

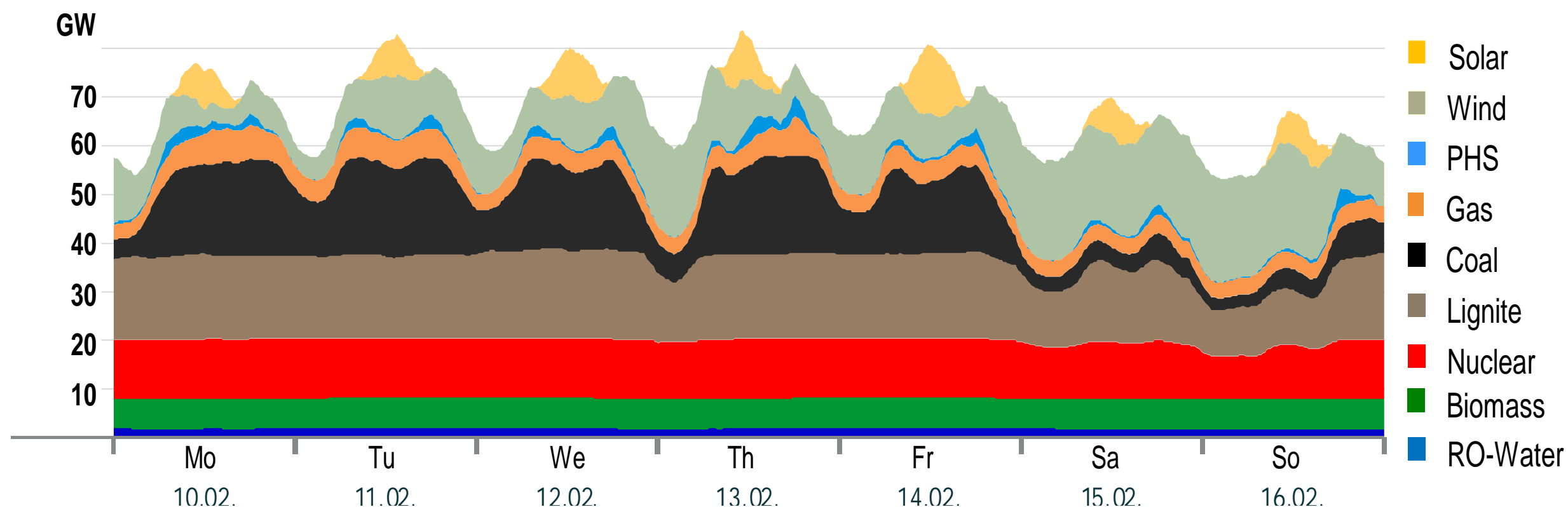
Non-destructive Raman Spectroscopy: Innovative Solutions for Clean Coal Power Plants



Dr. Peter Haug, Managing Director AViSpectro UG (haftungsbeschränkt)
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Coal power is key in balancing fluctuating renewables, however...

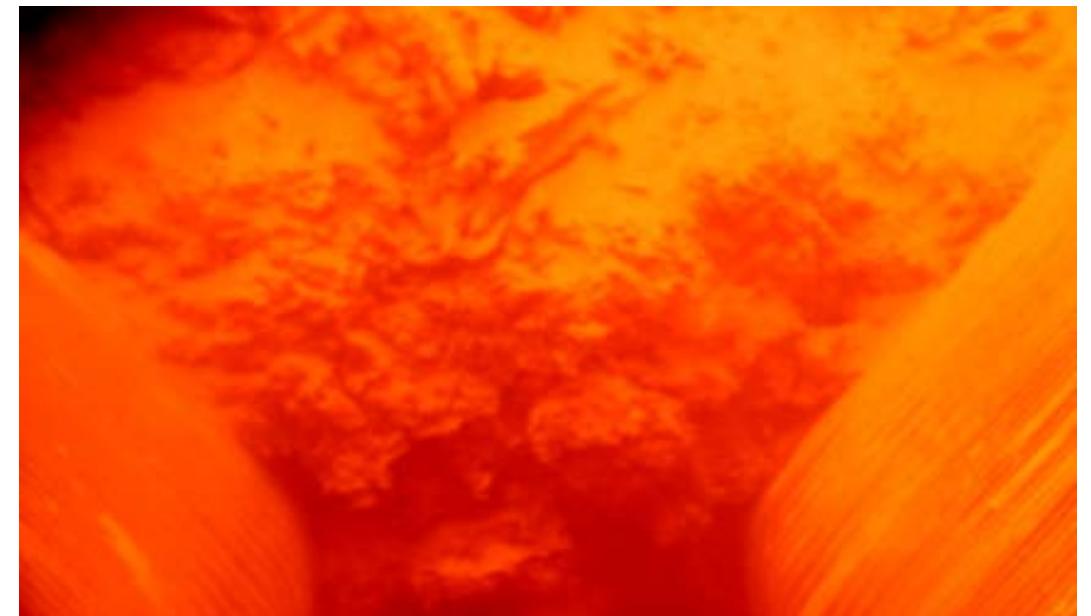
Power production in Germany
(typical week with high power production from renewables in February 2014)



PHS = Pumped Hydro
RO = Run-on-River

... severe challenges by new operational modes: urgent market need for quality determination

1. Coal power plant deposits lead to
 - severe operational problems
 - corrosion losses
 - unplanned plant shut downs
2. Strong raw material fluctuations increase slagging and fouling
3. Value of by-products ash and gypsum is severely depending on quality criteria



AViSpectro within KIC InnoEnergy

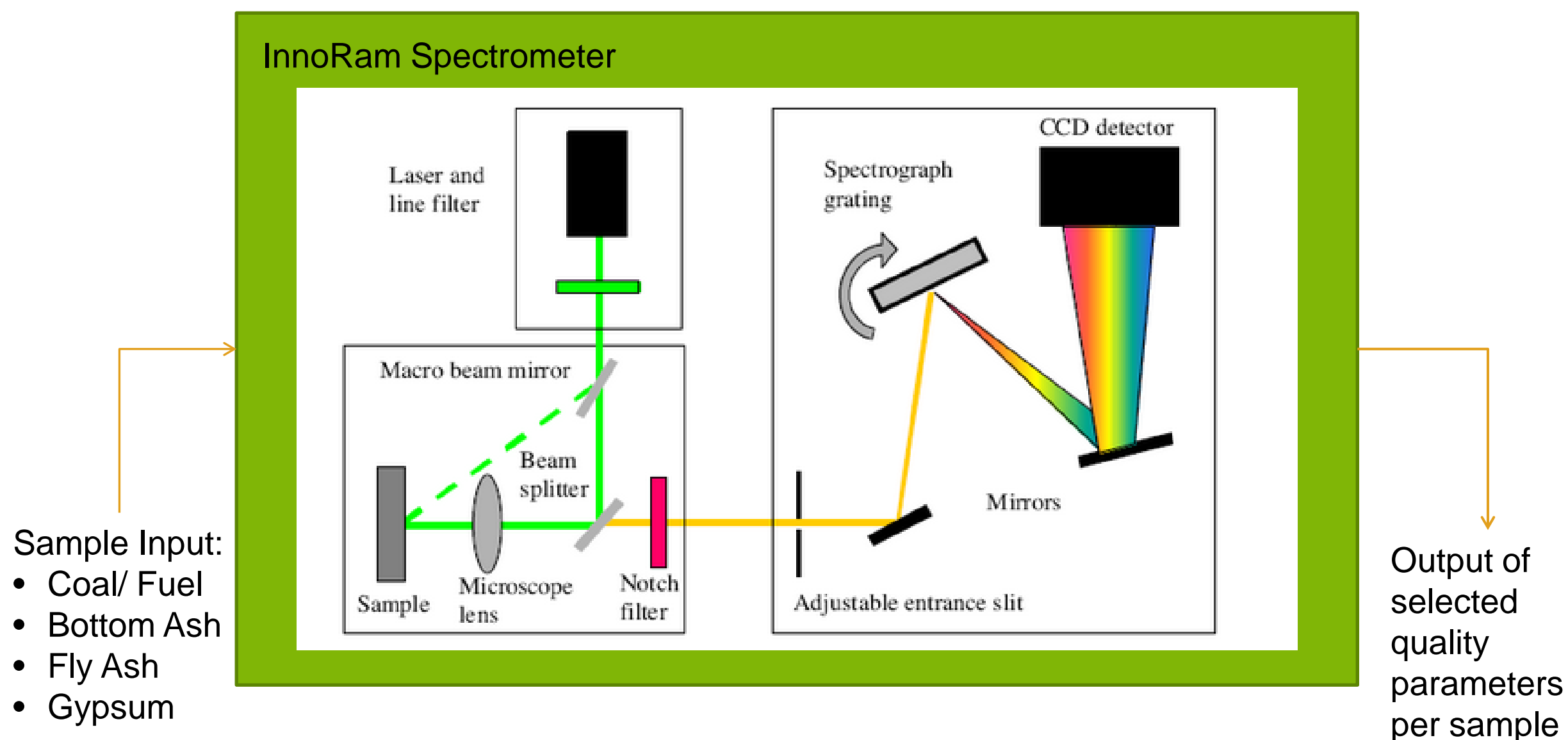
- Spin-Off from Stuttgart University with KIC InnoEnergy as shareholder and investor
- Partnering institutions/companies: Stuttgart University Institute for Combustion (IFK), EDF Polska
- Main Sector: Clean Coal Technologies, further expertise in pharmaceuticals and automotive/light-weight construction
- Core competences: Implementation of raman spectroscopy into industrial process and quality control operations (various service & product offerings)



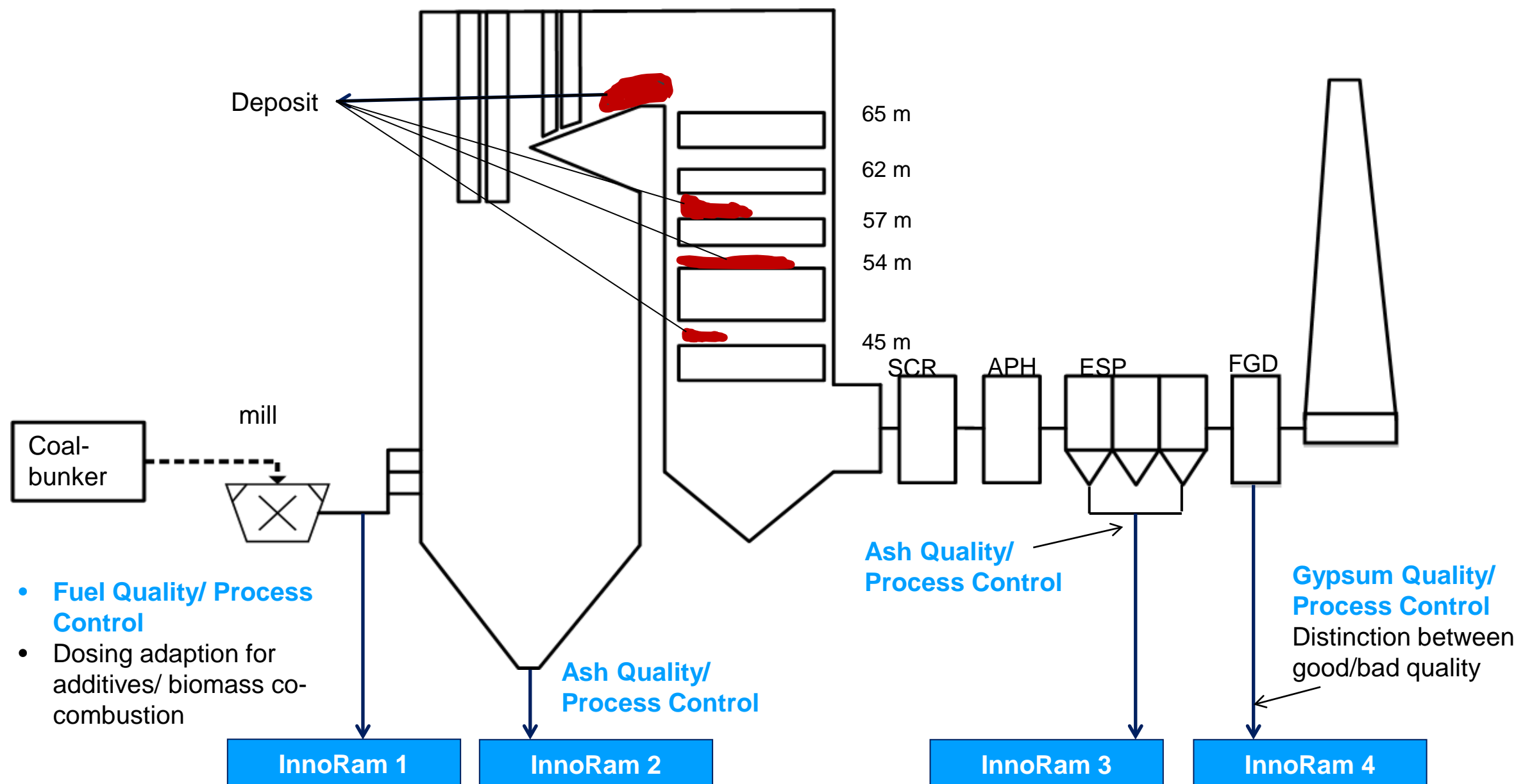
AViSpectro & InnoRam consortium: one device ideally suited to all required parameters for coal

Competitive Analytical Technologies Parameter	Corrosion	Ashes	Fuel (solid and liquid)	Non-Destructive	Non-substrate specific	Specific Information	Time	Price	No extensive tech equipment
AViSPECTRO InnoRam Project	+	+	+	+	+	+	+	+	+
Electron microscopy	+	+	-	+	-	+	+	+	-
Wet chemical analysis	+	+	+	-	+	+	-	+	-
Chromatographic methods	-	-	+	-	+	+	-	+	-
Abrasive Roentgenographic methods	+	+	-	-	+	+	-	-	-
Other Roentgenographic methods	+	+	-	+	+	+	-	-	-
Mass spectrometry	-	-	+	-	+	+	-	-	-

Quick determination of specific quality parameters in coal, ash and gypsum input samples



InnoRam spectrometers can be implemented with minor modifications in 4 different coal power plant process steps



Manufacturers & service providers benefit from know-how increase and attractive service business

Impact for Coal Power Plant Operators



1. **Reduction of unplanned shut-down times** of coal power plants due to corrosion, slagging & fouling
2. **Reduction of Capital expenditure** for repair of corrosion damages due to slagging and fouling
3. **Reduced spending for biomass co-combustion additives**
4. **Higher price premiums for by-products ash and gypsum** (e.g. shift into higher-paying market niches such as gypsum alpha)

Coal-power Manufacturers & Service Provider







1. **Know-how increase for optimization of turn-key plants:** increased value by CCP commercialization important trigger for plant upgrades; multiple opportunities for quantification and monitoring during transition periods (new boiler, after overhaul, new fuel input...)
2. **More security for start-up warranties in transition periods or after installing new capacity:** continuous monitoring of specified customer parameters, e.g. fuel input quality
3. **Attractive follow-on service business**

Non-destructive Raman Spectroscopy: Innovative Solutions for Clean Coal Power Plants

- Availability of live stream parameters is crucial for further improvement of coal combustion processes
- Established solutions are expensive, take much time and can deliver only some of the required parameters.
- InnoRam can very quickly determine various specific quality parameters in coal, ash and gypsum samples
- Payback for coal power plant operators is expected to be less than one year. Related manufacturers and service providers benefit from know-how increase for their turn-key plants and attractive InnoRam service business
- Joint consortium work within KIC InnoEnergy's Innovation Proposal is about to start, with demonstrators being available in 2016
- AViSpectro is open for discussions with further interested coal power plant operators and energy-related manufacturers & service providers

Thank you Any questions?

peter.haug@avi-spectro.com

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