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ION Novel Solvent System for CO_2 Capture
FE0005799

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Sheraton Station Square, Pittsburgh, PA
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Presentation Outline

- ION Advanced Solvent Background
- Project Overview
- Technology Fundamentals
- Progress & Current Status
- Plans for Future Commercialization
- Acknowledgements

ION Engineering Background

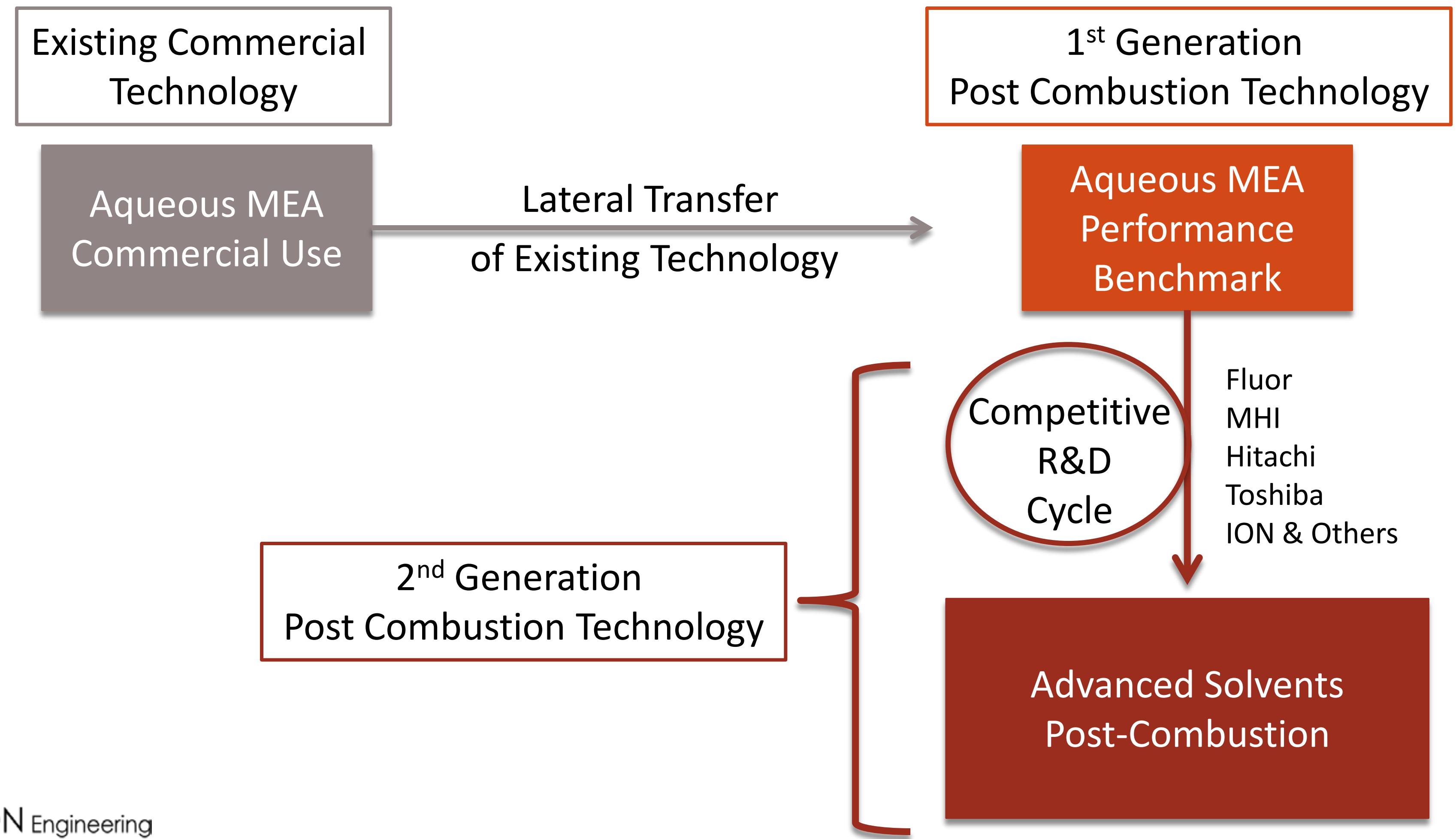
Mission Statement:

Develop new solvents and processes for *economic* removal of CO_2 from industrial emissions.

Markets:

- Coal-fired flue gas
- NGCC-fired flue gas
- Sour gas processing

1st & 2nd Generation CO_2 Capture



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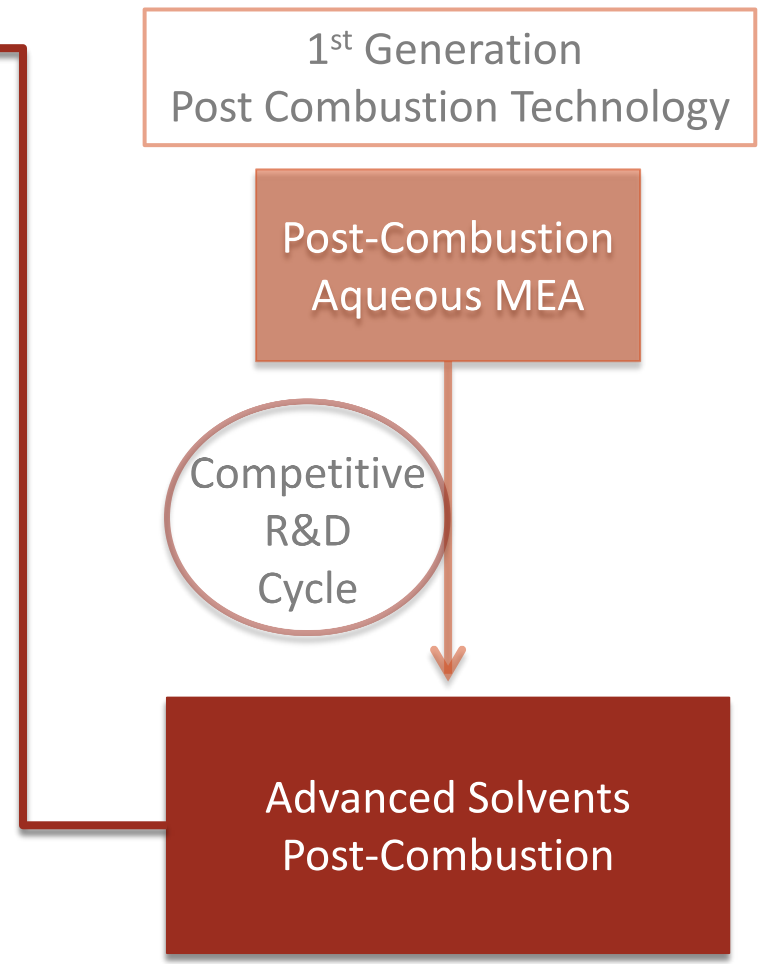
ION CO_2 Capture Technology

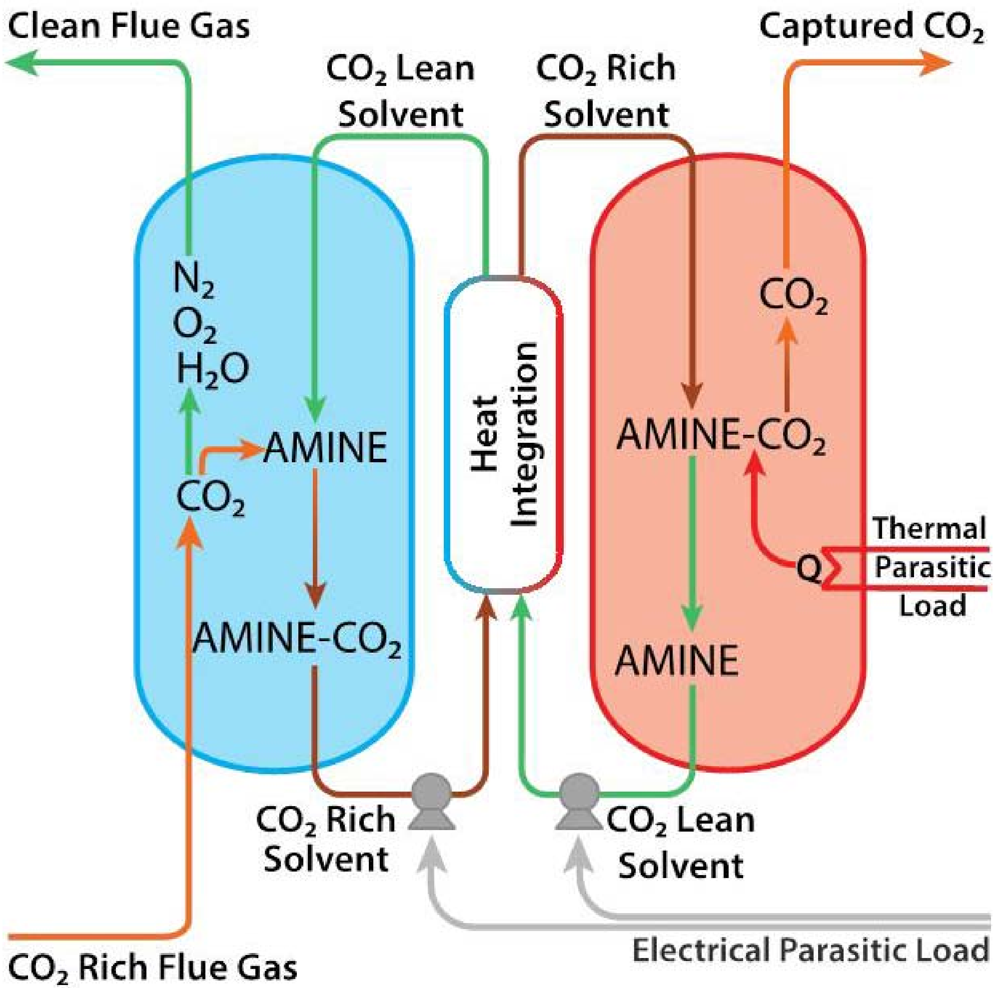
2^{nd} Generation - Adv. Solvent

- Non-Aqueous Solvent Matrix
- Enables ION to…
  - Manipulate physical and chemical solvent properties
  - Impact reaction rates, extent of reaction & thermal requirements
- Solvents are H_2O miscible & tolerant



ION Solvent Process

- **Retrofit** for 1st generation aqueous amine processes
  - Utilize existing process equipment & capital investments
- Compatible with aqueous amine CO_2 capture processes
- Leverage existing know-how, R&D and technology



Advantages & Challenges

Advantages

- Regeneration energy
- Circulation rates
- Auxiliary load
- Make-up water
- Established engineering process

Challenges

- Overall capture costs
- Access to CO_2 utilization sites
- Availability of project financing
- Market demand
- Regulatory pressure

ION Advanced Solvent Project Overview

- 36 month project (Oct. 2010 – Sept. 2013)
- Goal: Determine if ION's solvent has the potential to meet DOE performance objectives
- $6.5M total project funding
  - $4.8M DOE
  - $1.6M ION (25% ION and partners)

CO_2 Capture Project (CCP3)

Goals and Objectives

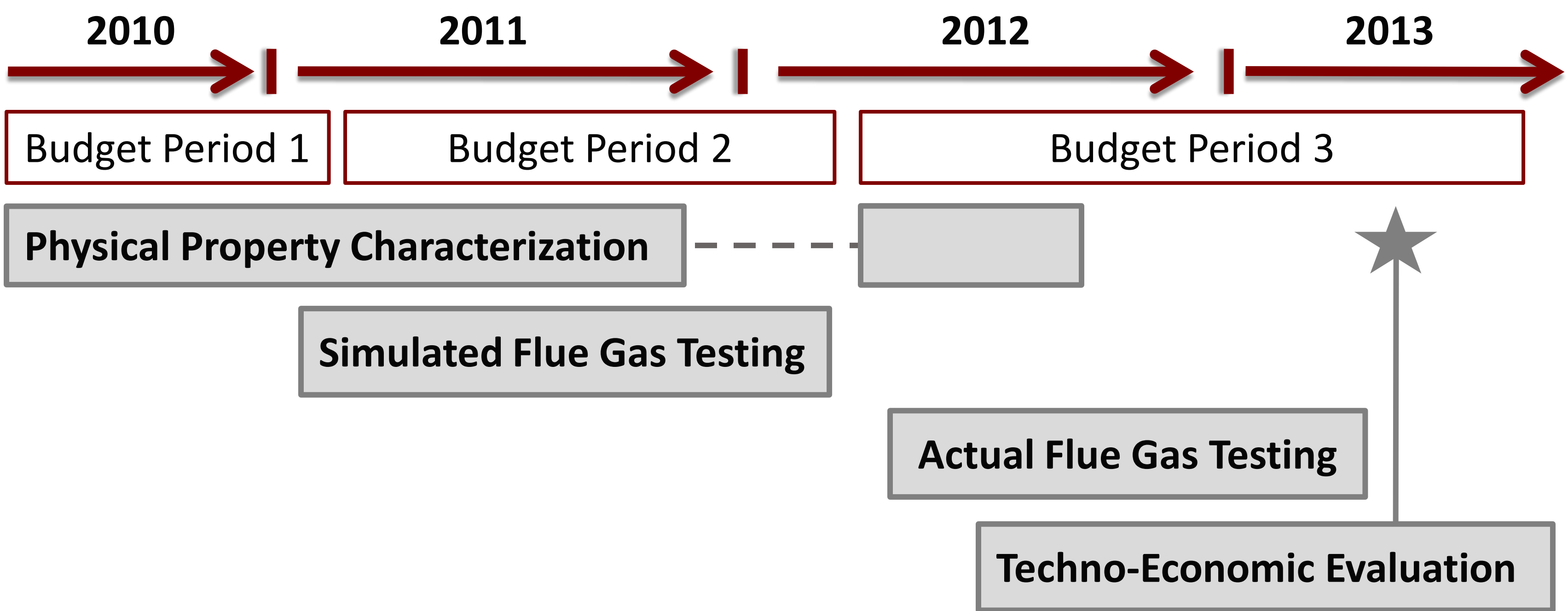
Primary Project Goal:

Determine if ION’s solvent process can achieve > 90% CO_2 capture with < 35% increase in COE

Primary Objectives:

- Physical & chemical property analyses
- Steady-state testing
- Techno-economic analyses

Scope of Work & Project Status



<u>As of 6/30/2013:</u>

- The Program is >95% complete.
- Final data analysis and report preparation remaining.
- The Program has advanced from TRL 3 to TRL 5.

Testing at ION

Chemistry

- Solvent screening and development
- Physical and chemical property analytics

ION Lab Pilot

- Simulated Flue Gas
- Steady state testing
- 0-180 slpm gas; 6-12 gph liquid

Simulations (Aspen Plus)

- Regeneration energy

Testing at EERC

EERC CTF Facilities

- 550,000 Btu/hr (0.25 MW) multi-fuel capability

ION Testing Program at EERC

- Actual flue gas
- Measurement of heat input required for solvent regeneration
- Performance Benchmarking – Direct comparison to Aq-MEA

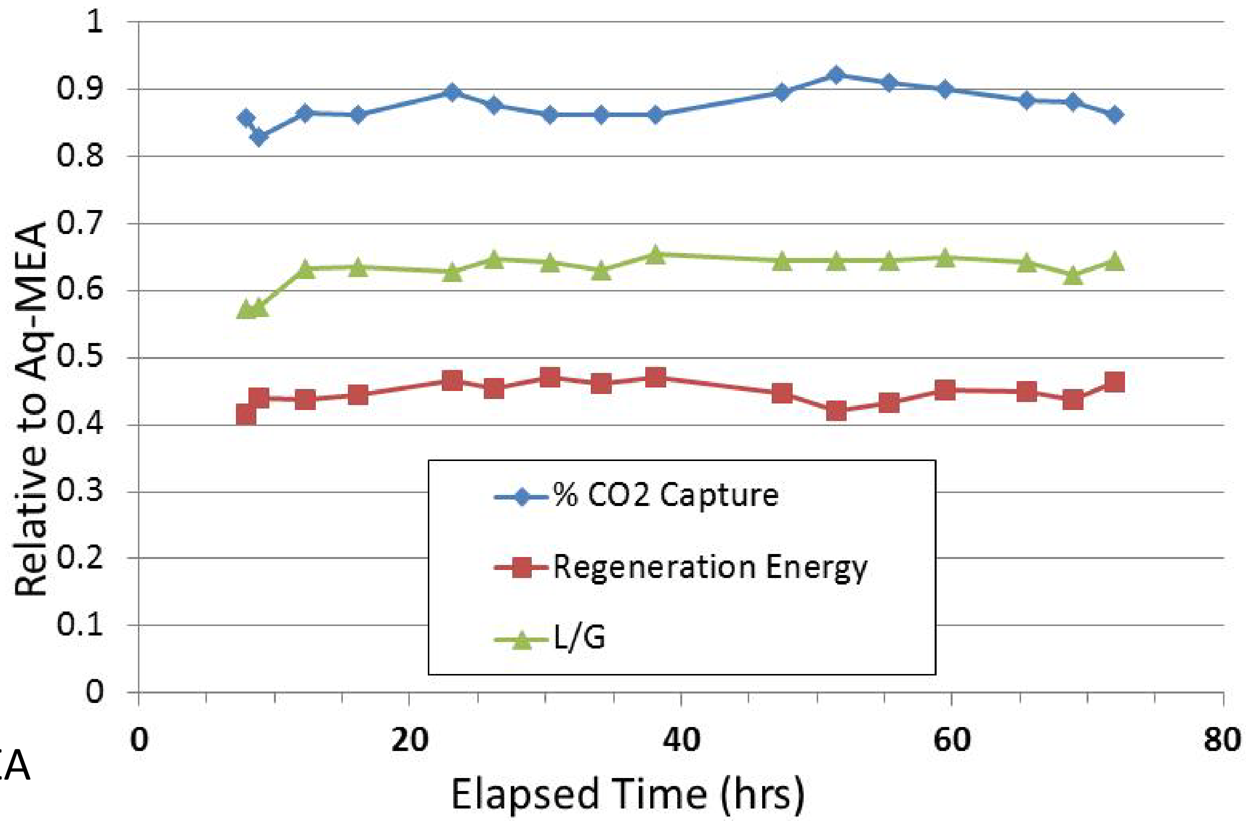
Results from 72 hr test at EERC

Test Conditions

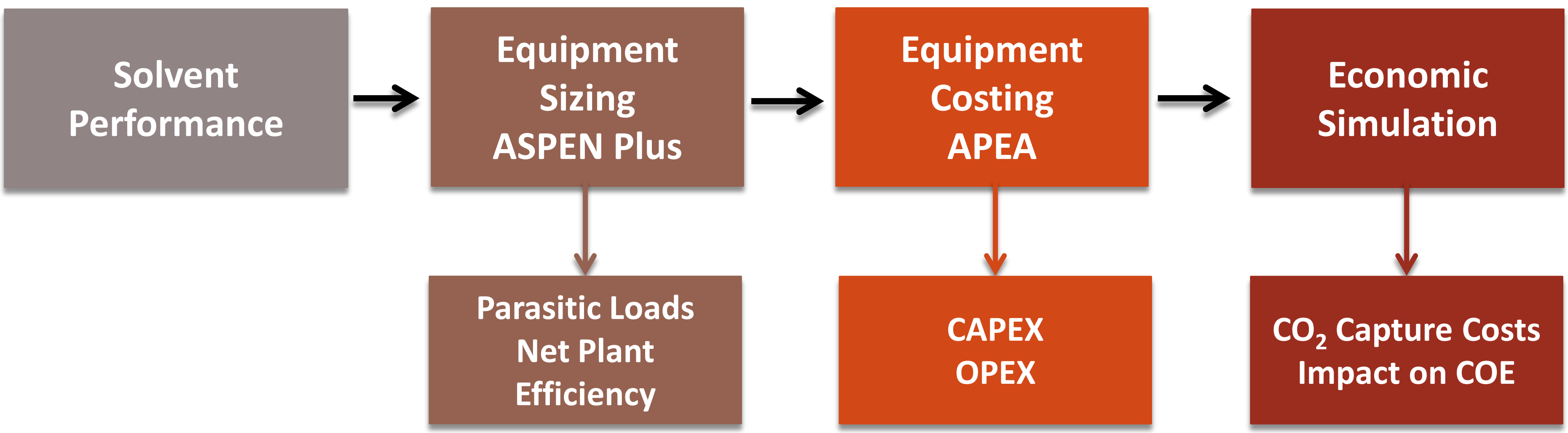
- Inlet flue gas:
  - 100 scfm
  - 80-90 ^{o}F
- Stripper:
  - 8 psig
  - 220 ^{o}F

Test Results

- CO_2 capture: 82-92%
- L/G: 35% < MEA
- Regen energy: 55% < MEA



Economic Simulation & Analysis



Economic Analysis from EERC

	Base Plant Case 9	MEA Case 10	MEA EERC	ION	ION % Change vs EERC MEA
TOC	$1,160,000	$2,090,000	$1,910,000	$1,700,000	11%
OC_{FIX}	$33,700	$56,200	$53,200	$44,000	17%
OC_{VAR}	$22,200	$39,400	$37,100	$30,100	19%
Fuel	$77,800	$109,000	$105,000	$92,300	12%
COE, $/MWh	**$64**	**$108**	**$100**	**$88**	**12%**
ICOE, %	**NA**	**69%**	**57%**	**37%**	**35%**
$/ton CO_2	**NA**	**$45**	**$39**	**$27**	**31%**

Performance factors used for adjusting Aspen-Based model for ION solvent:
L/G Ratio: 0.75, Regeneration energy: 0.57 relative to EERC MEA

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Overall Plant Performance

	Case 9	Case 10	ION	ION vs. Case 10
Net Power, kWe	550,000	550,000	550,000	
Total Auxiliaries, kWe	33,000	123,000	74,000	(49,000)
Total Power, kWe	**583,000**	**673,000**	**624,000**	**(49,000)**
Net Plant Efficiency, HHV	**37%**	**26%**	**31%**	**5%**
Coal Consumption, (ton/yr)	**1,920,000**	**2,690,000**	**2,270,000**	**(420,000)**

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Slipstream Development Pathway

Initiate 0.5-2 MW Post-Combustion Slipstream Project in 2013

- Identified potential partners
  - Host site
  - Engineering & Construction
- Obtained partner commitments
- Finalize partner & contractor agreements

Q4 2012
- 0.2 MW operating data for flue gas

Q1 2013
- Continue solvent & process optimization

Q2 2013
- Preliminary design & costing for slipstream project

Q3 2013
- Secure project funding

Q4 2013
- Initiate slipstream project

Commercialization Pathways

CO_2 Capture for Coal and Natural Gas Fired Power Generation

2013 | 2016 | 2020

EERC Pilot
0.2 MW

Slipstream
0.5-2 MW

Demonstration
5-50 MW

Commercialization
> 100 MW

Market Driven Applications: Value Added Products & Services

2017

Demonstration
5-10 MW

Commercialization
10+ MW

Scale-Up Potential

- Reduced engineering, design & operation risk
  - Established Process
- Ability to remain competitive & affordable for low margin markets
  - Process improvements relative to ION solvent are likely but not required
- Short-term supply chain bottlenecks are not anticipated
  - Chemicals are produced in sufficient quantities for scale-up & initial commercialization

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Program Acknowledgments

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  - DOE/NETL
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  - EERC, Brandon Pavlish

CO_2 Capture Project (CCP3)