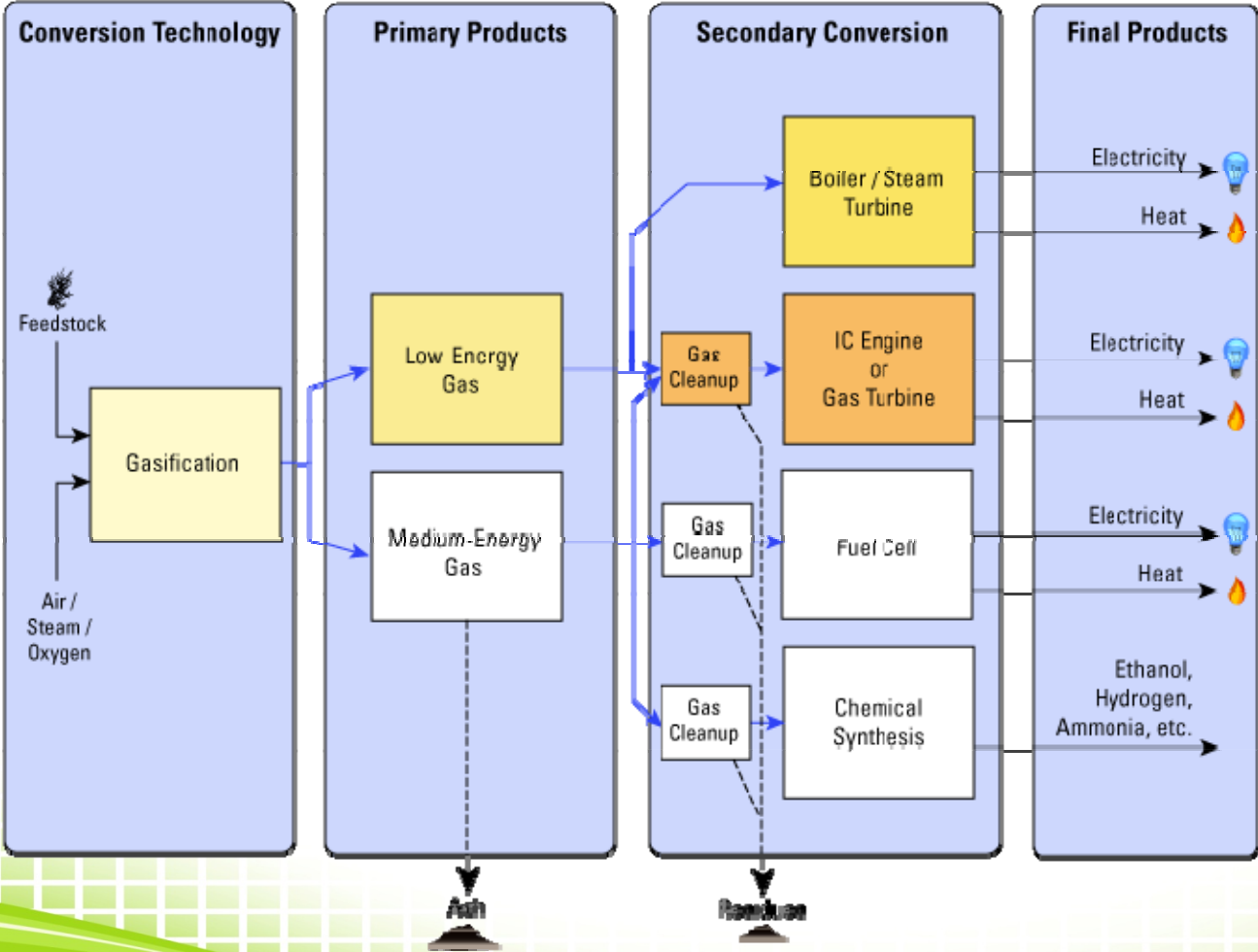


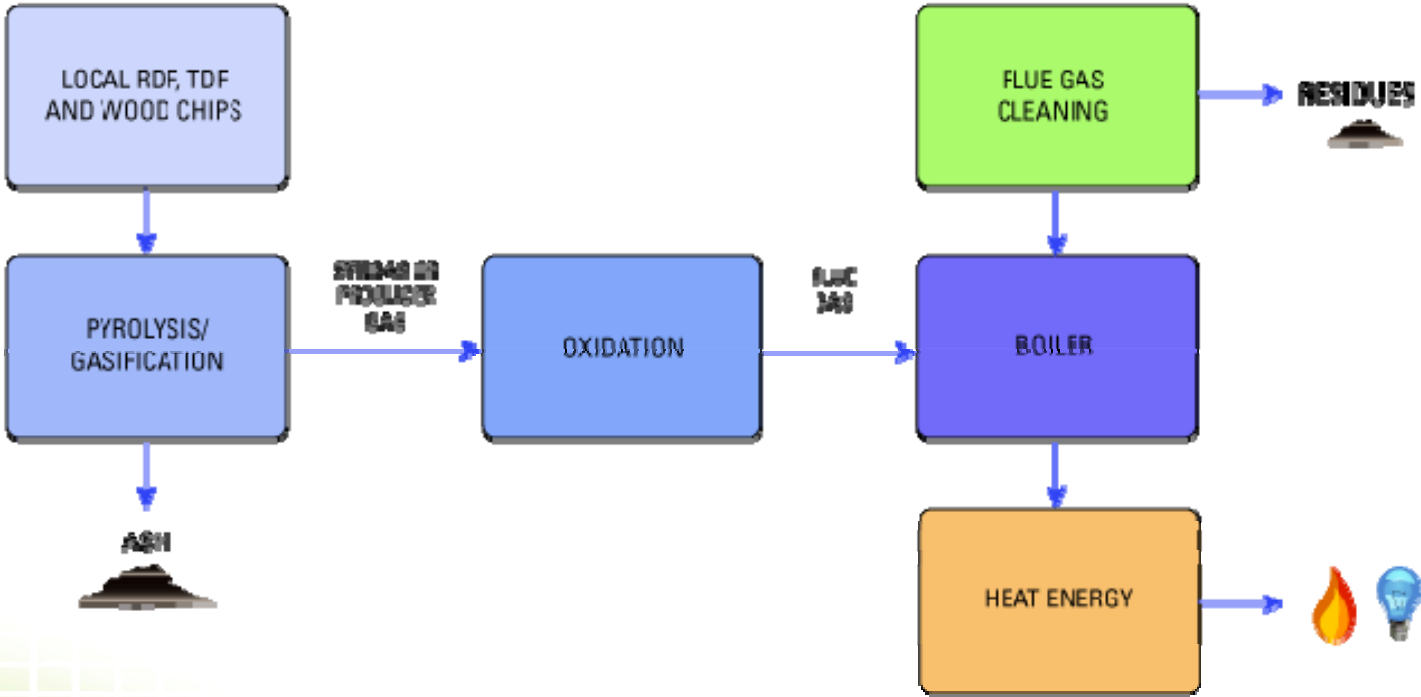
One Approach with Gasification and Advanced Pollution Control

Presentation for Waste Conversion Technologies
Showcase at WasteCon 2011, Nashville, TN

Gasification for Waste-to-Energy



Gasification the ICM Way or Path to CHP with a gasifier



Why Gasification vs.?

- **Less air passing through gasifier fuel pile**
 - Reduced pile temperature and PM emissions
- **Less air and lower pile temperatures in the gasifier**
 - 1200°F – 1300°F versus 2000°F – 2200+°F
 - Lower pile temperature reduces heavy metal emissions
- **Oxidation: controlled, staged combustion**
 - Mixing and retention in Oxidizer
 - Lower NOx production
 - Flue gas recycle to control combustion temperatures
 - Reduced excess air
 - Selective non-catalytic reduction ... capable
- **Multi-Pollutant Emissions Abatement**

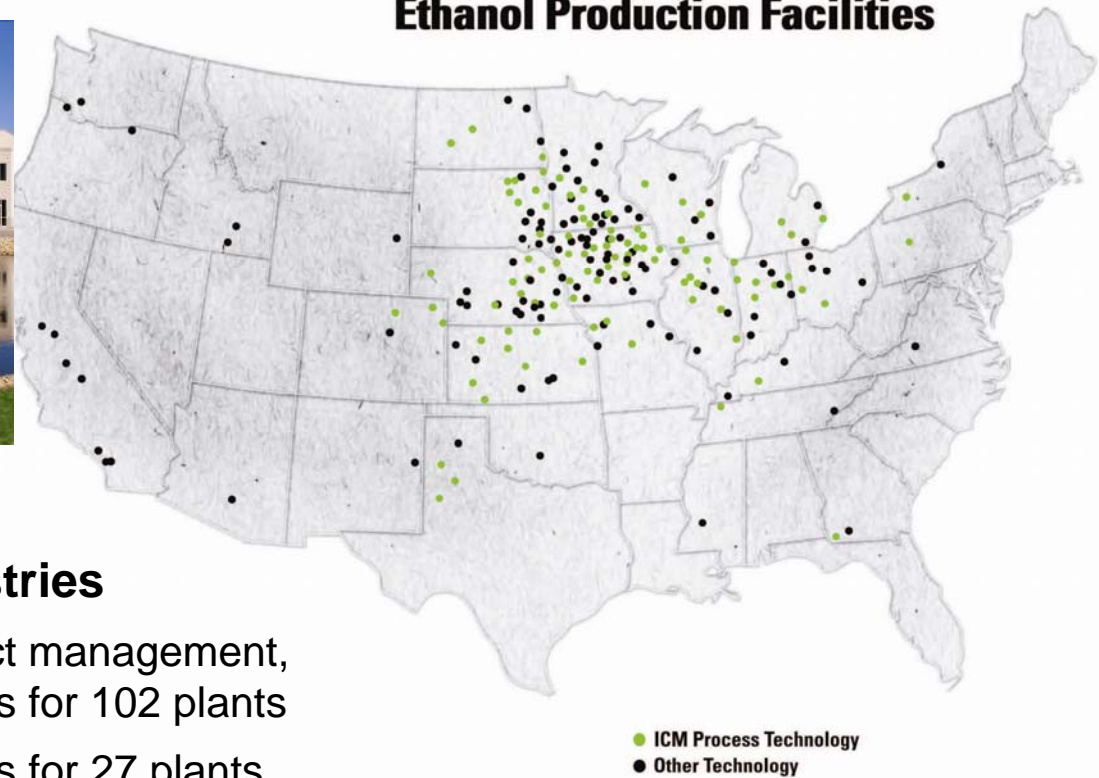
ICM and EISENMANN Demonstration Project - Goals

- Demonstrate at Commercial Scale Viable Technologies for Waste-to-Energy Conversion with Appropriate Emission Controls
- Focus on Gasifier to CHP Path & Related Technologies
- Initial Feedstock Targets:
 - RDF from MSW
 - TDF/Tires
 - Recovered Plastics
 - Construction & Demolition Waste
 - Woody Biomass
 - Agricultural Residuals, Especially Ethanol-Related
 - Poultry, Dairy & Other Wastes
- Create Flexible Evaluation & Technology Development Platform

ICM Technology



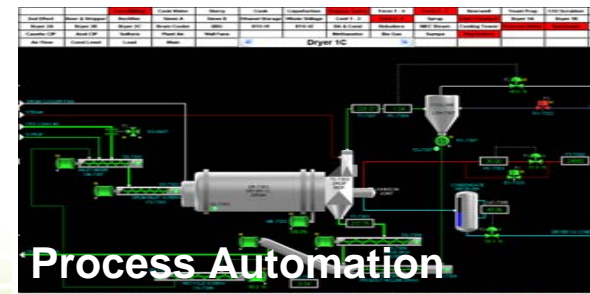
United States Ethanol Production Facilities



Serving the U.S. and Canadian Ethanol Industries

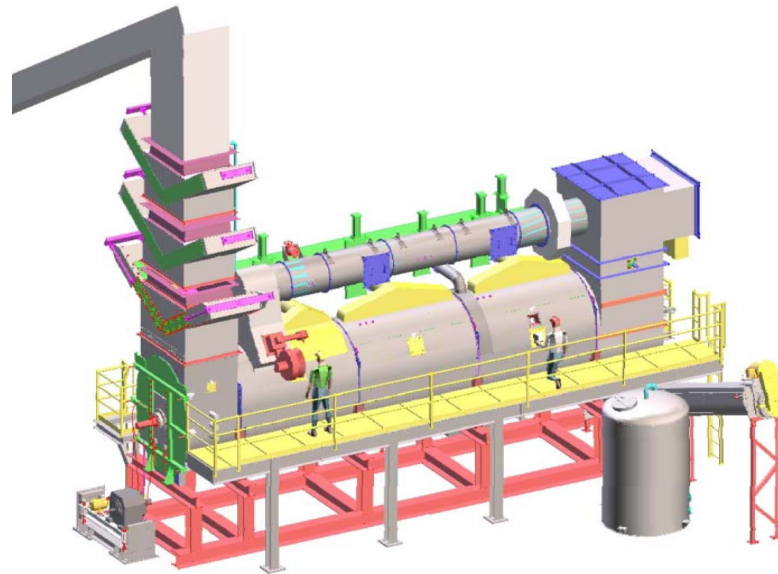
- Process engineering, project management, training, and start-up services for 102 plants
- General contracting services for 27 plants

Engineering, Manufacturing, Construction and Management



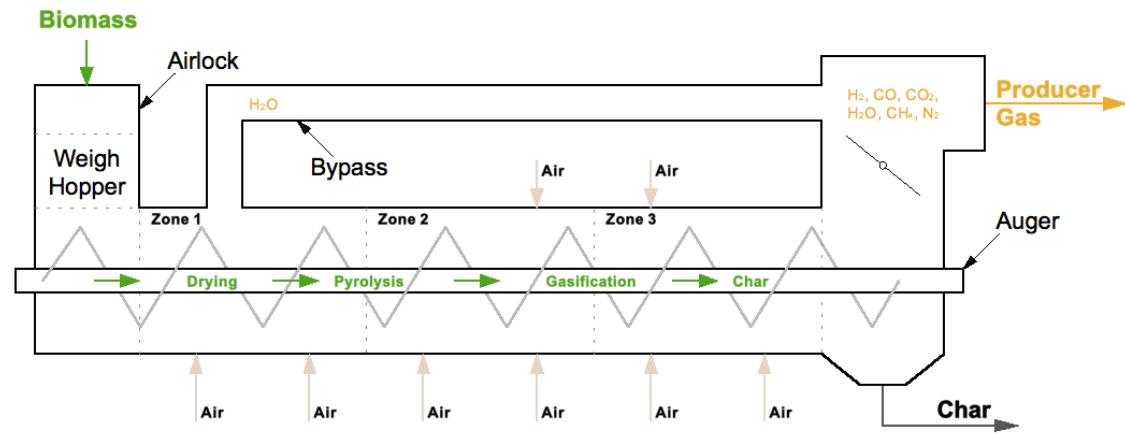
ICM's Auger Gasification Technology

- **Successfully developed in the late '70s early '80s**
 - Tested 250 TPD using MSW and wood wastes
 - Supported by US DOE and Boeing
- **After working with existing technologies, and reviewing all other options, ICM's path forward...**
 - Licensed technology
 - Fuel flexibility
 - Greater control
 - BioChar capable
 - Shop fabricated



ICM Gasifier

- **Better Control**
 - Mass input
 - Low rpm auger
 - Retention time
 - Wet gas bypass
 - 10% - 50% mc
 - Zoned air input
- **Robust Design**

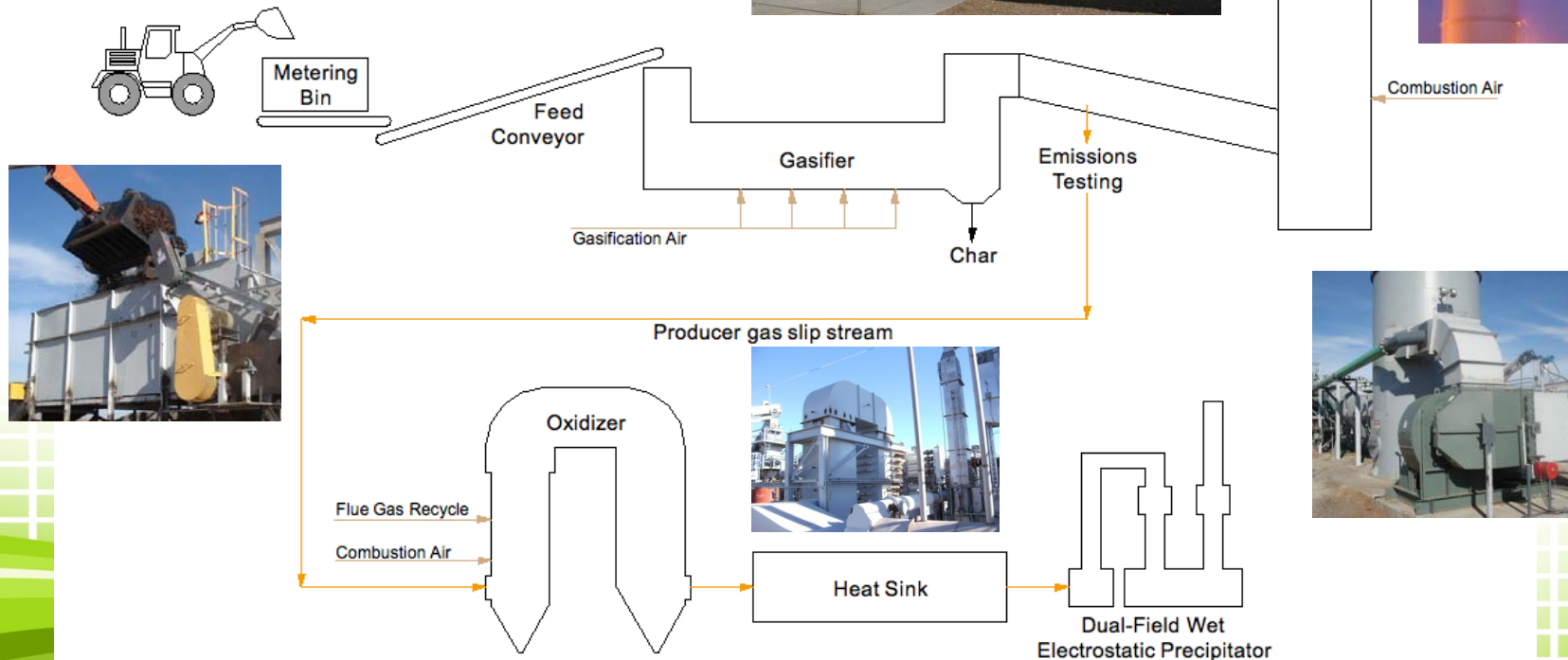


- **Small footprint**
 - 8 ft x 40 ft =150 ton/day
- **Low energy**
 - Minimal size reduction
 - < 5 hp for auger
 - < 15 hp air fan
 - **Fluid bed >>hp**



ICM's Commercial Demonstration Gasifier

- Evaluate feedstock performance
 - Maximum feed rate and turndown
 - Mass & energy balance and carbon conversion
 - Emissions testing services

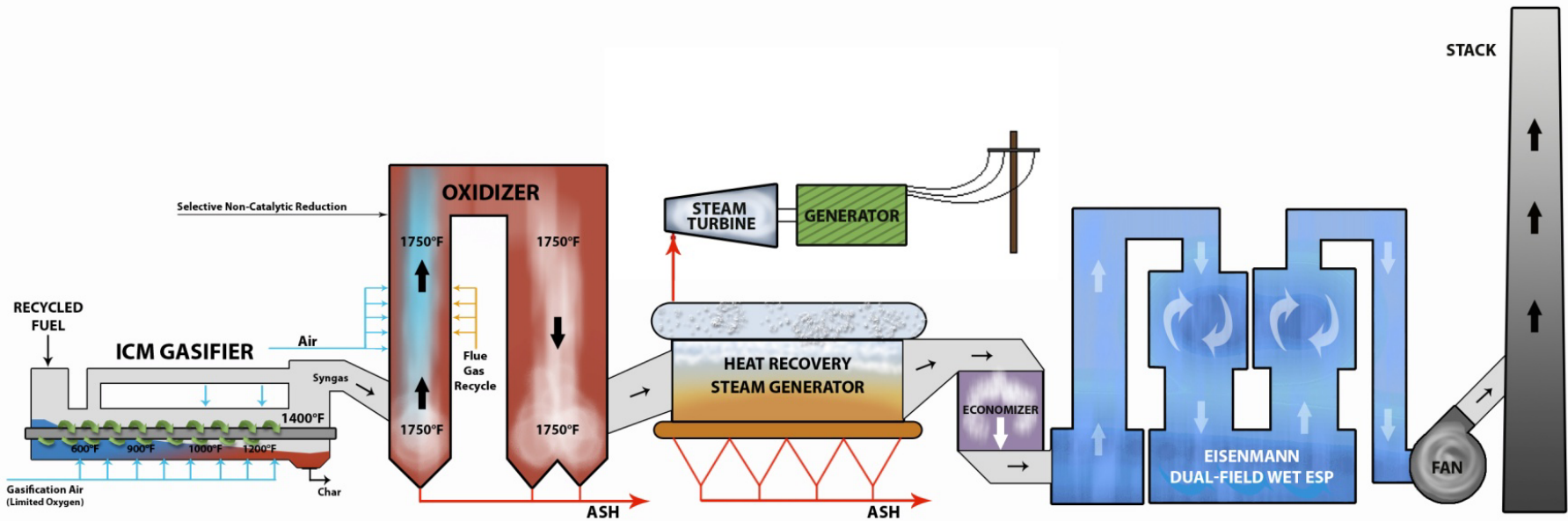


ICM's Commercial Demonstration Gasifier

- Located in Newton, Kansas
- 150 - 200 ton/day capacity

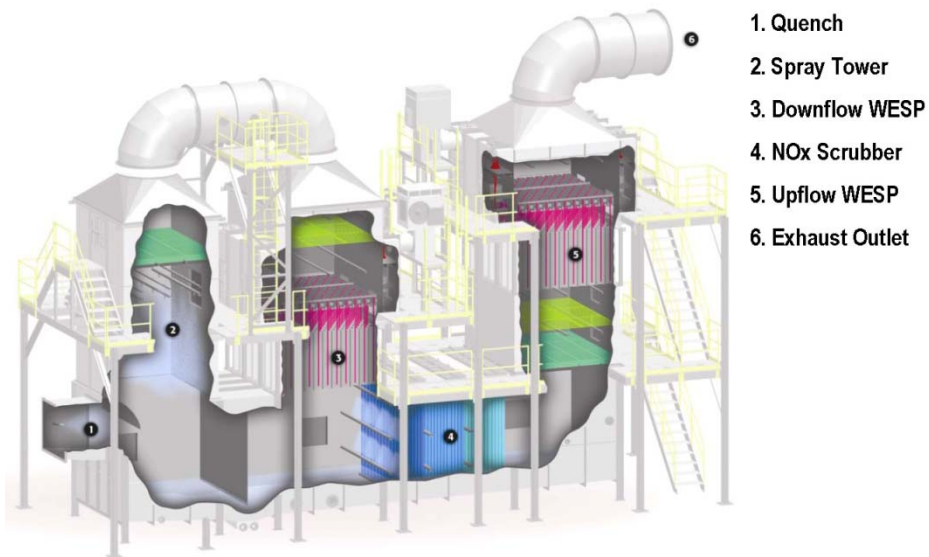


Process Overview – Combined Technologies



Flue Gas Emissions Control

- Particulate removal
- Staged injection of air & flue gas recycle
- NO_x - Selective non-catalytic reduction
- Dry sorbent injection
- Dual-field Wet ESP
 - Strategic alliance with
 - Syngas Gas Cleanup



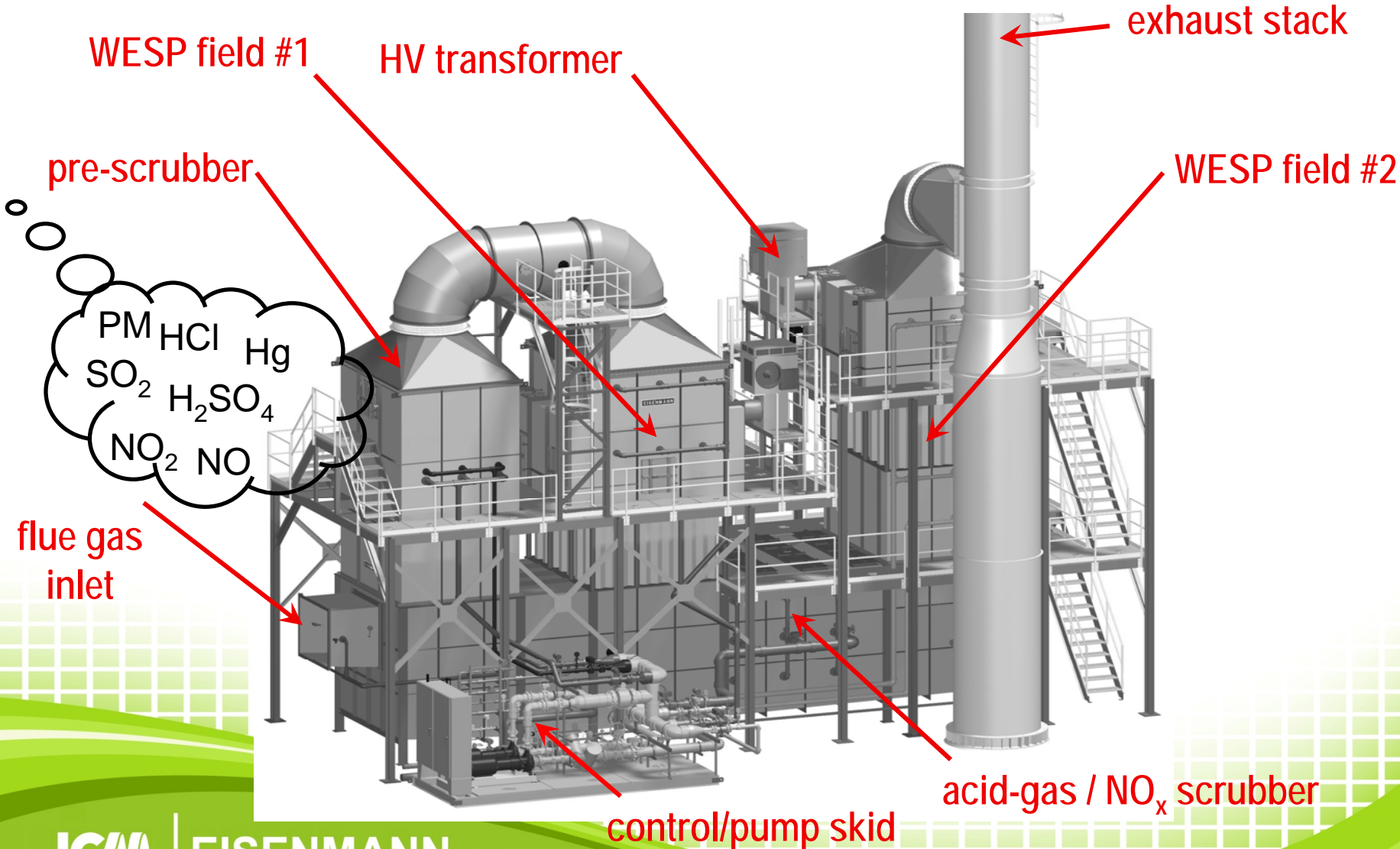
EISENMANN Crystal Lake, USA

Engineering, Project Management, Service, Sales and Marketing for US and Canadian Markets

- Planning
- Design
- Construction
- Installation
- Commissioning
- Training
- Maintenance
- Operation of Systems



WESP-2F Overview



Emission Abatement: WESP-2F

- Highly effective means to remove a wide array of pollutants
- SO₂, SO₃, HCl, NO_x, VOCs, PM, PM_{2.5} & Elemental Hg
- Condensable particulate, acid gases, and other compounds
- Unique and very effective method to abate constituents that are otherwise difficult to remove, such as NO_x and elemental Mercury.
- Few moving parts, this system is virtually maintenance free
- Very effective method to remove multiple pollutants

Demonstration Results to Date – Feedstock & Operation

- **7,300 tons** gasified
- **24 months** in operation, 2100 hrs
- **Two 100 hour continuous runs**
 - 100 hours on corn stover
 - 100 hours on wood chips
- **35 day continuous run**
 - Wood chips, stover and straw
 - Independent engineer's review

- **Wood Chips** **4,400 tons**
- **Corn Stover** **1,000 tons**
- **Wheat Straw** **400 tons**
- **Sorghum Stalks** **400 tons**
- **C & D** **200 tons**
- **Paper Pulp + Plastics** **100 tons**
- **Switchgrass** **50 tons**
- **Corn Bran + Syrup** **50 tons**
- **Auto Shredder Res.** **50 tons**
- **MSW (RDF) + Tires** **350 tons***
- **Chicken Litter** **200 tons**
- **Dairy Manure** **50 tons**
- **Manure + Woodchips** **50 tons**

* With November Test, figure will go over 1400 tons



Flared
Producer Gas



RDF

Wood Chips



Demonstration Results – Functionality & Emissions

- Fuel Flexibility – Wide Variety, Particle Size, Easy Transition/Switchover on Types of Fuel Demonstrated
- Moisture Contents Up to 50 wt% → No Drying Required in Most Cases
- Gasifier Paired with EISENMANN WESP meets BACT/LAER standards
- The gasifier & related equipment have literally been put through hundreds of thermal cycles (with day shift ops; restart & cold start times as low as 1 hr)
→ No refractory or related equipment issues
- Turndown demonstrated at 4:1
- Up to 90% volume reduction
- Vetted with two IE assessments
- EPA compliant emission testing on extended runs for RDF, RDF/TDF, Plastics & Cardboard, Wood Chips, Dairy Manure, and Poultry Litter.



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EISENMANN

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