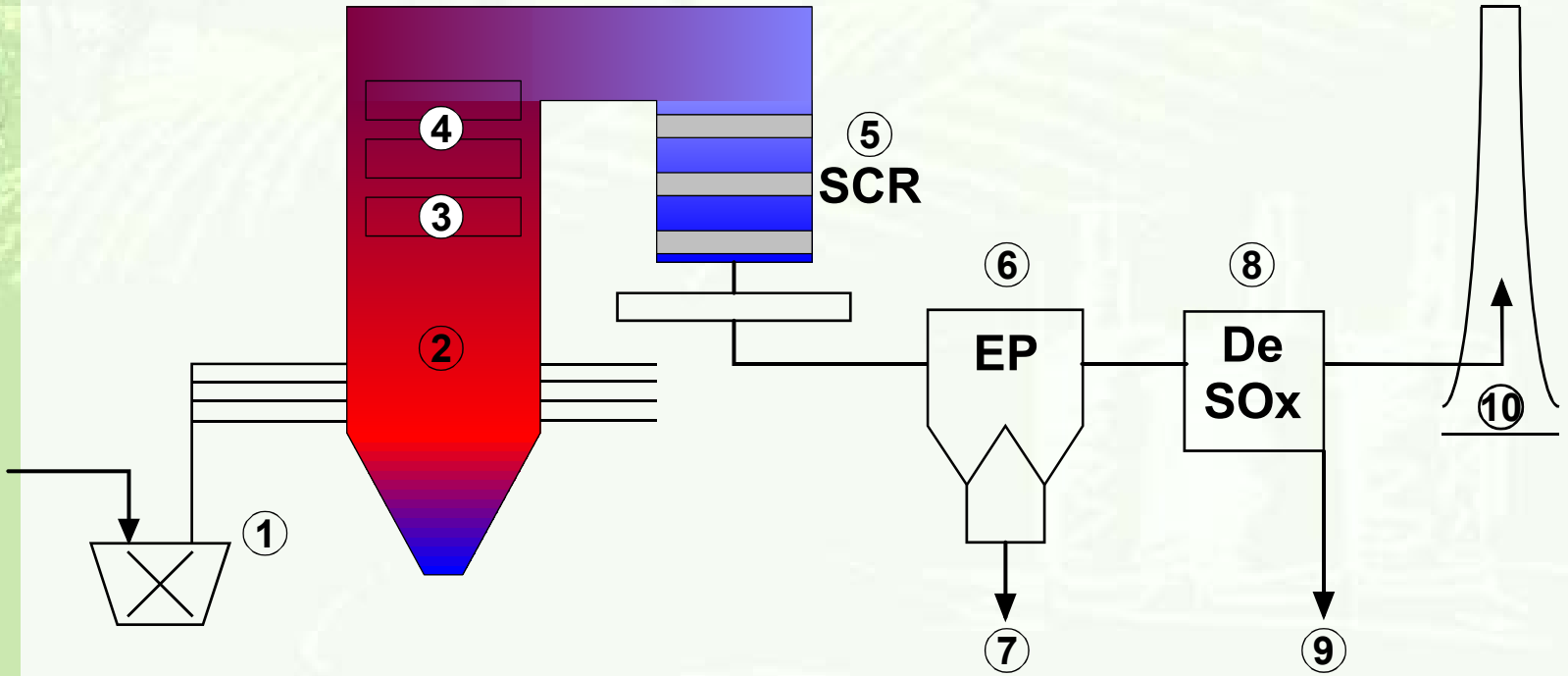


Direct co-combustion

Indirect Co-Combustion

- Pyrolysis
- Gasification
- Pre-Combustion

Areas of Concern



1 milling system: capacity, wear
2 furnace: slagging
3 super heater: corrosion
4 convective heat exchanger: fouling, erosion
5 DeNOx: deactivation, capacity, erosion
6 precipitator: capacity
7 ash: utilisation
8 DeSOx: capacity
9 DeSOx-residues: utilisaton
10 flue gas: emissions

Previous EC-Projects @ IVD

- Co-Utilisation of Coal, Biomass and Waste
  APAS, 1993 - 1994
- Operational Problems, Trace Emissions and By-Product Management of Industrial Biomass Co-Combustion
  OPTEB, 01.01.1996 - 31.12.1998
- Prediction of ash and deposit formation for biomass co-combustion
  DEPOSIT PREDICTION, 01.07.1998 - 30.06.2000
- Slagging and Fouling Prediction by Dynamic Boiler Modelling
  SLAGMOD, 01.06.2000 - 31.05.2002
- Quality of Secondary Fuels for Pulverised Fuel Combustion
  SEFCO, 01.08.2000 - 31.07.2002
- Utilisation of Residues from Biomass Co-Combustion
  UCOR, 01.10.2000 - 30.09.2003

Conclusions

- Biomass preparation and co-firing with coal technically feasible
- Limited operational problems at lower shares of biomass (< 10 $\%_{th}$)
- Effects of biomass constituents on
  - by-product quality (UCOR)
  - air pollution control devices (CATDEACT)
  - emissions of toxic metals (TOMERED)

  are not completely understood
- Co-utilisation of bio-wastes and refuse-derived-fuels (RDF) not investigated

Reduction of Toxic Metals (ToMe) from Industrial Combustion Plants - Impact of Emission Control Technologies

TOMERED

ENK5 - CT2002 - 699

01/01/2003 - 31/12/2005

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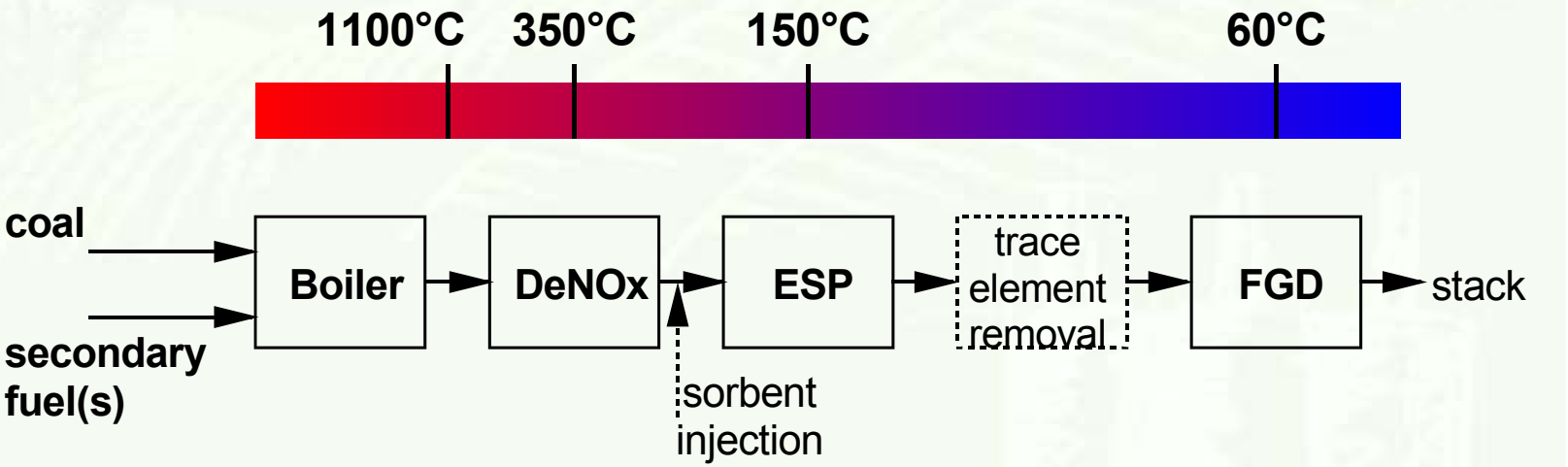
Definitions

Toxic Metals (ToMe):

3 groups according to EC-Directive 2000/76/EC

1. Hg (main focus of project)
2. Cd, Ti
3. Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V

Field of Interest



Background

- EU-Directive 2000/76/EC: "On the incineration of waste"
  - Gaseous emissions, trace elements (Hg, Cd, Pb) and particulates

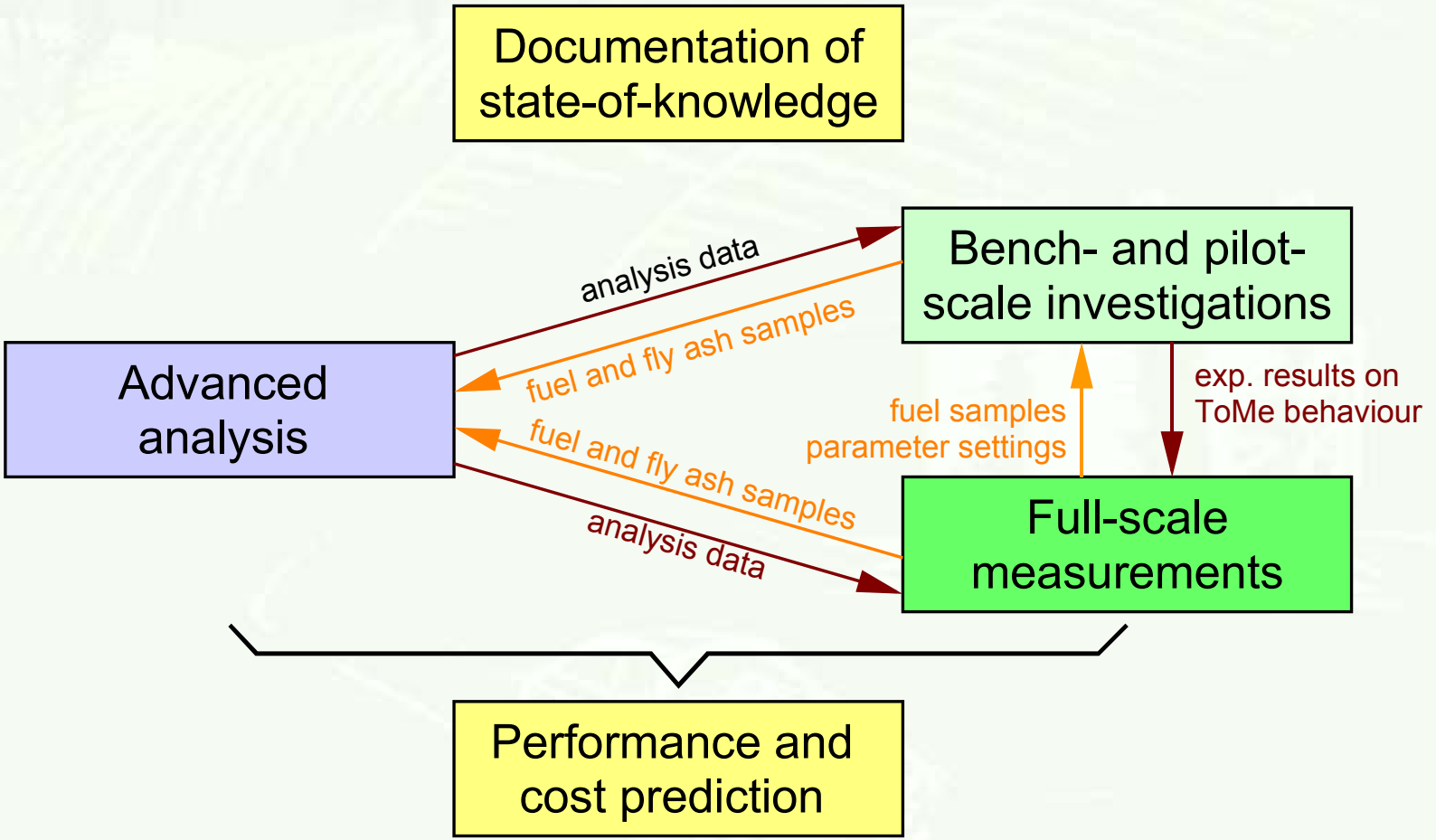
  => Incinerators, cement kilns and co-combustion in coal boilers
- EU-Directive 2001/80/EC: "On the limitation of Emissions of Certain Pollutants into the Air from Large Combustion Plants"
  - NOx, SOx and particulate, concerns about heavy metal emissions
- UN-ECE: "Convention on Long-Range Transboundary Air pollution"
  - 8 protocols on NOx, VOCs, SOx, heavy metals, ...
- upcoming US regulation and limits
  - NOx, SOx and Hg

  => adoption of emission limits in 2003/2004

Project Partners

1 Universität Stuttgart, IVD (co-ordinator)
2 Technical University of Denmark
3 Energy Research Centre the Netherlands
4 E.ON Engineering GmbH
5 Abo Akademi University
6 Reaction Engineering
7 Mitsui Babcock Energy Ltd.
8 Technische Universiteit Delft
9 PowerGen UK Plc
10 Imperial College
11 University of Nottingham
12 KEMA Nederland B.V.
13 ENEL Produzione S.p.A.
14 University of Alicante
15 Helsinki University of Technology

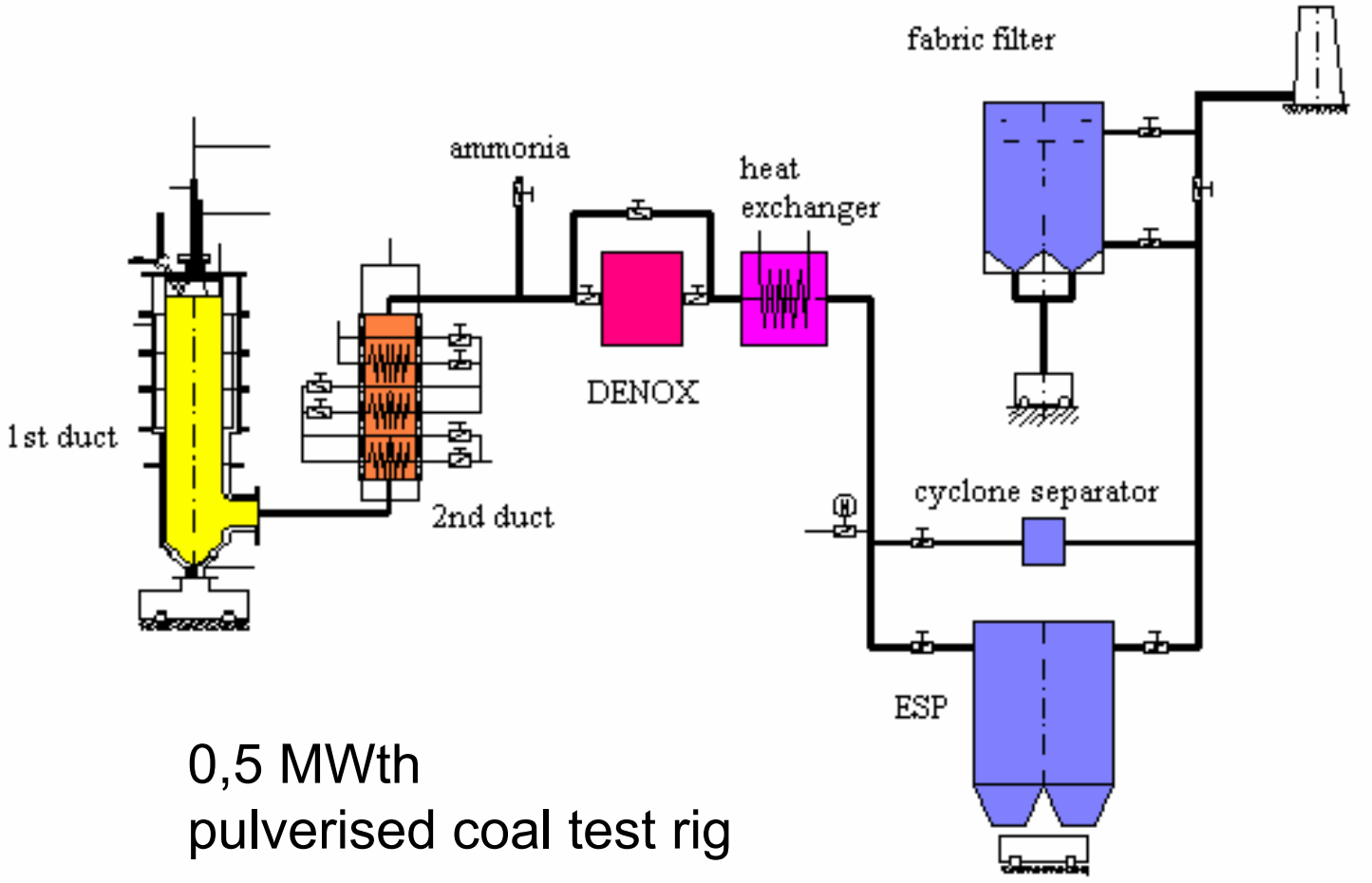
Work Plan


Documentation of state-of-knowledge
Bench- and pilot-scale investigations
Advanced analysis
Full-scale measurements
Performance and cost prediction
analysis data
fuel and fly ash samples
fuel and fly ash samples
analysis data
fuel samples
parameter settings
exp. results on ToMe behaviour

Advanced Analysis

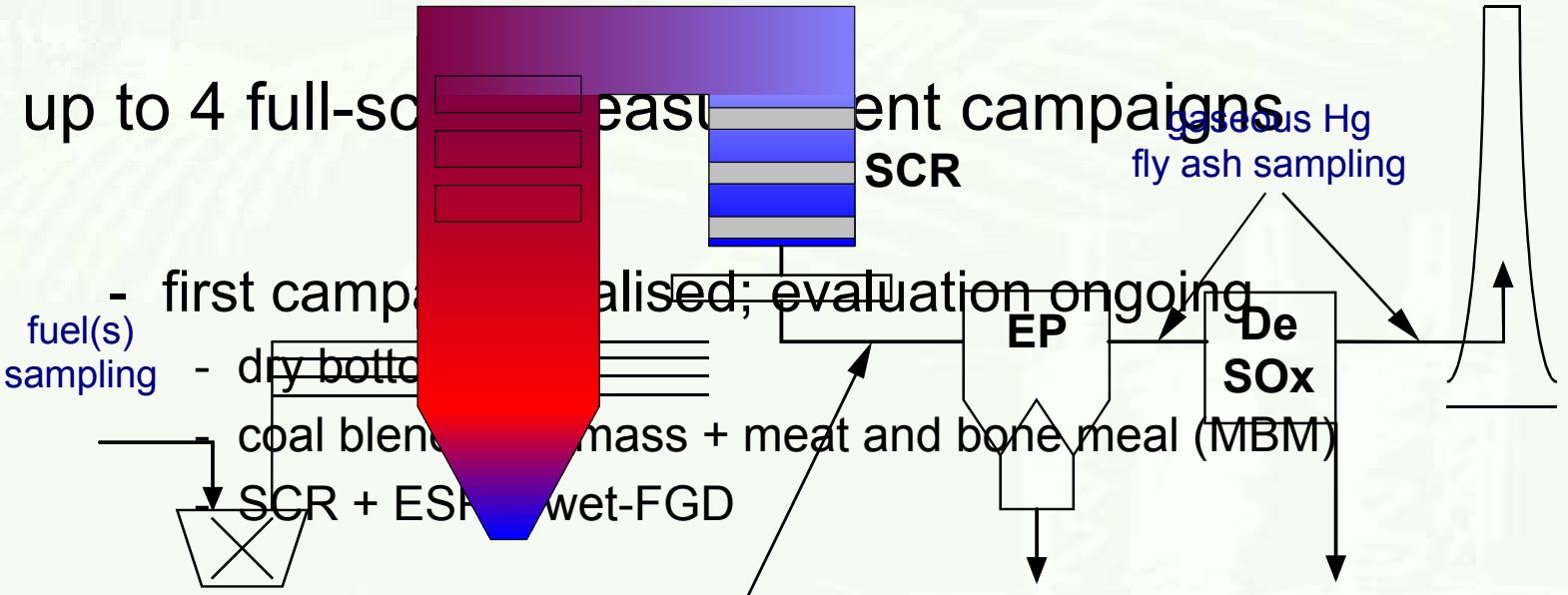
- fuel analysis
  - ToMe content
  - chemical bonding -> release
- impactor fly ash sampling
  - enrichment/ sorption depend. on particle size
- surface characterisation of fly ashes and sorbents
  - sorption and release of ToMe

Bench- and Pilot Scale



0,5 MWth
pulverised coal test rig

Full-Scale Investigations



up to 4 full-sc easu ent campaigns

- first campa alised; evaluation ongoing
- dry botto
- coal blen mass + meat and bone meal (MBM)
- SCR + ESP wet-FGD

-next campaigns

-influence of :

- dry bottom and slag tap furnaces
- coal and coal/secondary fuel blends
- wood, sewage sludge, MBM
- different configurations
- different combustion and flue gas technologies
- additives and sorbents

Expected Results

- mechanisms determining ToMe
  - release
  - behaviour/speciation
  - fly ash enrichment
  - removal by common air pollution control dev.
- provide valid data on ToMe from full-scale plants
- develop novel, low-cost, multi-pollutant approaches
- recommendations for policy makers and power plant operators

Project Management and Dissemination of Information

For further information please visit:

www.eu-projects.de

or directly

www.eu-projects.de/SEFCO
www.eu-projects.de/CATDEACT
www.eu-projects.de/ TOMERED

or contact:

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