Sargent & Lundy LLC

Industry Status on "Novel" Multi-Pollutant Control Technologies for Power Plants

Andy Carstens – Sargent & Lundy

Conventional Vs. Novel

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"Conventional" Technologies with Multi-Pollutant Capabilities:

- ESPs, Baghouses (PM, Hg, SO_2, HCl)
- FGD (Dry / Wet) – (PM, SO_3, SO_2, Hg, HCl)
- SCR (NOx, Hg Oxidation)

To squeeze everything out of existing technologies:

- Fuel additives (Halogens)
- FGD Additives (organic/Na sulfides)
- Sorbents (Carbon, Trona, Lime)

Multipollutant Technologies

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Technology Status Updates:

- Process Name – Company Offering Technology
- Pollutants Removed
- Brief Description of Process
- Latest Status (Pilot, Slipstream, Commercial)

NOTES:

- S&L is not endorsing any of these technologies
- S&L is presenting its best information to date

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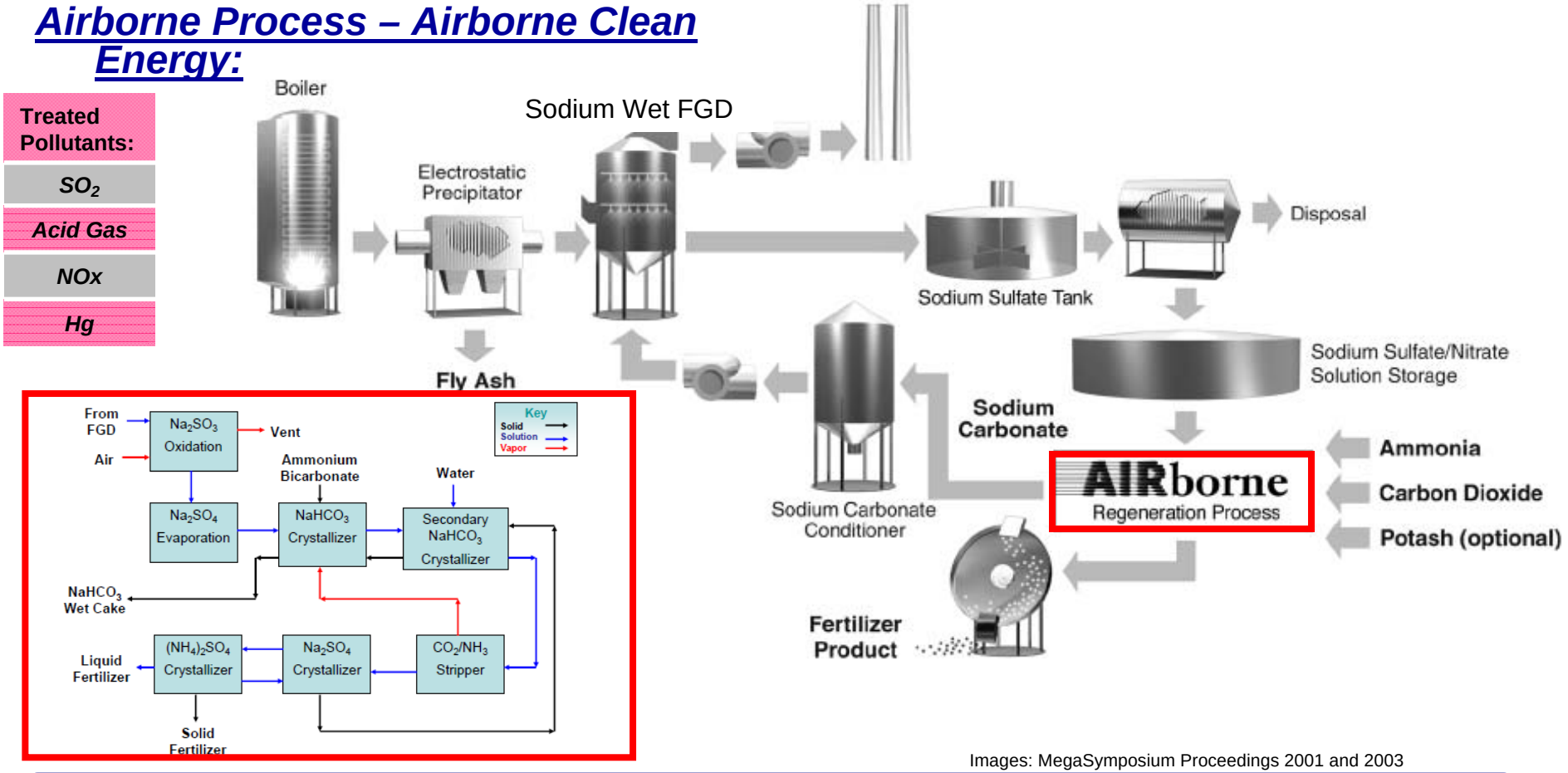
Airborne Process – Airborne Clean Energy:

Treated Pollutants:

- *SO_2*
- *Acid Gas*
- *NOx*
- *Hg*



Images: MegaSymposium Proceedings 2001 and 2003

Status: 5 MW Slipstream at Ghent, Full-scale demonstration scheduled for Peabody – Mustang / LGE-Ghent, but both canceled. No recent updates.

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Calera Process – Calera:

Treated Pollutants:

- ***SO_2***
- ***Acid Gas***
- ***Hg***
- ***CO_2***

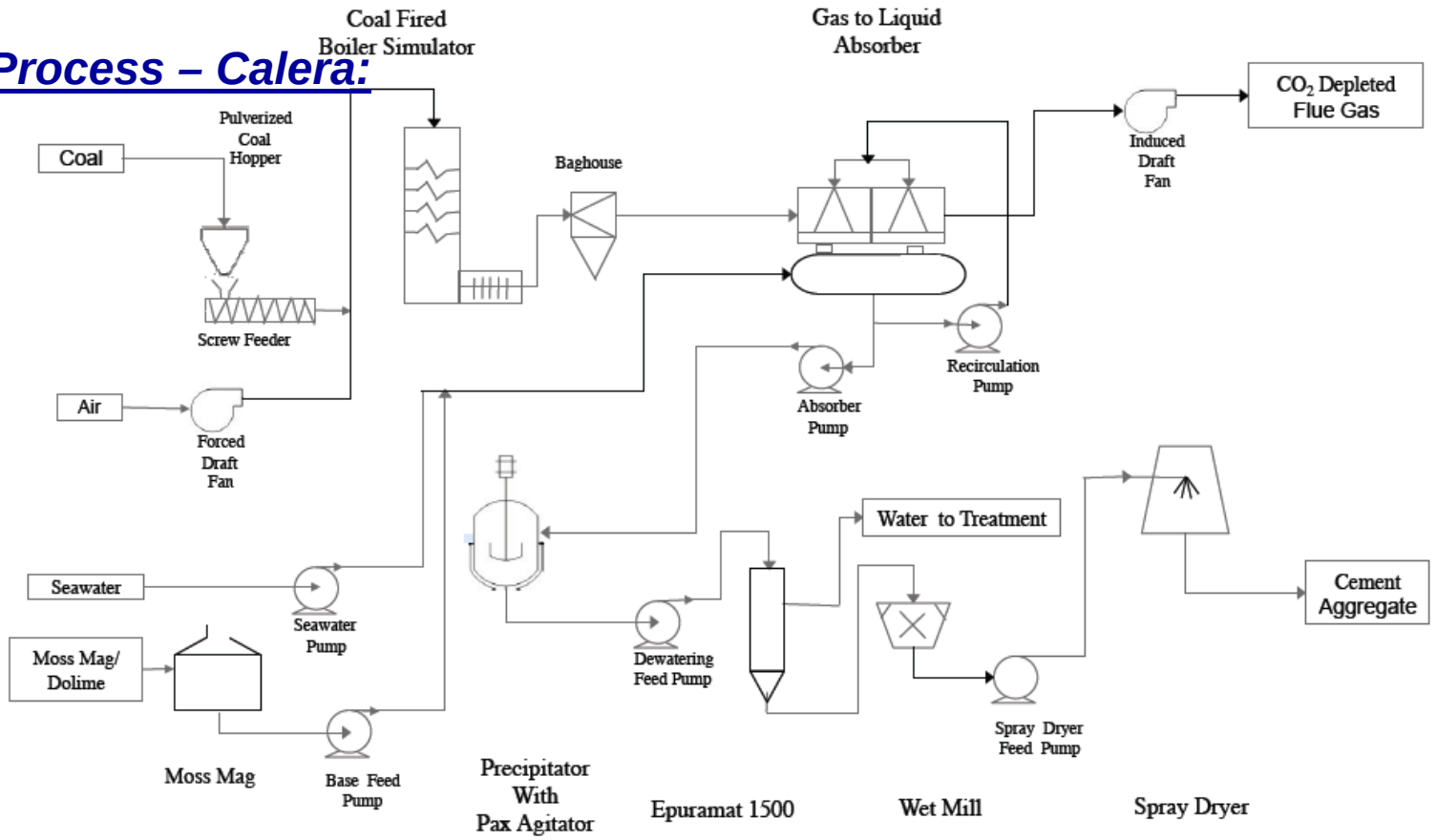

Image: http://mitei.mit.edu/system/files/calera-sequestering.pdf

Status: Pilot Plant Facility (Coal - 0.3 MW); Demonstration at Dynegy's Moss Landing (Natural Gas – 10 MW)

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CEFCO – Global Clean Energy:

Treated Pollutants:
SO_2
Acid Gas
NOx
Hg
PM
CO_2

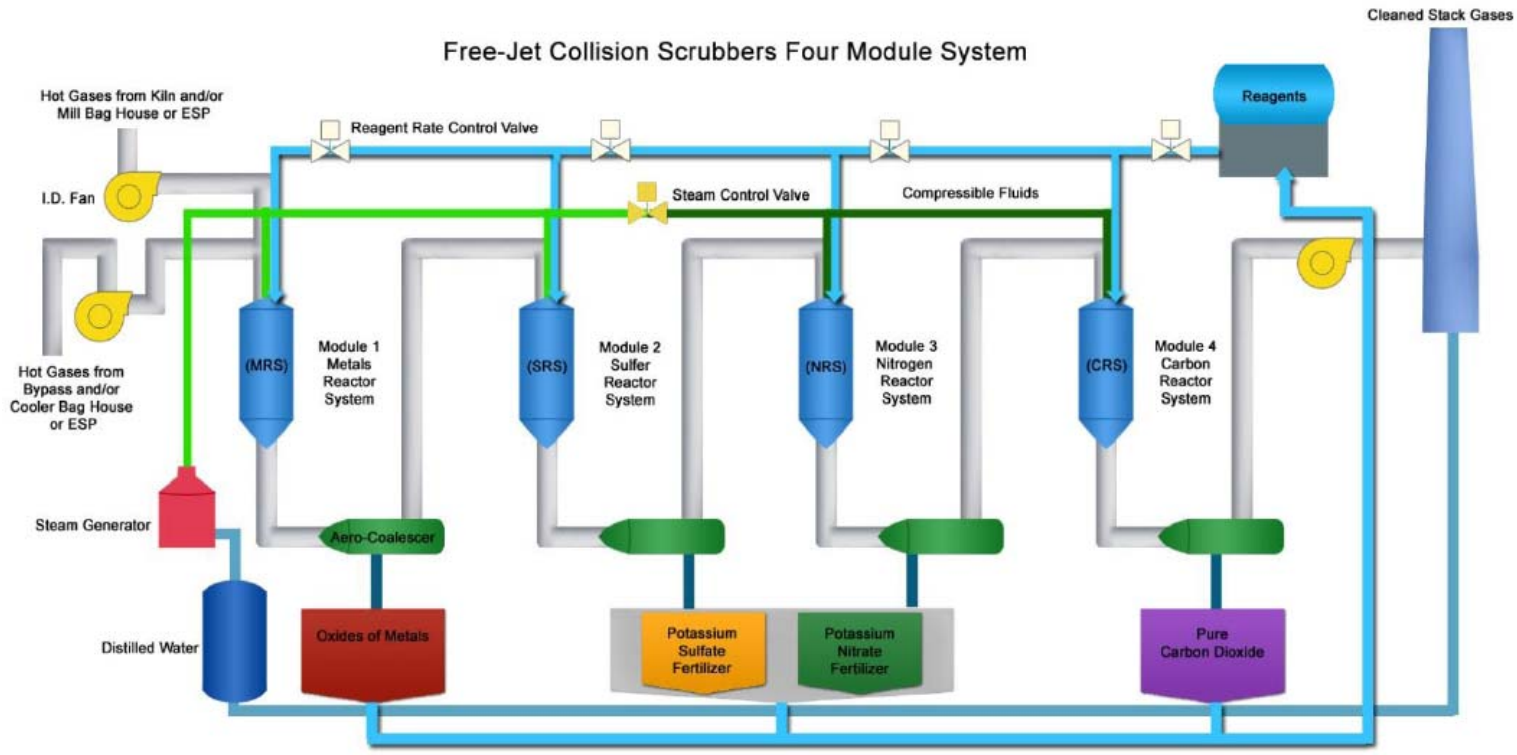

Image: http://www.cefcoglobal.com/

Status: 1-3 MW Pilot in Witchita Falls, TX. No published performance data

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Comply 2000 – Eco Power Solutions:

Treated Pollutants:
SO_2
Acid Gas
NOx
Hg
PM
CO_2

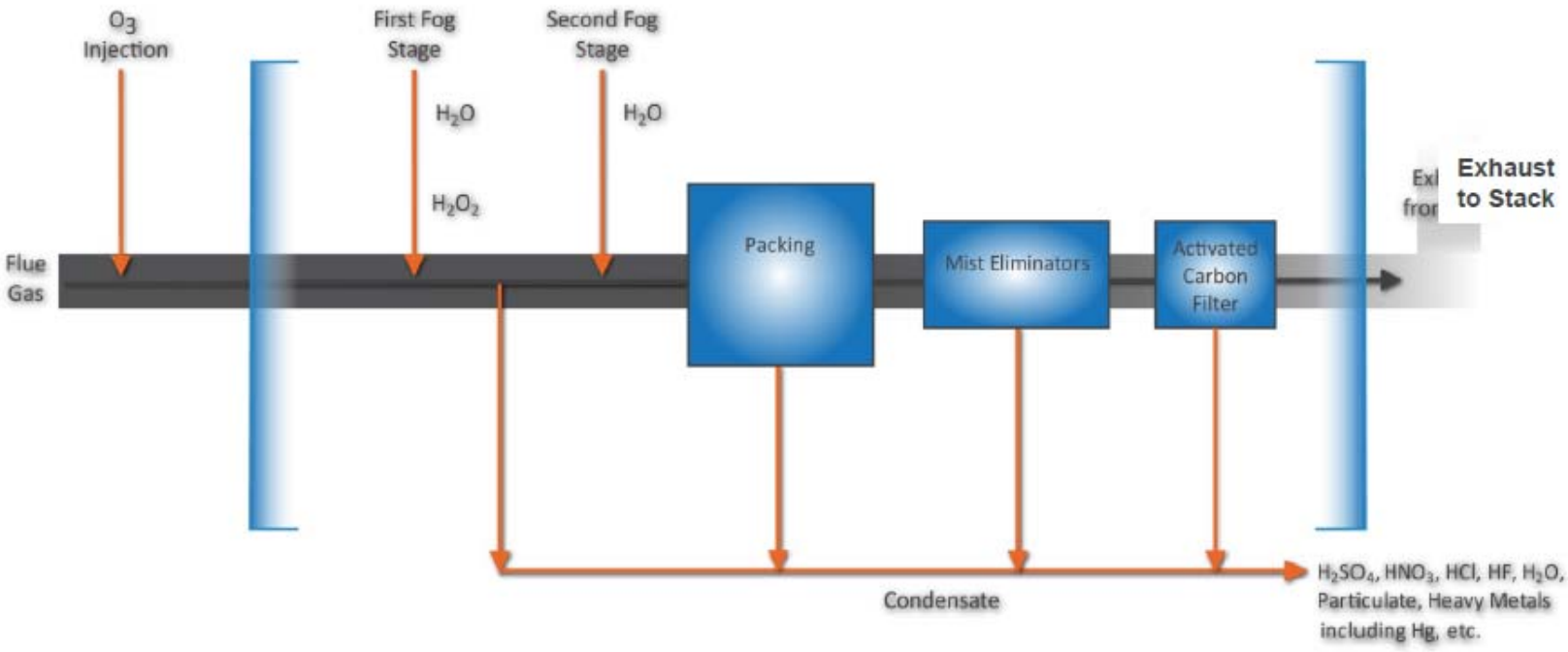

Image: Sanjeev Jolly, Eco Power Solutions at S&L office 4-11-2013

Status: 5 MW Pilot Facility in Louisville, KY

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Electro Catalytic Oxidation (ECO) – PowerSpan Corporation:

Treated Pollutants:

- ***SO_2***
- ***Acid Gas***
- ***NOx***
- ***Hg***
- ***PM***

CO_2 Requires ECO_2 Process

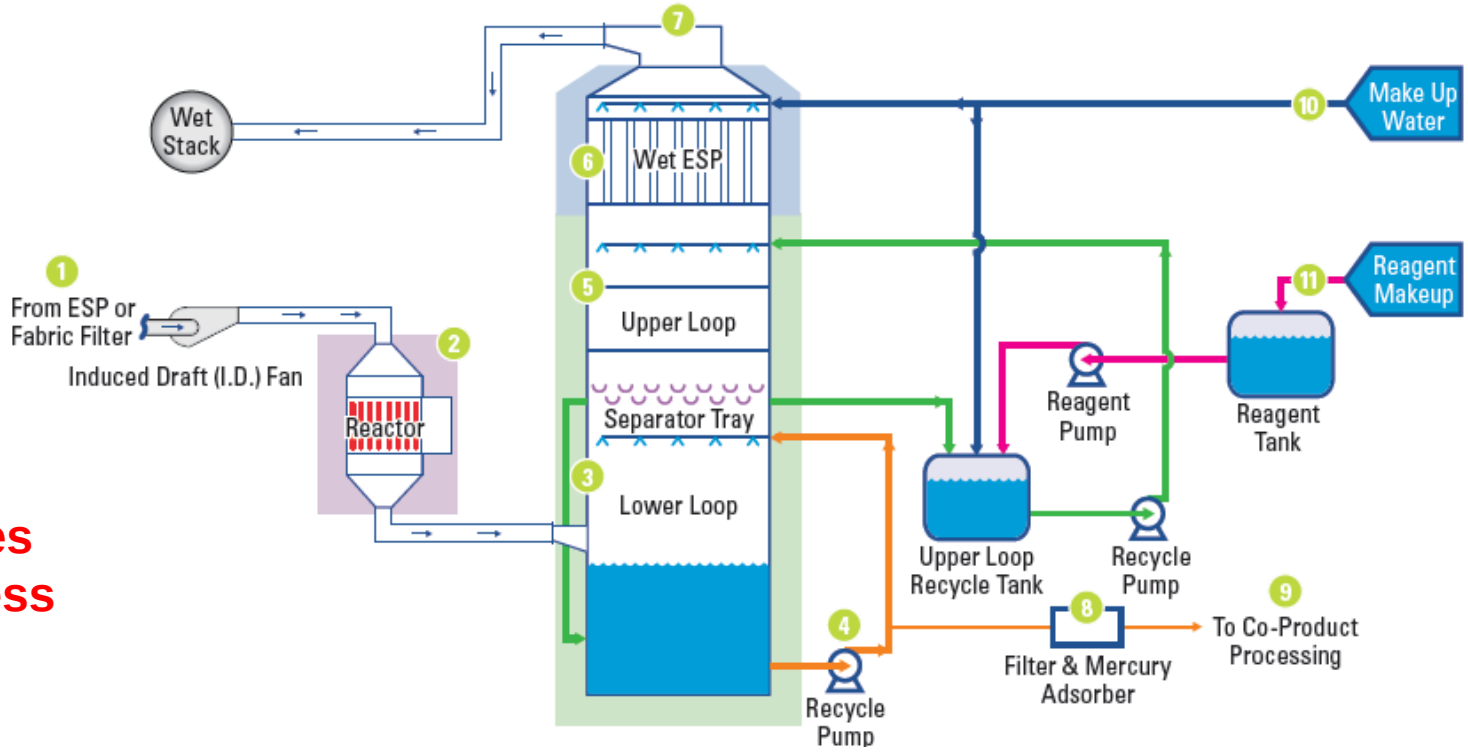

Image: http://www.powermag.com/r-e-burger-plant-shadyside-ohio/

Status: Pilot Testing, and 50 MW Slipstream of ECO at First Energy's Berger plant. ECO_2 commercial scale planned at Basin Electric's Antelope station, but canceled.

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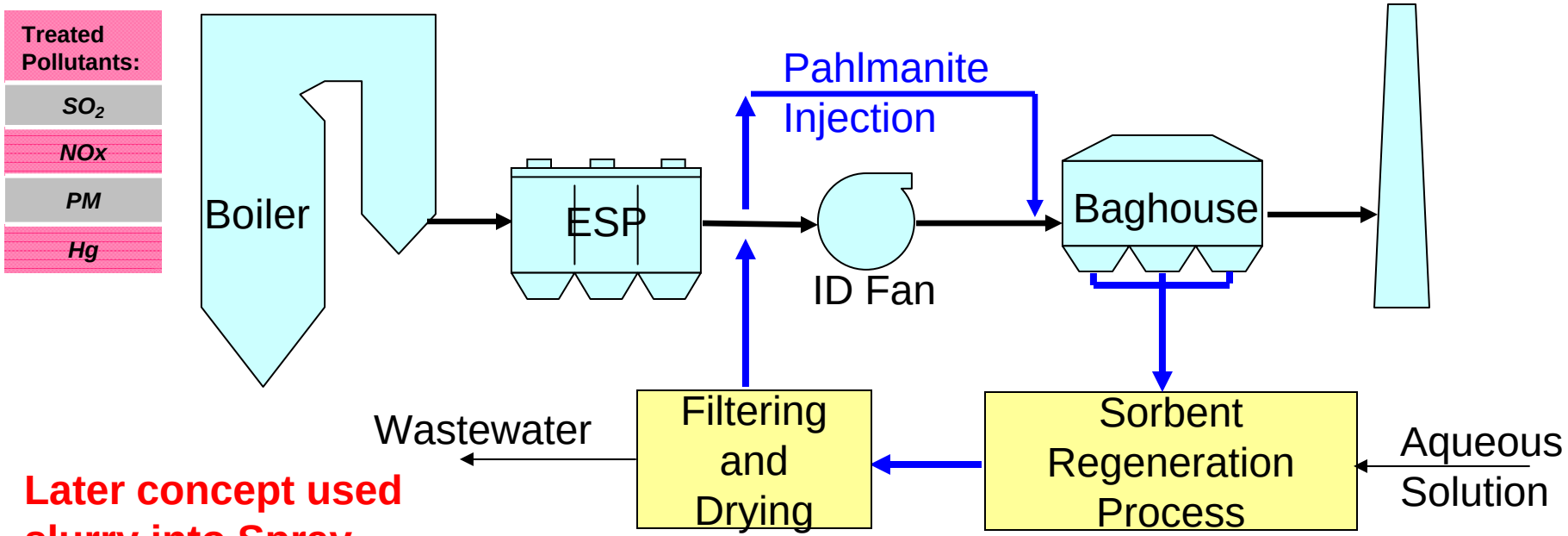
Enviroscrub (Pahlmann Process) – Enviroscrub Technologies Corporation:



Later concept used slurry into Spray Dryer followed by Wet FGD

Status: 0.5 MW test at Ameren Hutsonville, and 1M test at Minnesota Power Boswell; No longer offered

Multipollutant Technologies

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GORE™ Mercury Control Technology – URS and W.L. Gore & Associates:

Treated Pollutants:
SO_2
Acid Gas
Hg

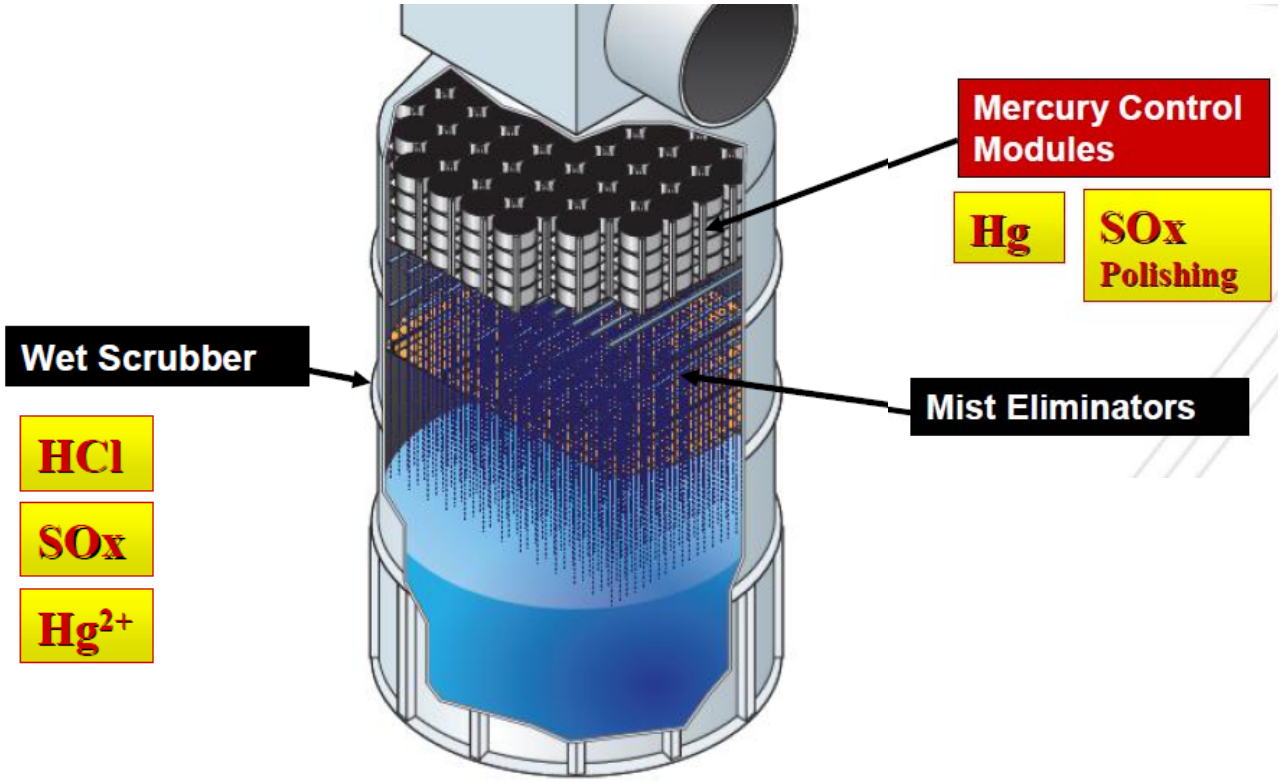

Image: John Darrow and Jeff Kolde, Gore, at S&L office 5-30-2012

Status: Commercial – Full Scale Demonstration (75MW) at Sherco Unit 1 Starting in July 2013

Multipollutant Technologies

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NeuStream-S – Neumann Systems Group, Inc:

Treated Pollutants:
SO_2
Acid Gas
Hg

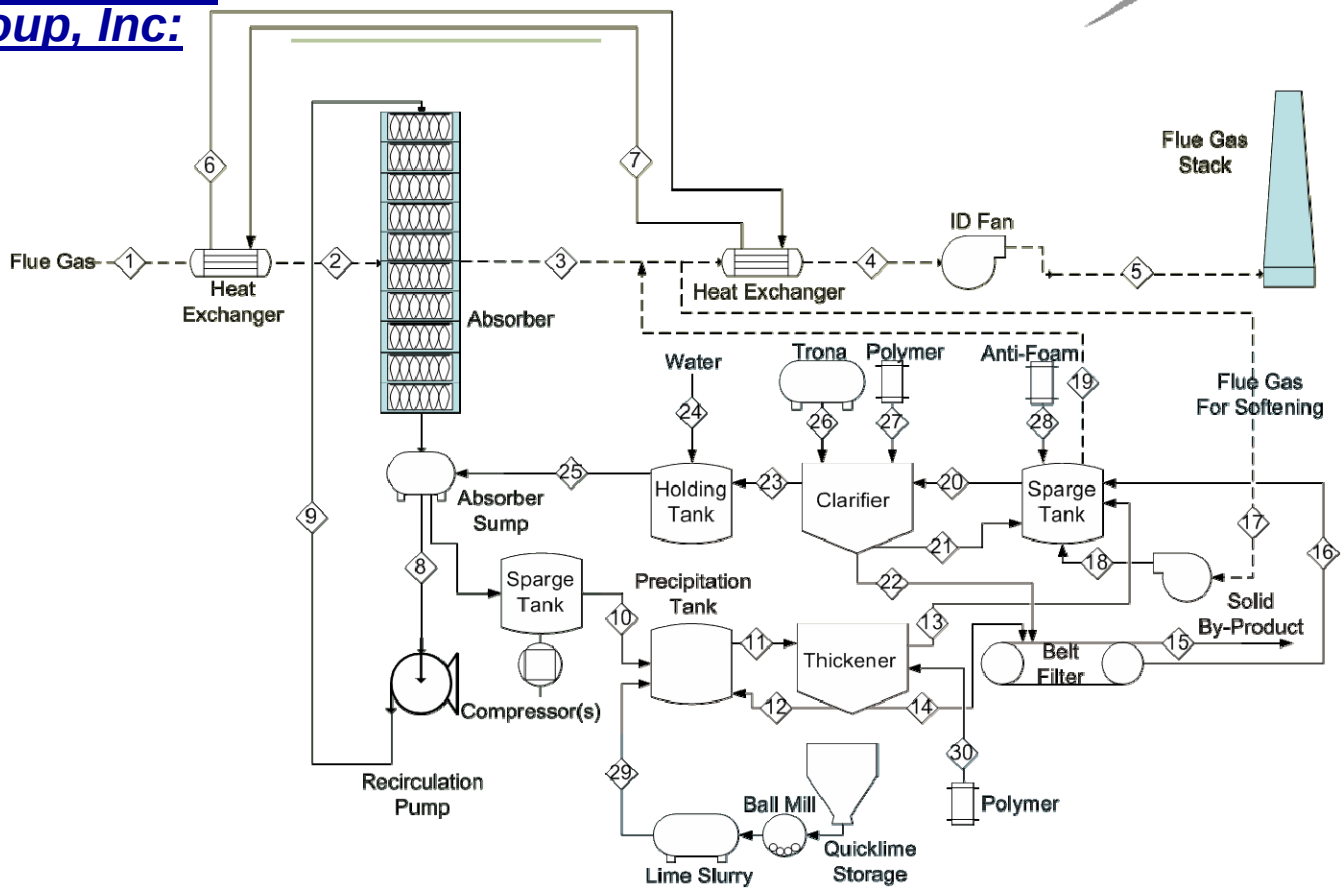

Image: http://www.neumannsystemsgroup.com/multi-pollutant

Status: Commercial – Currently installing at CSU Martin Drake 6 & 7, 2014

Multipollutant Technologies

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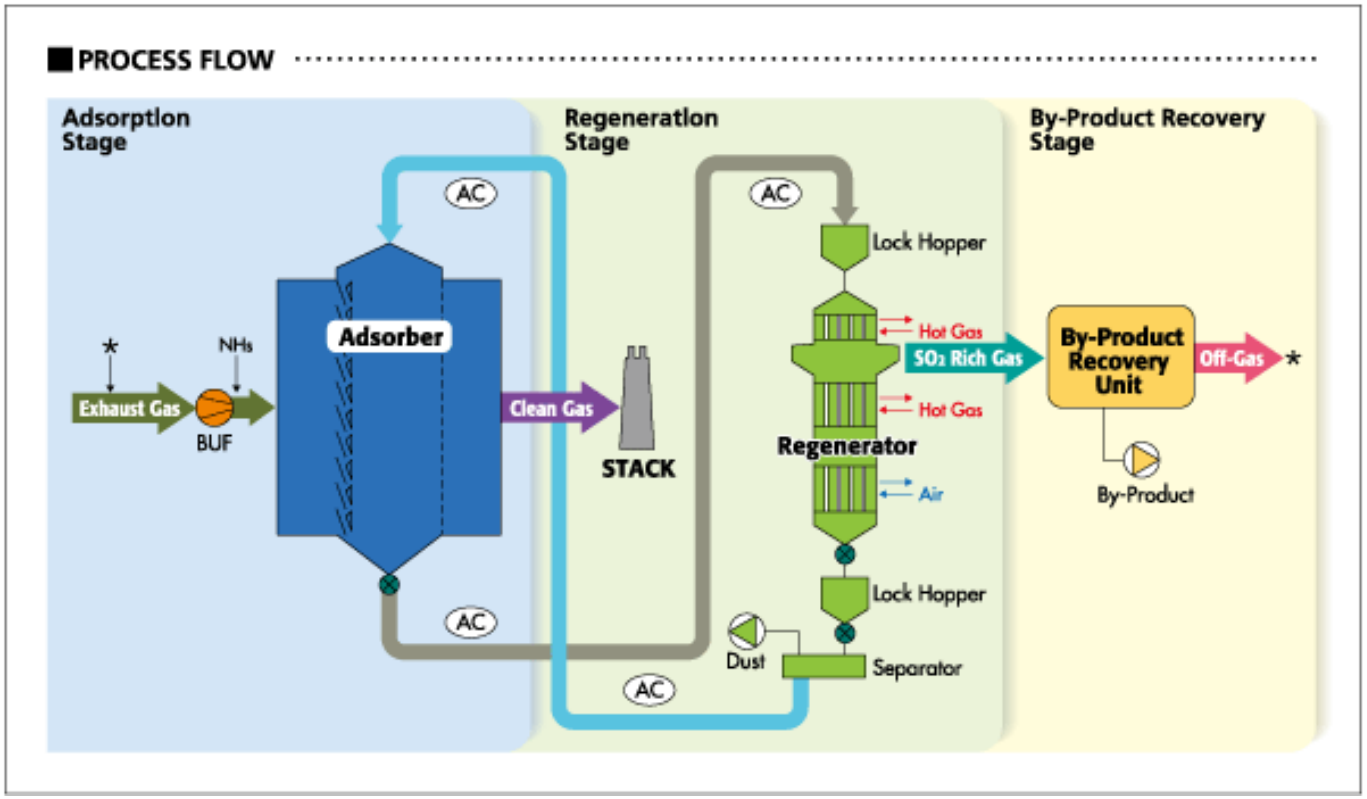
Regenerated Activated Coke Technology (REACT) – J-Power EnTech, Inc. and Hamon Research Cottrell:

Treated Pollutants:
SO_2
Acid Gas
NOx
Hg



http://www.powermag.com/react-reduces-emissions-and-water-use/

Status: Commercial, 2 coal units in Japan; Wisconsin Public Service Weston 3 (~330MW) to install full-scale system ~2016

Multipollutant Technologies

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SkyMine – Skyonic:

Treated Pollutants:
SO_2
Acid Gas
NOx
Hg
CO_2

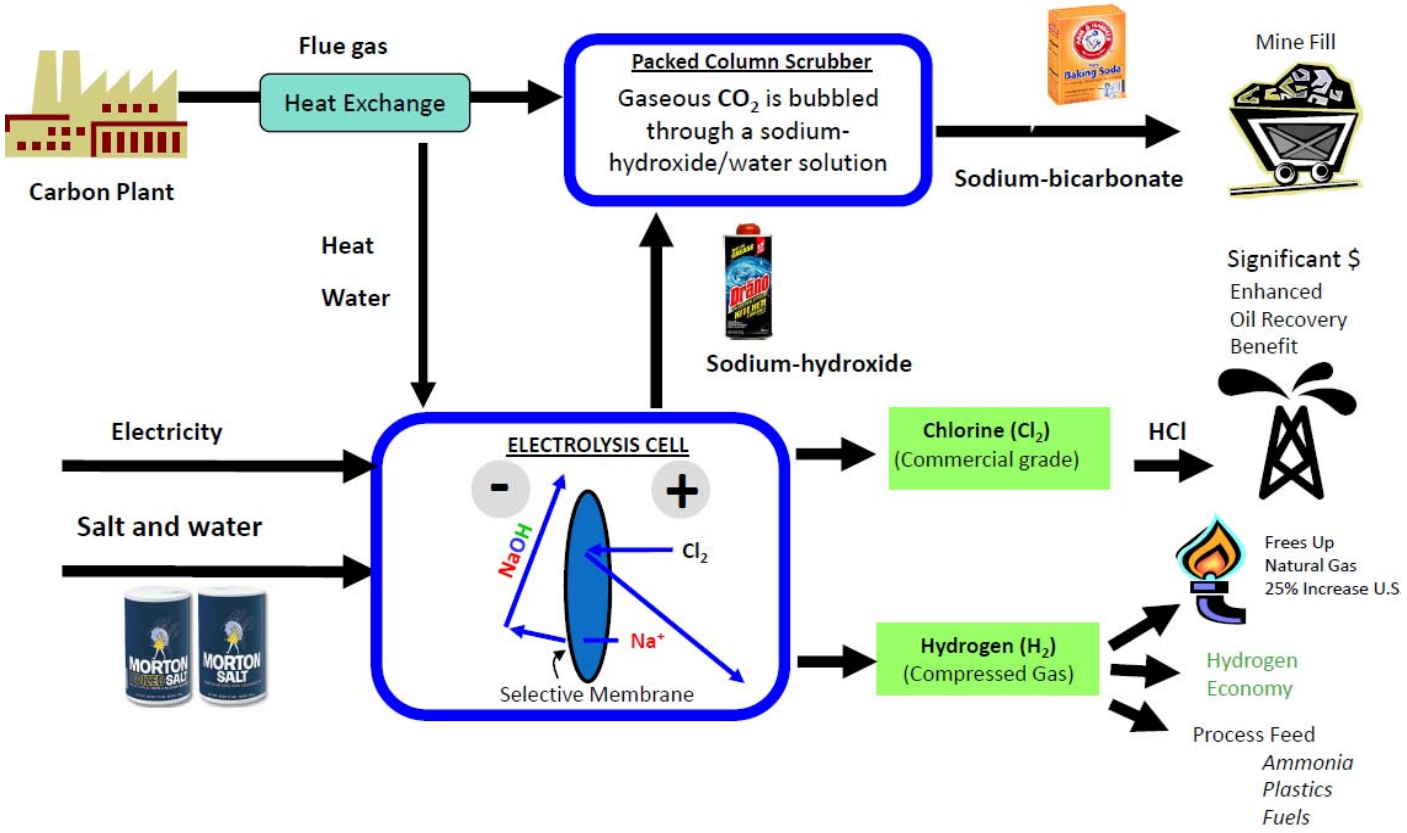

Image: http://www.mcilvainecompany.com/CO2_Decision_Tree/subscriber/Tree/DescriptionTextLinks/David_St._Angelo_Skyonic_-_Hot_Topic_Hour_May_22_2008.pdf

Status: June 2013 obtained funding for 1st Commercial Scale plant at Capital Aggregate Cement in San Antonio

Multipollutant Technologies

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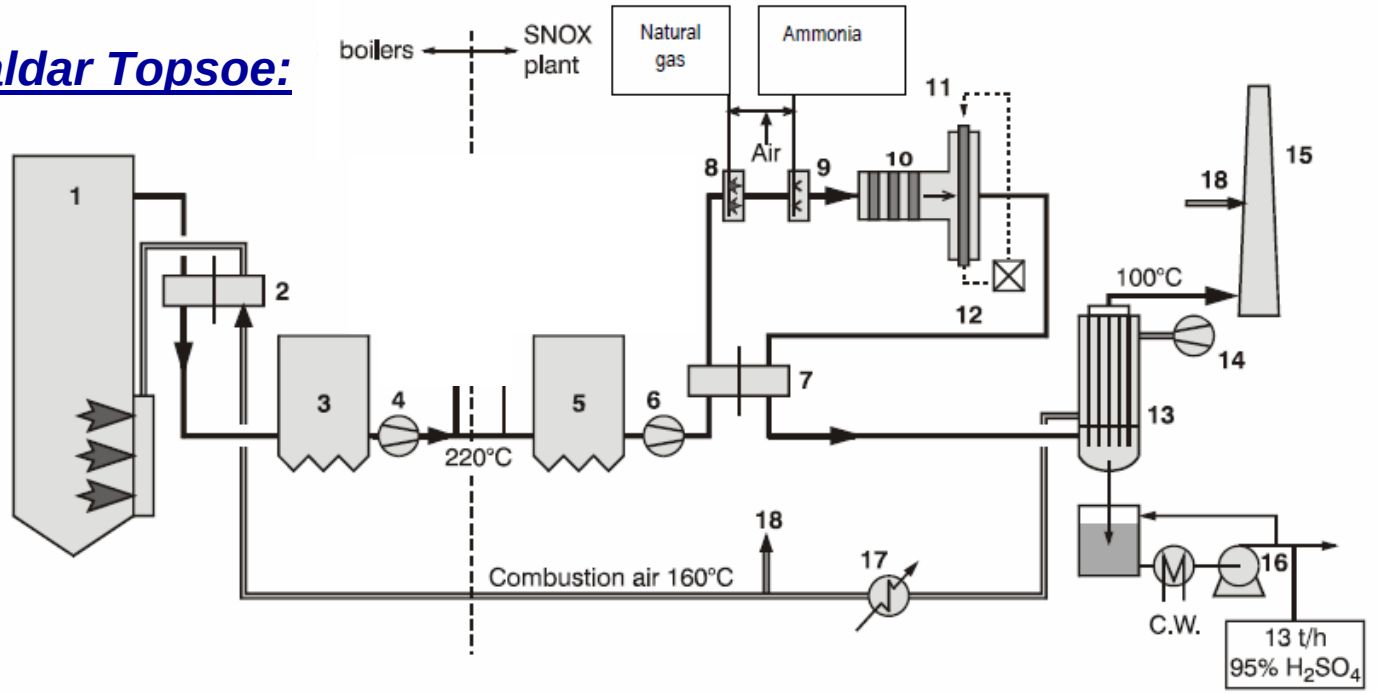
SNOX – Haldar Topsoe:

Treated Pollutants:

- SO_2
- Acid Gas
- NOx



1 Boilers
2 Air preheaters
3 Dust precipitators
4 Boiler flue gas fans
5 New dust precipitator
6 New flue gas fan
7 Gas-gas heat exchanger
8 Gas heater
9 NH_3 injection grid
10 SCR deNOx reactor
11 $SO_2 \rightarrow SO_3$ reactor
12 Catalyst cleaning system
13 WSA sulphuric acid condenser
14 Air fan
15 Stack
16 Acid cooling system
17 Air cooler/boiler
18 Excess air to stack

Image: www.topsoe.com

Status: Commercial – 300 MW Plant in Denmark and PetCoke Plant in Italy

Conclusion

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"Novel" Technology Potential Obstacles:

- Economics (Capital / O&M)
- Demonstrated Experience
- Power Plants as Chemical Processing Facilities
- "From Air to Water"