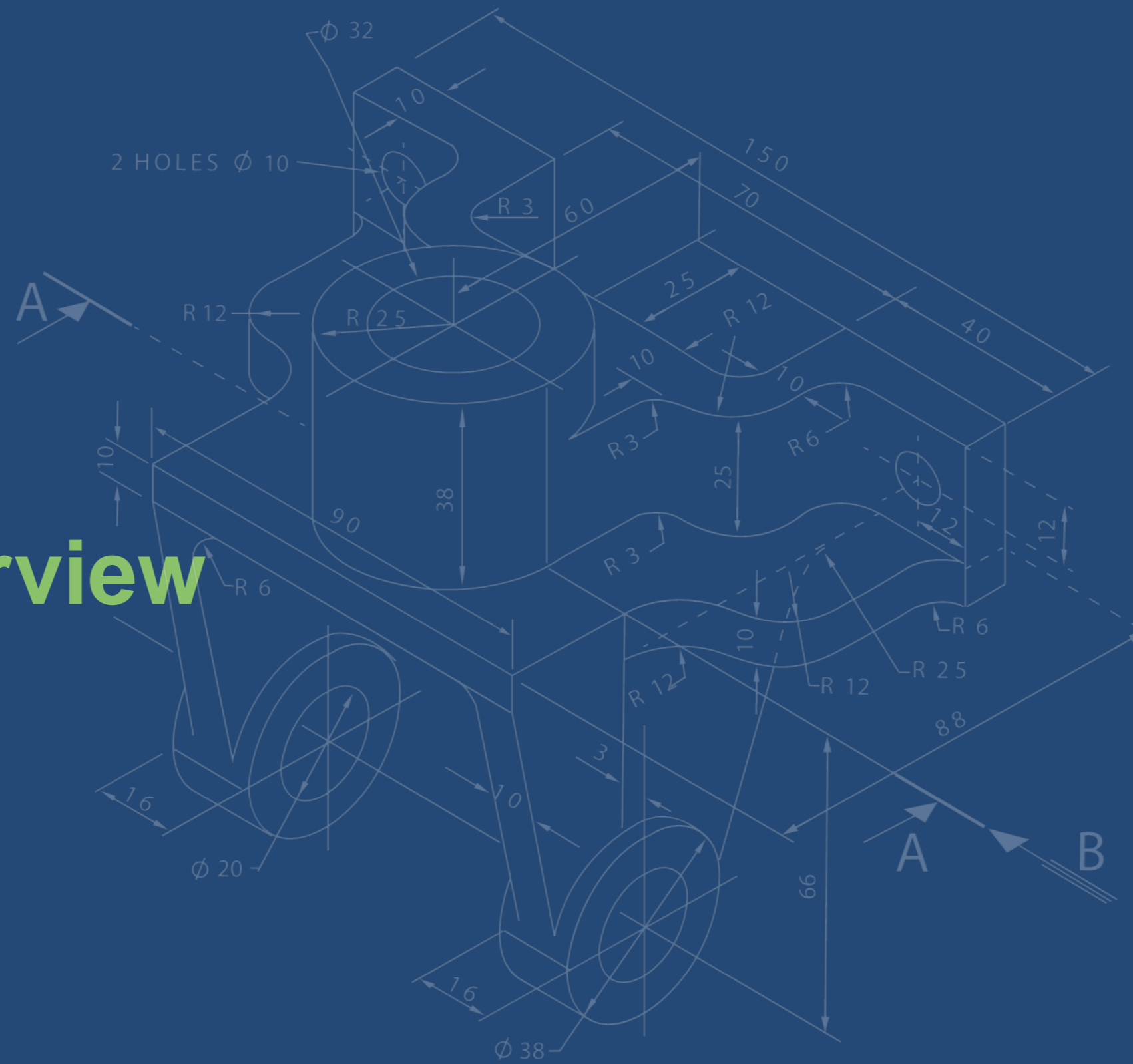


LP Amina Overview

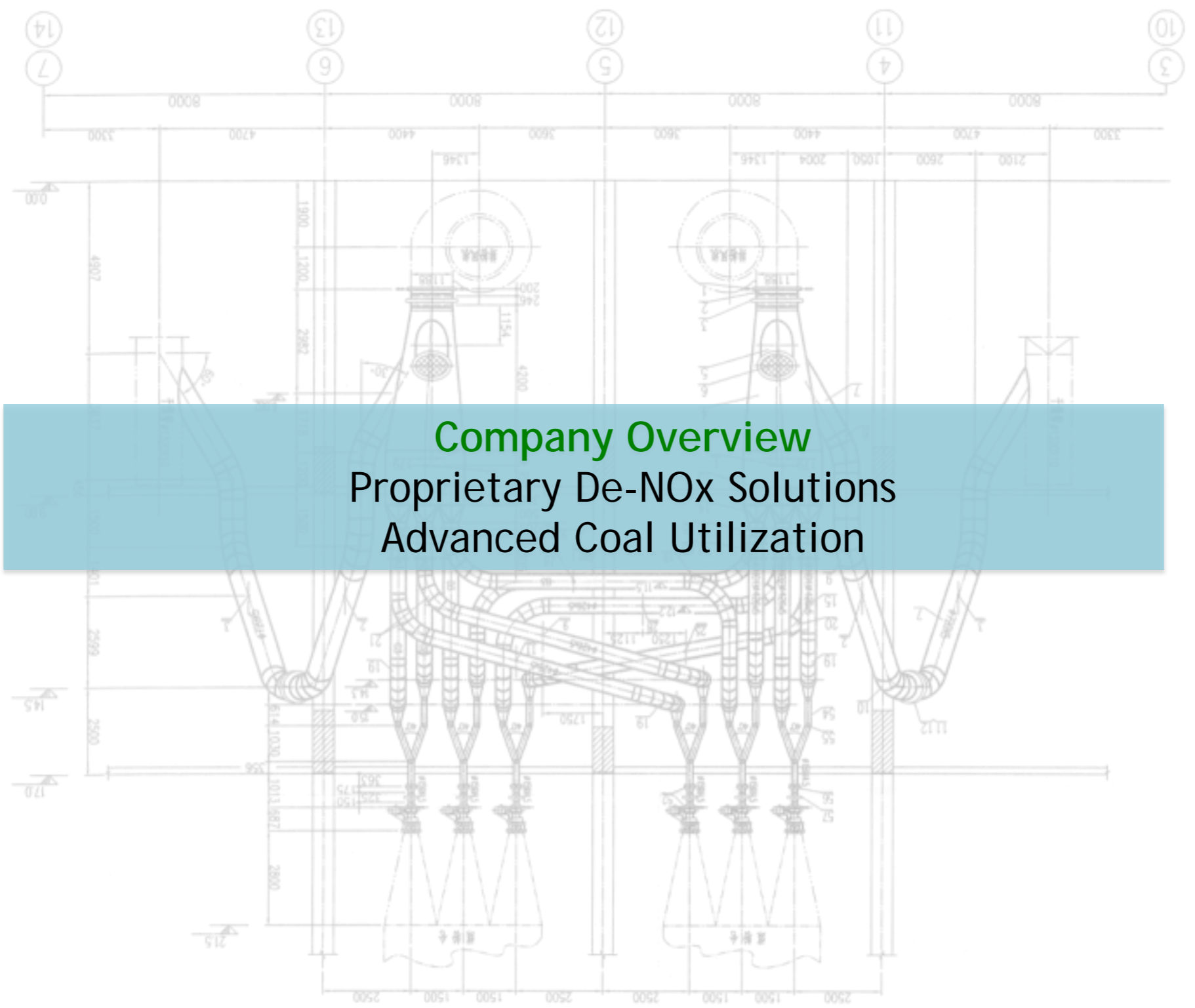


August 2015

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LP AMINA | Energy and Environmental

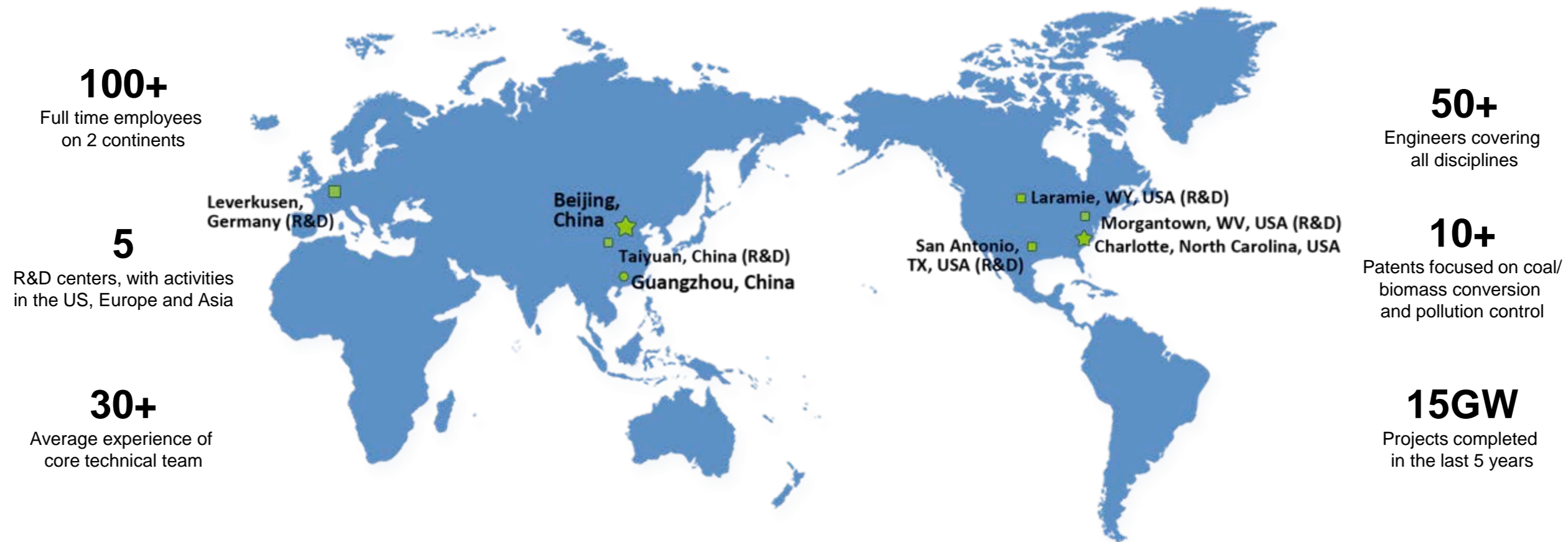


Company Overview

Proprietary De-NOx Solutions
Advanced Coal Utilization

LP Amina at a Glance

LP Amina was established in 2007 with a mission to develop and deploy clean and profitable energy solutions globally



Emissions Control Solutions

Wide range of proprietary and customized De-NOx solutions that help coal-, gas-fired power plants as well as the industry (cement, paper, steel) meet the emissions regulation at an affordable price.



Advance Coal Technologies

Family of technologies that enable existing coal-fired power plants to produce valuable chemicals and fuels while generating electricity, all under one roof. Have extraordinary cost and environmental advantages.

LP Amina - Three Innovations in One

LP Amina is underpinned by a unique R&D model and a vast network of partnerships that support the development of the technology.

What is Unique About Our Approach:



1. Market-Disrupting Technology
2. Unique Business and R&D Models
3. Cross-Border & Cross-Industry Collaboration Network

LP Amina plays a **constructive role** in developing clean energy cooperation between the US and China. Pairing **technological know-how** from the U.S. with China's **robust infrastructure** and drive for economic development, LP Amina's technology portfolio is a great tangible example of the **new age** of the US-China Energy Cooperation.

U.S.-China Bi-Lateral Cooperation Shaping Our Markets

LP Amina has formed public sector partnerships, in both U.S. and China, to benefit the provision of sustainable energy in both markets and globally



ECP Member Companies with US Secretary of State Kerry (2013)



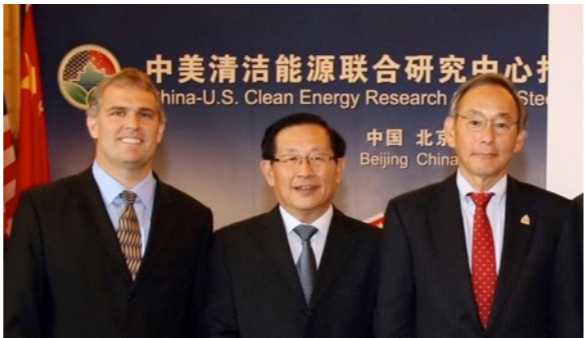
US Ambassador Baucus at Hepo Power Plant (2015)



US Ambassador Baucus at Hepo Power Plant (2015)



Will Latta and the former US Ambassador Gary Lock (2011)



Will Latta with the Minister of Science and Technology of PRC and the former US Secretary of Energy Dr. Steven Chu (2012)



US Ambassador Baucus at Hepo Power Plant (2015)



Will Latta with the US Secretary of Energy Dr. Ernest Moniz and Ningke Peng, VP Dow Chemicals (2014)

Private Companies



Bayer
Technology
Services



China
Huaneng
Group



Gemeng
Energy
Group

Research Institutions



University
of Wyoming



West Virginia
University



US-China
CERC

Government Entities



US-China
ECP

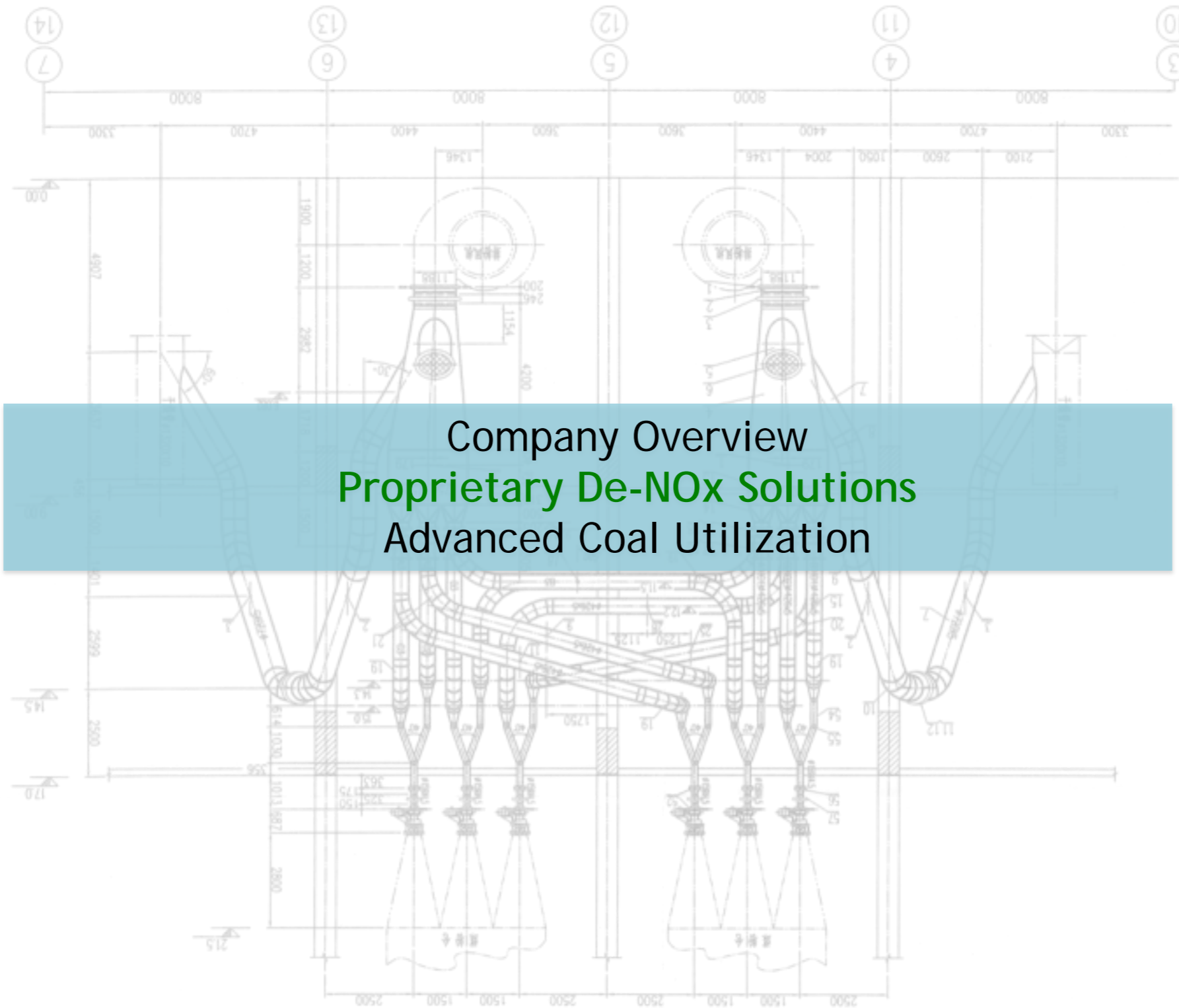


US-China
CERC



US
TDA

Growth Through Innovation

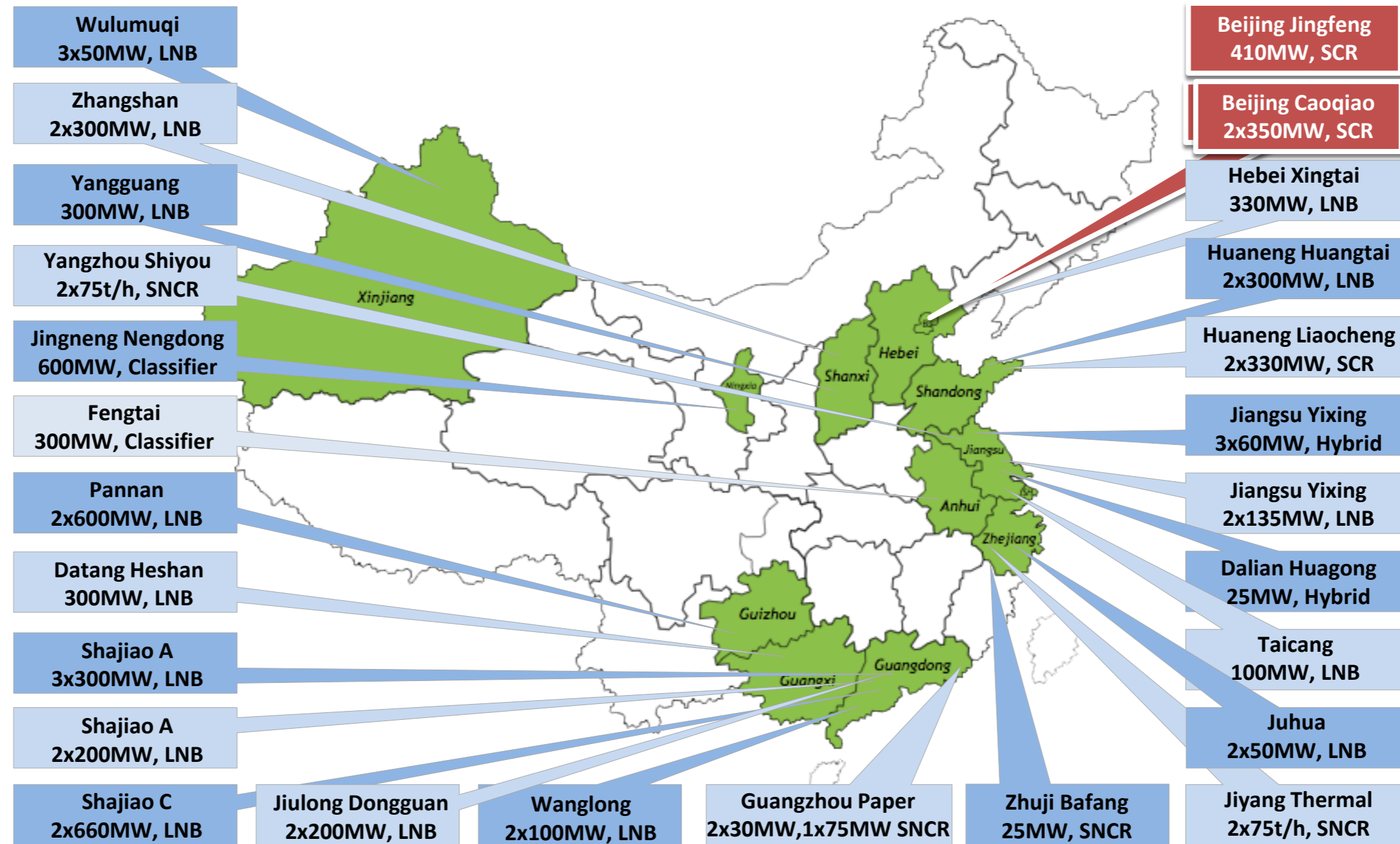


Company Overview
Proprietary De-NO_x Solutions
Advanced Coal Utilization

LP Amina's Completed De-NOx Projects in China



Since 2009, LP Amina has completed over 50 projects in China, achieving superb results and lowering NOx emissions below target levels

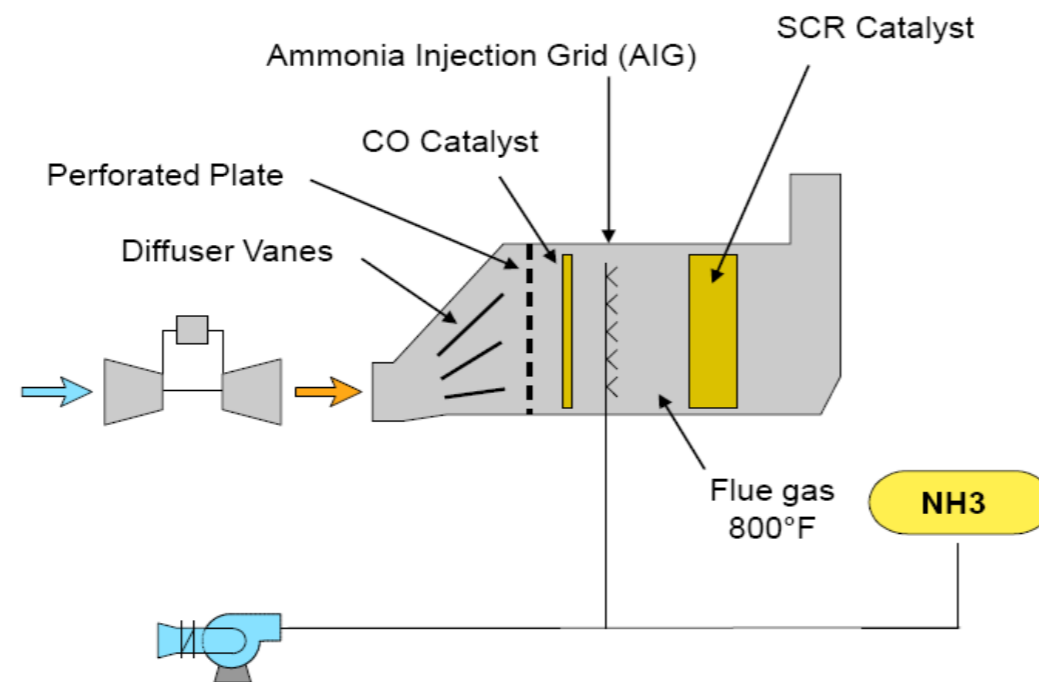


Direct Injection SCR / CO Reactor Design

Patent Approved July 2015

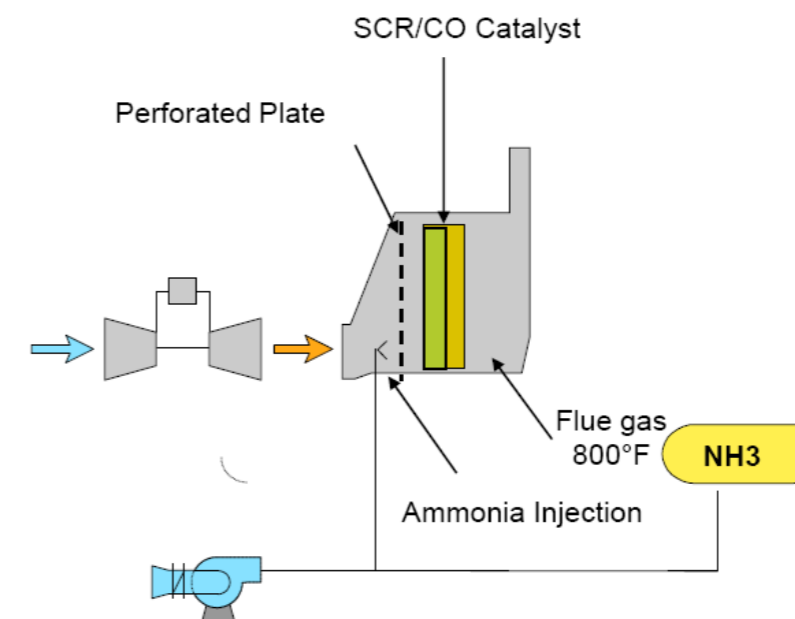
Solution Comparison

Traditional



- CO Cat/AIG/SCR Cat
- Large Distance Between AIG & SCR Cat. (Mixing)
- Fairly Complex AIG
- Difficult to achieve NH₃/NO_x RMS < 10%

Direct Injection

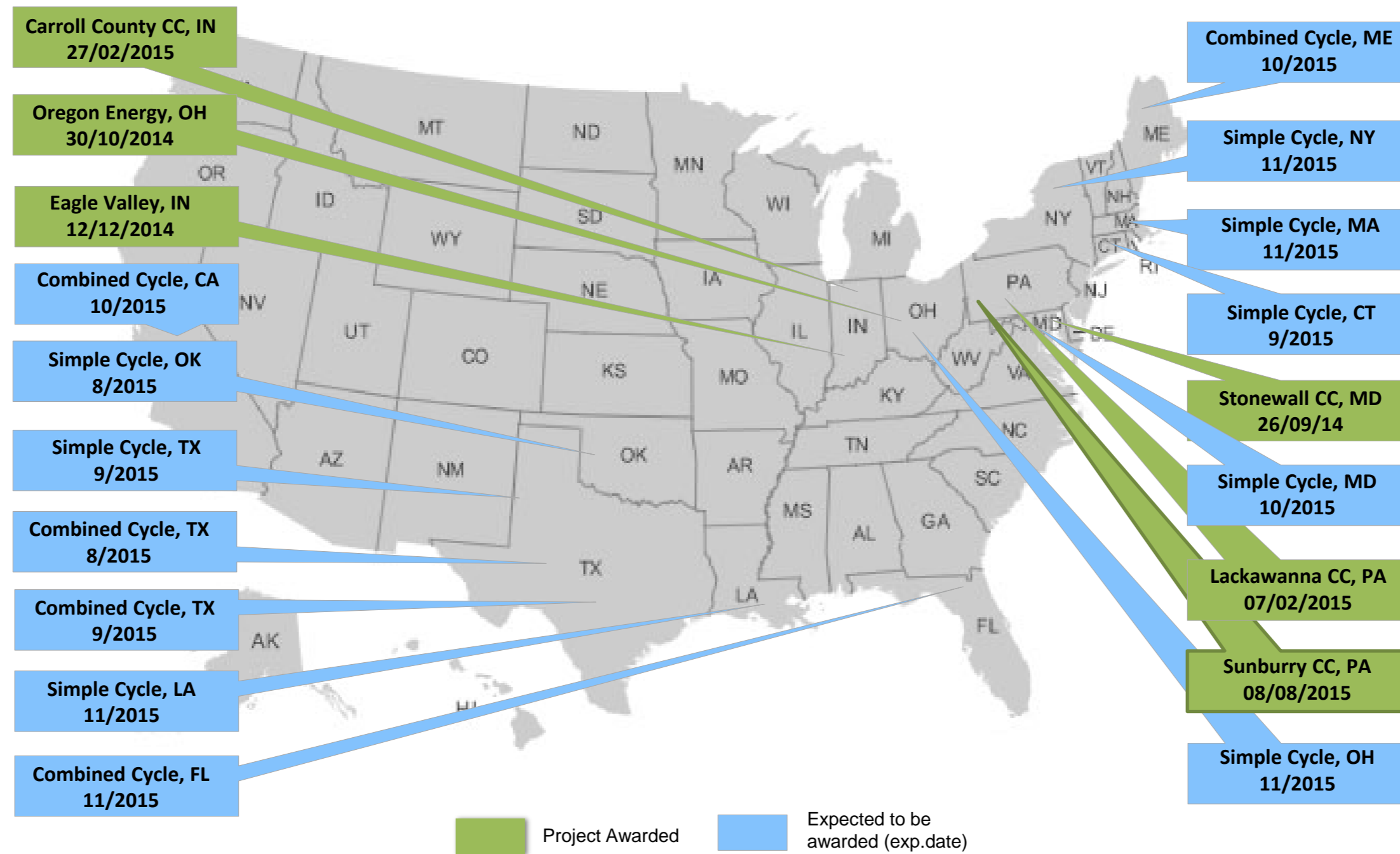


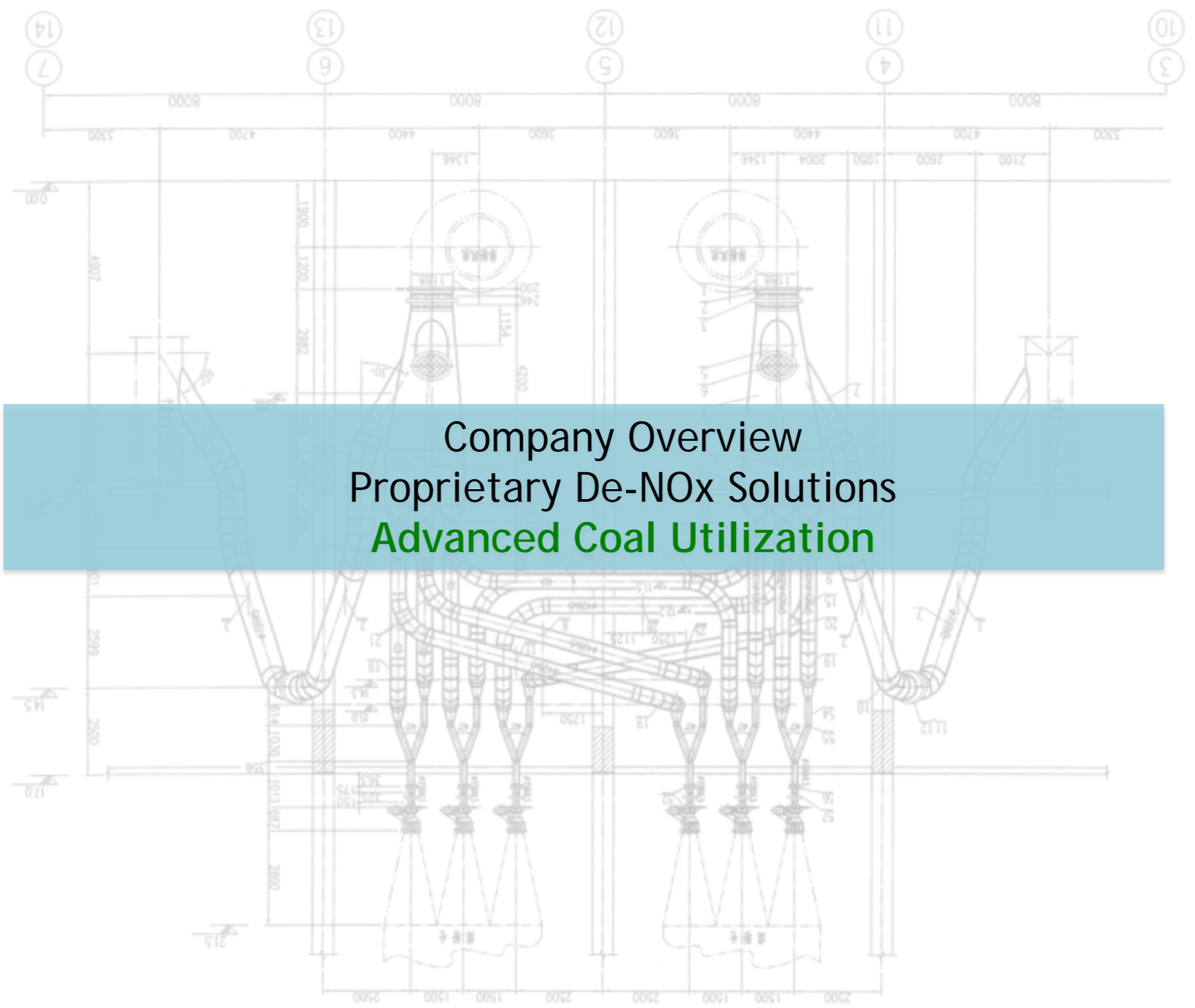
- AIG/SCR Cat/CO Cat
- Much more compact design
- CO Cat also reduces NH₃ slip
- Simple Reagent injection near turbine exhaust
- High velocities improve mixing
- Easy to achieve NH₃/NO_x RMS ~ 5%

LP Amina's Awarded and Hi-potential Projects in the US



In 2014, with the development of the US gas market, LP Amina successfully transferred its latest innovative technologies from China to capture US market share.



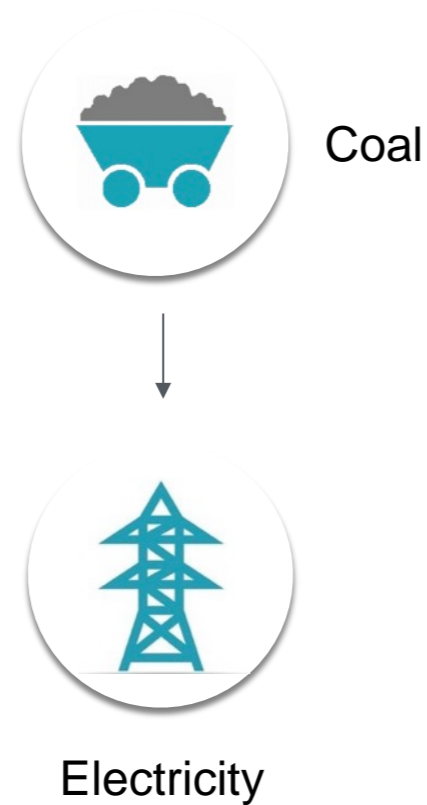


Company Overview
Proprietary De-NOx Solutions
Advanced Coal Utilization

Significantly Improving the Economic Viability of a Power Plant

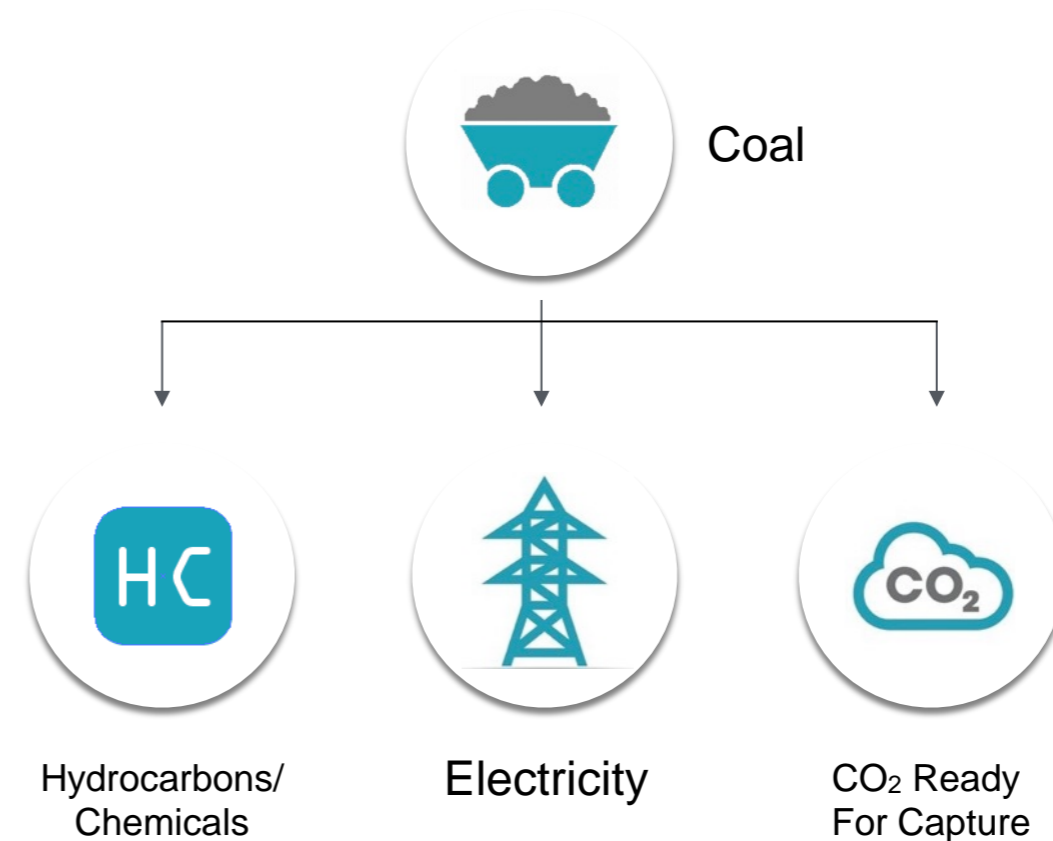
LP Amina's technology combines the highest value components of several processes to increase efficiency resulting in compelling economics.

Conventional Approach



*At a conventional power plant coal is **directly** oxidized to produce steam and then electricity.*

LP Amina's Technology (BenePlus and Polygen)



*LP Amina's technology enables existing **power plants** to co-produce electricity, valuable **chemicals and CO₂**, which improves efficiency, improves economic return and reduces carbon emissions.*

Pilot Plant in San Antonio Texas Started Operation in March 2015

Pilot plant is demonstrating improved yields compared to bench scale results

About SwRI

LP Amina's Pilot Scope & Timing



- Independent non-profit organization
 - Over 1,200-acre facility in San Antonio, Texas
 - Founded in 1947; Over 3,000 employees
 - Revenues ~\$600 million per year, 60% gov.
 - Chem. Eng: 69 FTEs, 6 PhDs, 7 M.S., 45 B.S.
 - Vast experience with liquids handling
 - Experience with clean coal technologies
- **Processing capacity:** ~1 ton / day continuous
 - **Timeline:**
 - Sept 2014: Started work
 - Jan 2015: Construction complete
 - Feb 2015: Single pass tests
 - Mar - Aug 2015: Range finding
 - Sept – Dec 2015: Continuous operation (24/7)

Reducing Emissions to Near Zero

BenePlus achieves efficient low-cost removal of pollutants from coal enabling cleaner more efficient combustion.

1. Removes Water

- Can reduce moisture content to 5%
- Reclaimed water can be purified and reused

2. Reduces Pollutants

- Reduces mercury content by 50%-80%
- Reduces sulfur content by 90%+

LP Amina's BeneficiationPlus

3. Improves boiler efficiency

- Up to 6% from burning higher rank coal
- Use of fuel gas further reduces CO₂ footprint

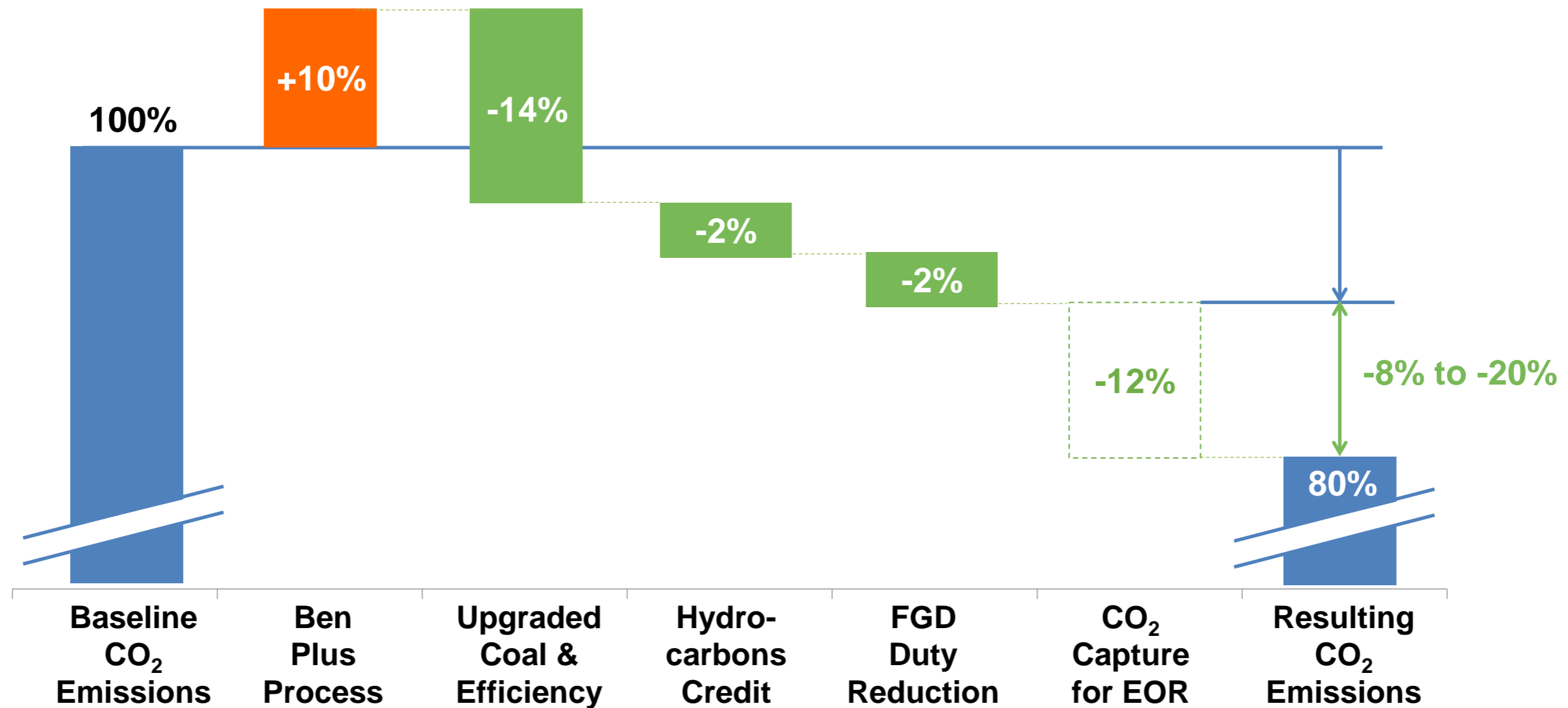
4. Captures CO₂:

- Pure stream of CO₂ as by-product
- Low cost to capture and compress

BeneficiationPlus™ CO₂ Reduction

CO₂ footprint reduction comes from: (1) upgraded coal & fuel gas efficiency gain (2) co-production credit (3) FGD duty reduction and (4) CO₂ EOR

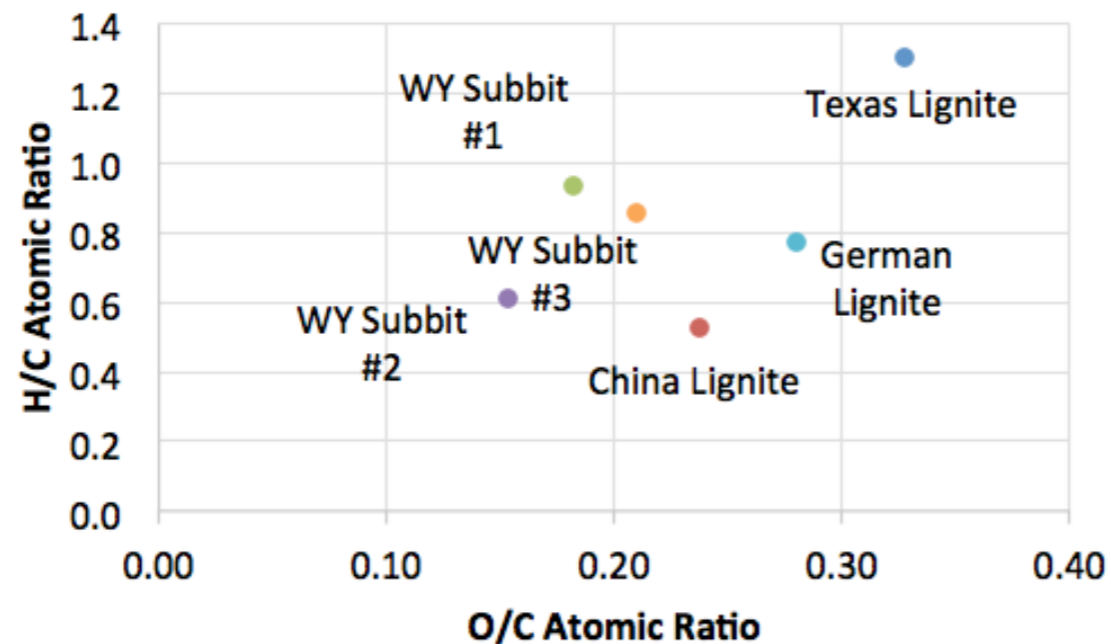
Effect of BeneficiationPlus™ on a Lignite-fired Power Plant CO₂ Footprint



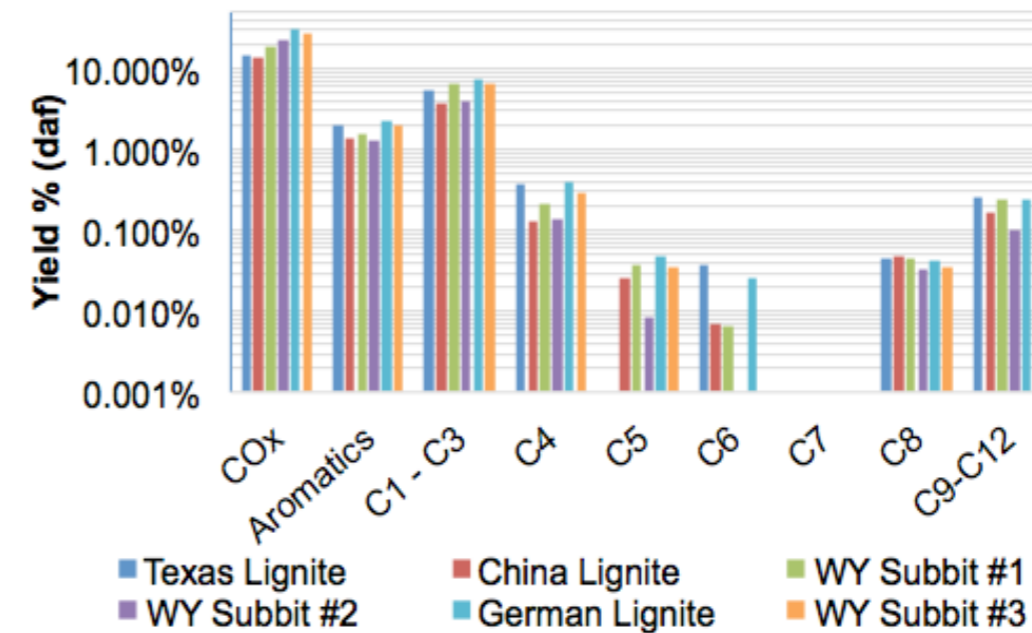
BeneficiationPlus Process

The BenePlus process converts part of the volatile matter to high quality, low sulfur, low tar, light fuels and aromatics

Van Krevelen Diagram for Tested Coals



Pyrolysis Product Yield for the Tested Coals



Patent Filing

- **Patent** filed on May 23, 2014
- **7 inventors**, including 4 LP Amina staff and 3 Bayer Technology Services staff
- IP legal counsel provided by **Foley & Lardner**, a long-time partner of LP Amina
- 30 claims; claims structured to provide **broad patent coverage** of the technology
- **Low tars and heteroatoms among the significant advantages** over prior art
- Over **200 references** examined covering 100 years of prior coal-to-chemicals work

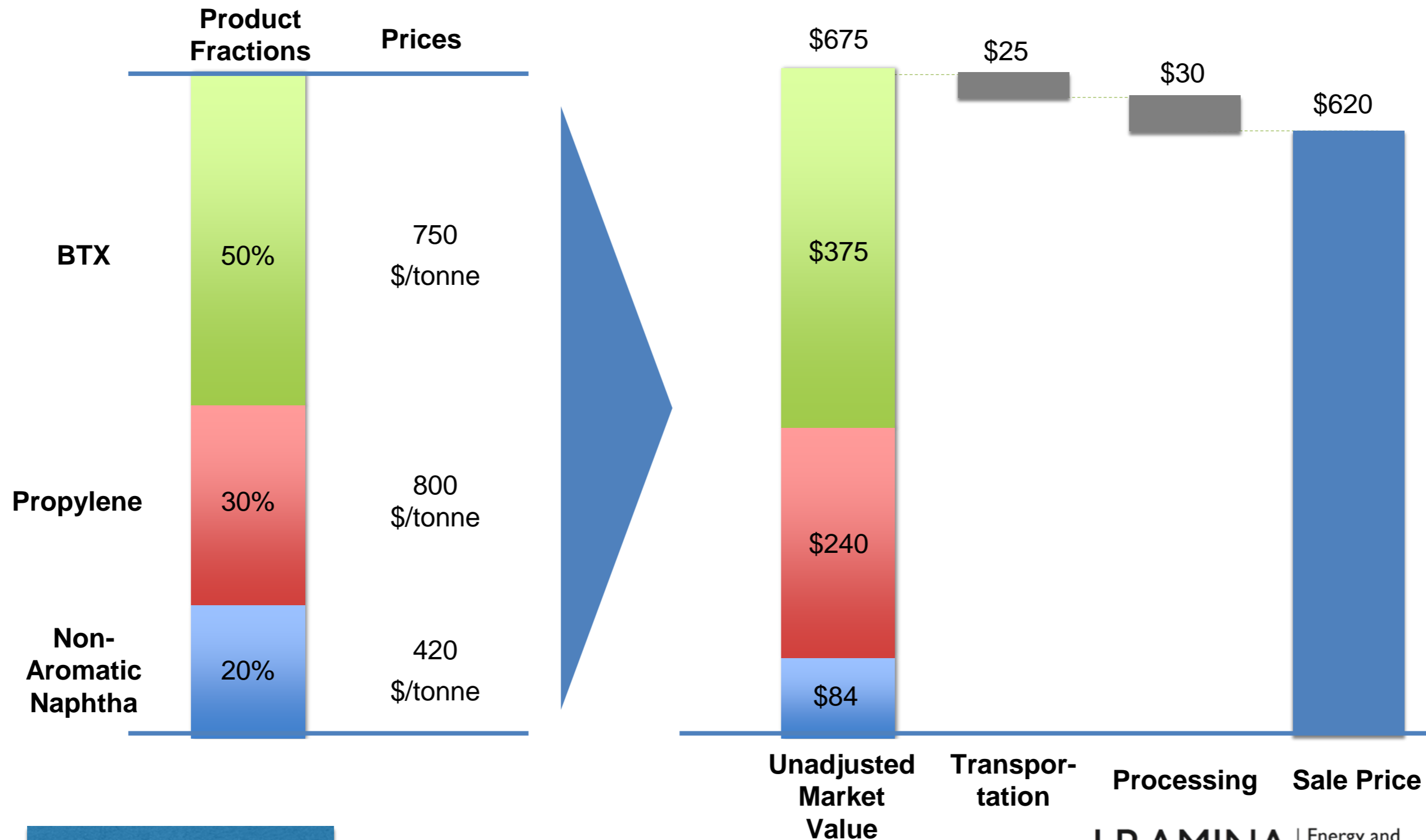
Beni+ Product Slate with ND lignite at optimized conditions

Lignite feed, dry basis	ND lignite (final data)
VM, wt%	43.8
Ash, wt%	14.5
Fixed C, wt%	41.8
Sulfur, wt%	1.7
Sulfur emissions, lb sulfur/MMBtu lignite burned	1.65
HHV, Btu/lb, dry	10,103
HHV, Btu/lb, as received	6,343
Moisture, wt%	37.2
Syncoal product	ND lignite
VM, wt%	25.4
Ash, wt%	19.0
Fixed C, wt% (by difference)	55.6
Sulfur, wt%	0.7
Sulfur emissions, lb sulfur/MMBtu syncoal burned	0.69
HHV, Btu/lb	11,016
Moisture, wt%	1.1
Yield, lb/100 lb dry coal feed	57.8
HHV upgrade, $HHV_{syncoal}/HHV_{feedcoal}$, as rec'd	1.7
Reduction in sulfur emissions per MMBtu	58%
Ash retained, lb / 100 lb ash fed	76

Product Gas Yield on Dry basis lb gas/lb coal fed Compositions (wt%)

CO2	CO2, wt%	10.2		
Fuel Gas	CO, wt%	6.67	10.7	
	H2, WT%	0.24		
	METHANE, WT%	2.18		
	ETHYLENE, WT%	1.16		
	ETHANE, WT%	0.43		
Hydrocarbons	RG Propylene	PROPYLENE, WT%	1.35	4.62
		N-PROPANE, WT%	0.15	
		ISOBUTYLENE, WT%	0.19	
	Naphtha Liq	1-BUTENE, WT%	0.10	
		1,3-BUTADIENE, WT%	0.08	
		TRANS-2-BUTENE, WT%	0.09	
		CIS-2-BUTENE, WT%	0.10	
		2-METHYL-2-BUTENE, WT%	0.11	
		N-HEXANE, WT%	0.13	
		BENZENE, WT%	1.19	
	BTX Liq	Toluene, wt%	0.98	
		Xylene, wt%	0.16	
	Sulfur	H2S, WT%	0.84	
OTHER SULFUR, WT%		0.13		
Phenol		0.1		
Higher HCs		0.2		
Total, wt%		26.77		

Given the high proportion of BTX and Propylene in the product slate, the hydrocarbons stream may be sold at up to 50% premium to crude



LP Amina has Developed a Consortium in ND to Commercialize BenePlus Technology

Partnerships



Coal Company
Provides input coal



Electric Utility
Upgraded coal off-take



Refinery
Hydrocarbon off-take

Preliminary Timeline (2014 – 2015)

Until February	Initial discussions with potential strategic partners. Steering Committee established (coal companies, utilities and fineries)
March	Technology readiness review at Pilot Facility, Texas, USA (1 st Steering Committee Review)
June	2 nd Steering Committee Review.
August	HCs produced at pilot facility validated
Sept - Dec	Kick-off 3 rd party validation, feasibility, permitting, FEL 1.

The Phased Deployment Approach

	PMU ~25 tons / day	Phase I* C5 – C12	Phase II* AGR, C3, C4 CO ₂ , deSOx	
Timing	2016	2017-2018	2018-19	
Coal Input	1 ton / hour	500 tons / hour	500 tons / hour	<ul style="list-style-type: none"> • Product Marketing Unit (PMU) will prove product quality and quantity • Phase I results in a product mix of aromatics and light diesel which is well suited for most refineries • Phase II is a fully commercialized system ready for world-scale deployment
Upgraded Coal Produced	.45 ton / hour	213 tons / hour	213 tons / hour	
Hydrocarbons Output	2 bbls / hour	14.5 tons / hour	70 tons / hour	
Capital Required	\$25M USD	\$150M USD	\$100M USD	
Simple Payback	NA	< 5 years	< 8 years	

Thank You