Efficiency Improvements Through Emerging Polygeneration Technologies
About LP Amina
Vision for Coal Integrated Solution
LP AMINA WAS ESTABLISHED WITH A MISSION TO SERVE AS AN INTEGRATED PLATFORM FOR DEVELOPMENT AND DEPLOYMENT OF CLEANTECH SOLUTIONS GLOBALLY

100+
Full time employees, on 3 continents

5
R&D Centers, with activities in the US, Europe and Asia

30+
years
Average experience of LP Amina’s core technical team

10+
Patents, focused on coal / biomass conversion and pollution control

60+
Engineers covering all disciplines

15GW
Projects completed in last 5 years

About LP Amina

GUANGZHOU SHAJIAO LNB PROJECT

BELING CAQIAO SCR PROJECT

FENGTAI, CLASSIFIER PROJECT
LP AMINA HAS DEVELOPED THREE COMPLEMENTARY PRODUCT LINES THAT IT MARKETS GLOBALLY, WITH PRIMARY FOCUS ON CHINA AND THE UNITED STATES

De-NOx Solutions

- **Market leader** in pre-combustion de-NOx solutions via *in-furnace optimization* in China.
- Developed proprietary post-combustion de-NOx solutions – **SCR** (Selective Catalytic Reduction) and **SNCR** (Selective Non-Catalytic Reduction)
- Over 30 **De-NOx** projects already installed across China’s 13 provinces.
- Up to 98% of the NOx reduction
- Clients include: China Huaneng Group, Guangzhou Yuedian Group.

Classifier Technology

- Developed a range of proprietary **coal-classification technologies** which applicable for most pulverizers
- Achieved 0.5-1% system efficiency improvements, **payback period is as low as 4 months**
- Incremental **10-15% reduction in NOx emissions** from improved fineness.
- Increased fuel flexibility, increased mill throughput potential.
- Successfully piloted in China.

Polygeneration Systems

- **A family of technologies** for converting coal and biomass into wide range of chemicals parallel to power production
- All technologies have extraordinary **cost and environmental advantages** for both power generation and chemical production
- **Joint Venture** signed with Gemeng in 2012 to pilot the technology in China and the unit is undergoing commissioning
- **R&D efforts** underway in China, U.S., and Germany to improve the performance and expand the versatility of the system

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EVERYTHING THAT CAN BE MADE FROM OIL CAN ALTERNATIVELY BE MADE FROM COAL THROUGH DIFFERENT PATHWAYS

Typical Gasification Pathways

Source: NETL
COAL OFFERS THE MOST RELIABLE AND AFFORDABLE FORM OF CARBON, ABOUT 15 TIMES CHEAPER THAN OIL-DERIVED CARBON

**Current Market Price for Carbon, USD per Ton of Carbon**

- **Coal**: $60 per ton, 50% carbon content
- **Natural Gas**: $158 per mmbtu, 78% carbon content
- **Biomass**: $235 per ton, 38% carbon content
- **Crude Oil**: $841 per barrel, 85% carbon content

Source: EIA, LP Amina Analysis
Coal to chemicals (olefins, methanol, etc) is a rapidly growing industry, primarily in China, with many projects under development now.

**Coal-to-Olefin Project Distribution**

Thirty-three coal-to-olefins (CTO) projects planned or running in China as of August 2013.

Source: 5th Coal to Olefin conference in Nanjing
Please confirm source with CHEN Jinqian (Coral) on the R&D team

Zedler, Matthew, 3/10/2014
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LP AMINA’S SOLUTION UPGRADES LOW-VALUE COAL AND TURNS A CONVENTIONAL POWER PLANT INTO A POLY-GENERATION FACILITY, CAPABLE OF PRODUCING POWER AND HYDROCARBONS

Conventional Approach

Coal → At a conventional power plant coal is directly oxidized to produce steam and then power → Power

LP Amina’s Integrated Solution

Low Rank Coal → COAL BENEFICIATION → Upgraded Coal → POLYGENERATION → Power

COAL BENEFICIATION

Low Rank Coal → Hydrocarbons

POLYGENERATION

Upgraded Coal → Hydrocarbons → CO2 (ready for capture)
IN COLLABORATION WITH GEMENG INTERNATIONAL LP AMINA HAS BUILT A DEMONSTRATION FACILITY FOR COAL-TO-INTERMEDIATES TECHNOLOGY IN CHINA

LP Amina 50 MW Demonstration Facility Designed to Co-produce 100,000 barrels/year

LP Amina’s demonstration facility in Shanxi, China. Groundbreaking design will allow the power plant to co-produce electric power and high value bi-products, increasing revenues and cutting emissions.
LP AMINA IS PURSUING A PHASED DEVELOPMENT OF ITS TECHNOLOGIES, WITH COAL BENEFICIATION WORK FOCUSED IN THE U.S. AND POLYGENERATION IN CHINA

**Phased Approach to Technology Development**

### Beneficiation

- **DEMO**
  - US site, TBD (2015)

- **1st COMMERCIAL**
  - 75 T/hr coal flow (2016-17)
  - Slipstream from 200 MW plant

- **2nd COMMERCIAL**
  - US, TBD (2018)
  - 300 T/hr coal flow 600 MW

### Polygeneration

- **DEMO**
  - Yangquan, Shanxi (2013-14)
  - 50 MW plant, 25% heat input

- **1st COMMERCIAL**
  - China, TBD (2015-16)
  - 150 MW plant, 100% heat input

- **1st COMMERCIAL**
  - TBD (2015-16)
  - 75 T/hr coal flow 600 MW

- **2nd COMMERCIAL**
  - TBD (2018)
  - 300 T/hr coal flow 600 MW
LP AMINA
Growth Through Innovation

For more information visit: www.lpamina.com