

HyDS Modeling Environment

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Project ID
#AN4

This presentation does not contain any proprietary or confidential information

Overview

Timeline

- Start – May 2005
- Finish – October 2006
- 80% Complete

Budget

- Funding for FY06
 - 100K

Barriers

- Infrastructure Analysis
- Scenario Modeling
- System Analysis

Partners

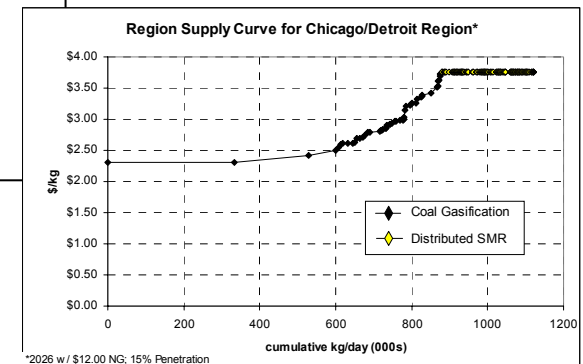
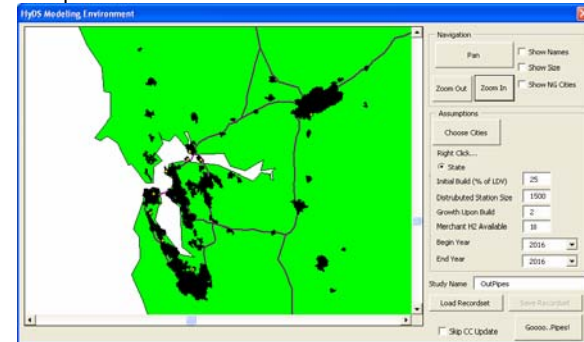
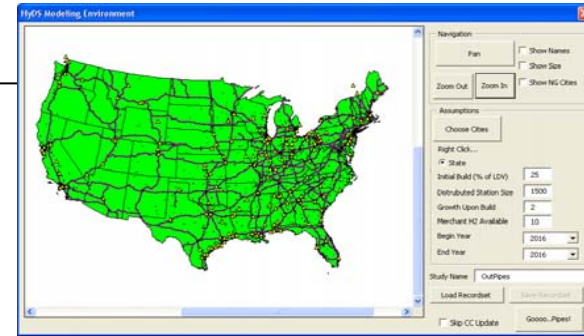
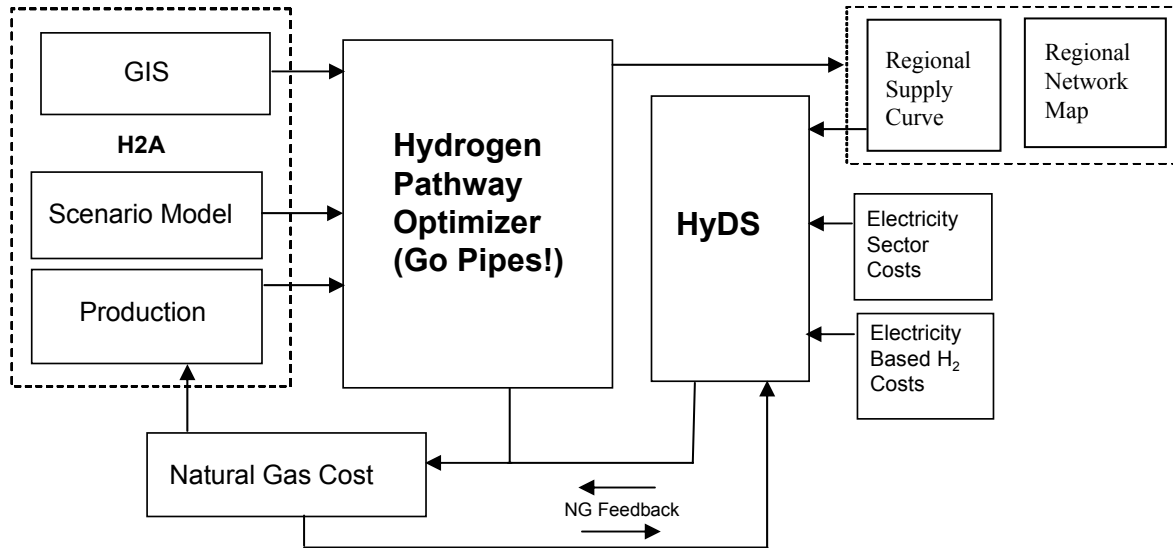
- Worked with DTI, ORNL, and ANL

Objectives

- **GIS-Based, Supply-Side Transition Analysis**
 - Cost out pathway for cities within a region
 - Determine the infrastructure layout for different production/delivery choices
 - Consider electricity sector impacts and contributions to hydrogen economy

Approach

INPUTS + OPTIMIZATION = OUTPUTS



*2026 w/ \$12.00 NG, 15% Penetration

- Detail to City Level (Population, Vehicles, Area)
- Existing H2 Facilities

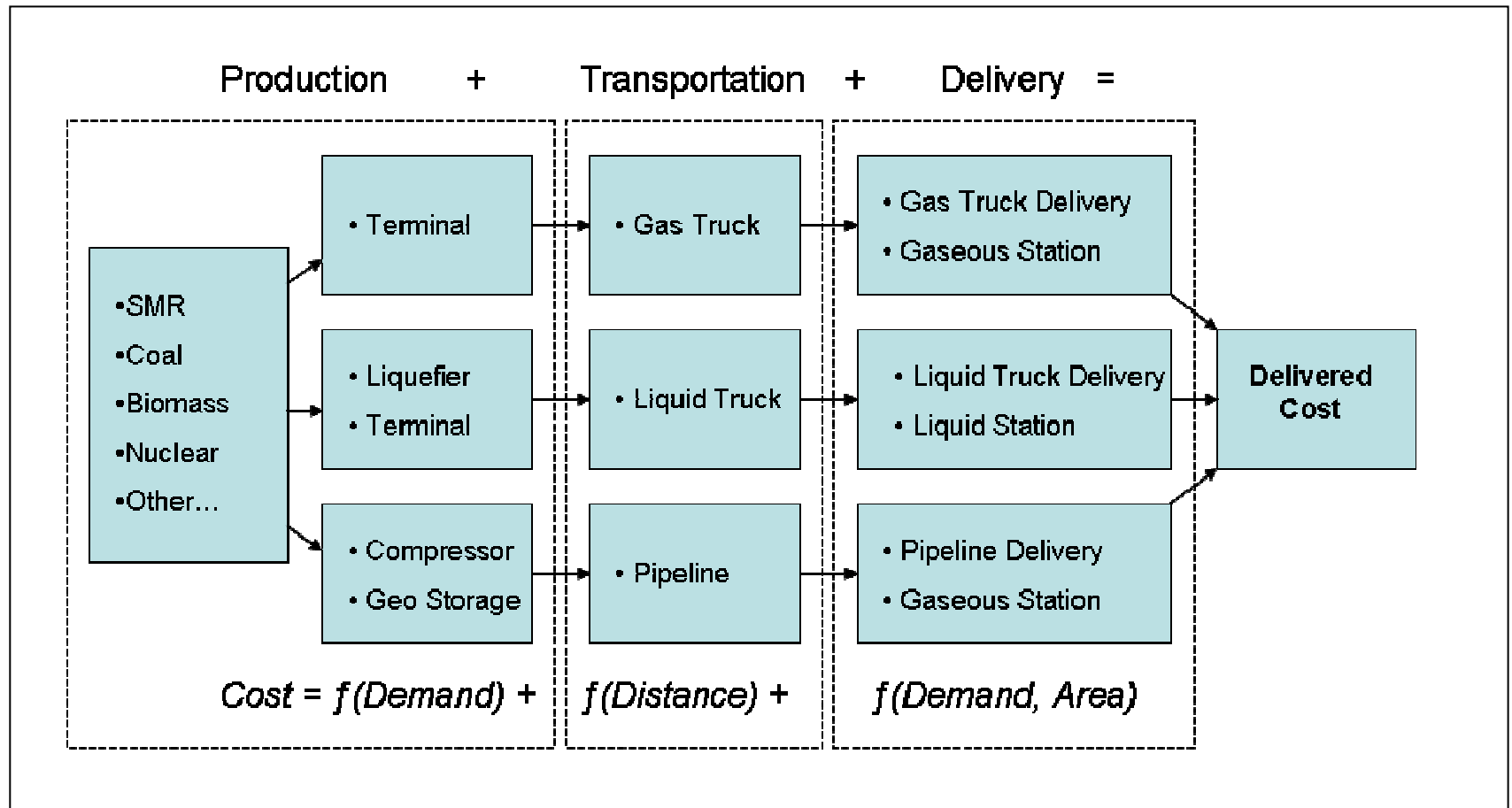
Inputs – H2A Production

- Production is the sum of fixed and variable costs
- Costs change with fuel forecast and H2A learning assumptions
- Min/Max Capacities enforced
- Production Technologies
 - Central/Distributed SMR
 - Central Coal gasification
 - Central Biomass gasification
 - Wind/electrolysis
 - Distributed electrolysis
 - Nuclear
- Dynamic Link to H2A Production Model
 - Updates Fuel Costs
 - Reruns H2A Cash Flow
 - Automatically Updates Costs

Inputs – H2A Scenario Model

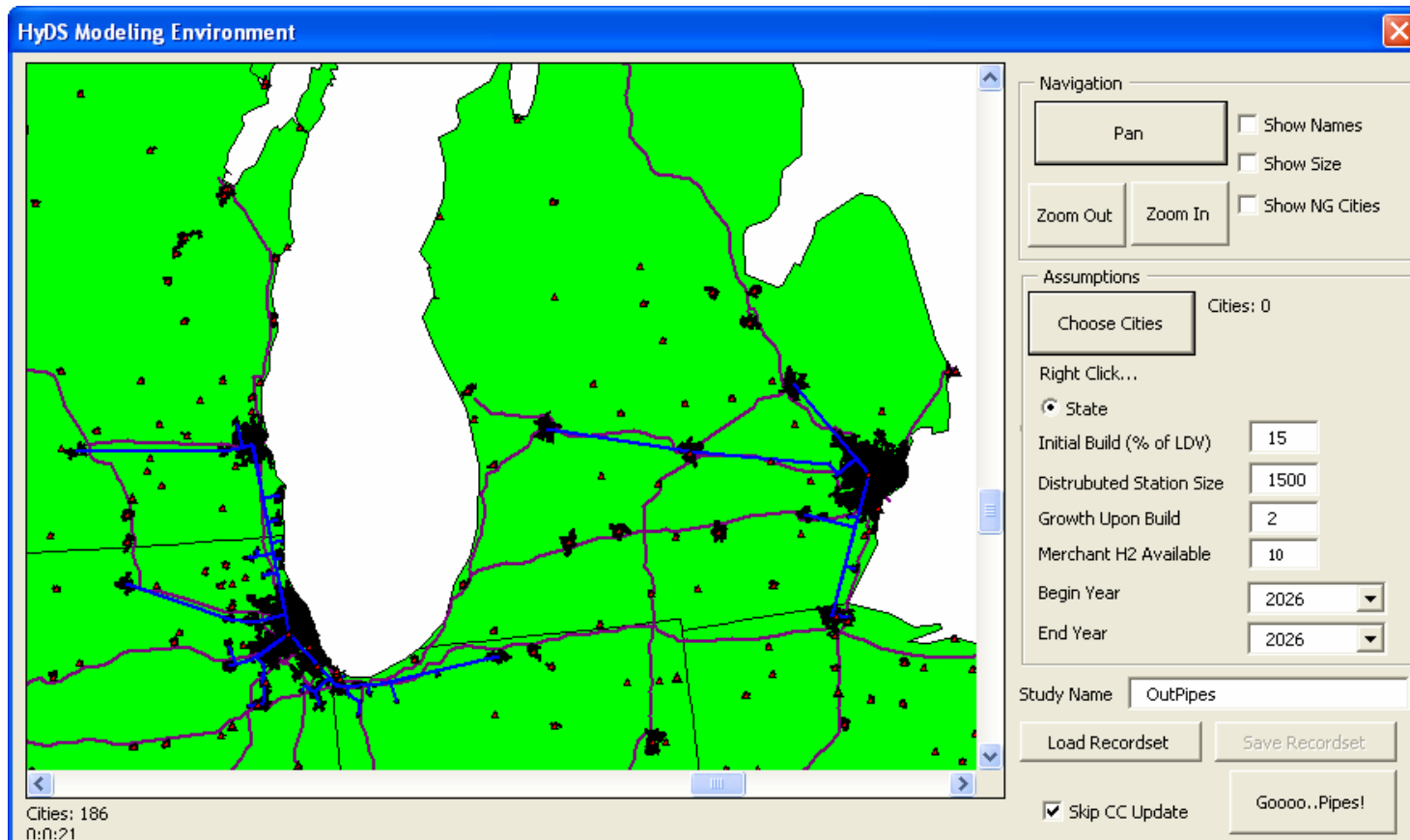
- Derived equation for **each component** (eg liquefier, compressed truck, pipelines)
 - All components influenced primarily by demand or city area, or both
 - Accuracy within \$0.05 for most scenarios (R^2 of >99% for all components)
 - Equation does less well at extremes
 - at very low penetrations in small cities
 - very large cities at high penetrations
- Worked with DTI, ORNL, and ANL in Using H2A Scenario Model

Pathway Optimization



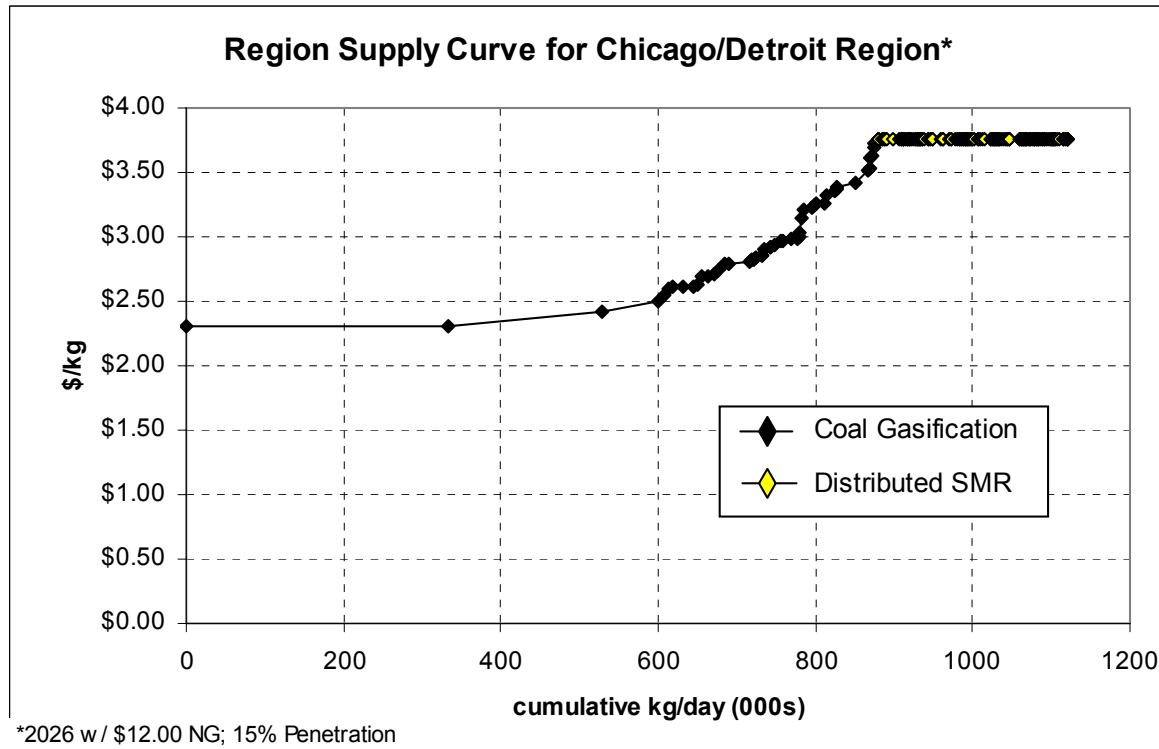
Putting It Together...

- Modified Minimum Spanning Tree Algorithm
- Considers Production and Transportation Economy of Scale
- GIS Output – Intuitive Results



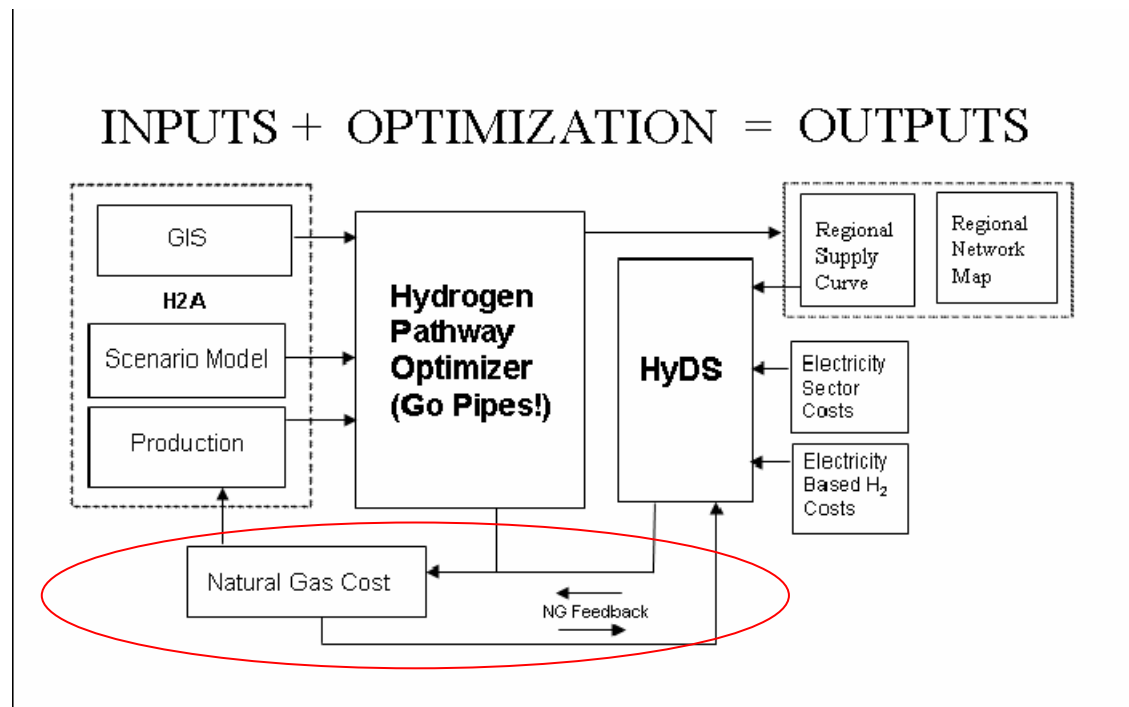
Regional Supply Curve

- Delivered Cost
- Color Coded by Production Type



Natural Gas Elasticity

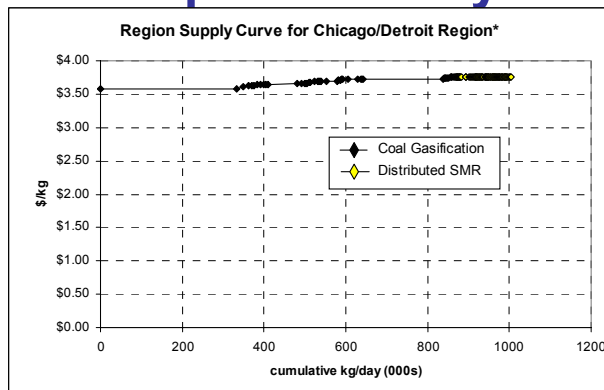
- Based on NEMS Forecasts
- Consistency between all components



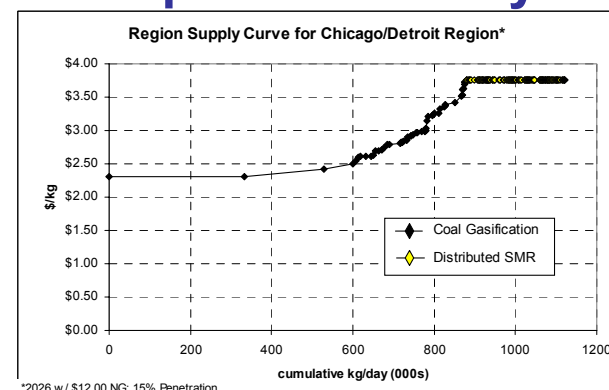
What Can We Answer?

- What are the hydrogen delivered costs within a region?
 - Least cost or for a particular technology
 - Quickly compares/contrasts technologies
- How does development of a hydrogen economy effect the capacity expansion of the electricity sector?

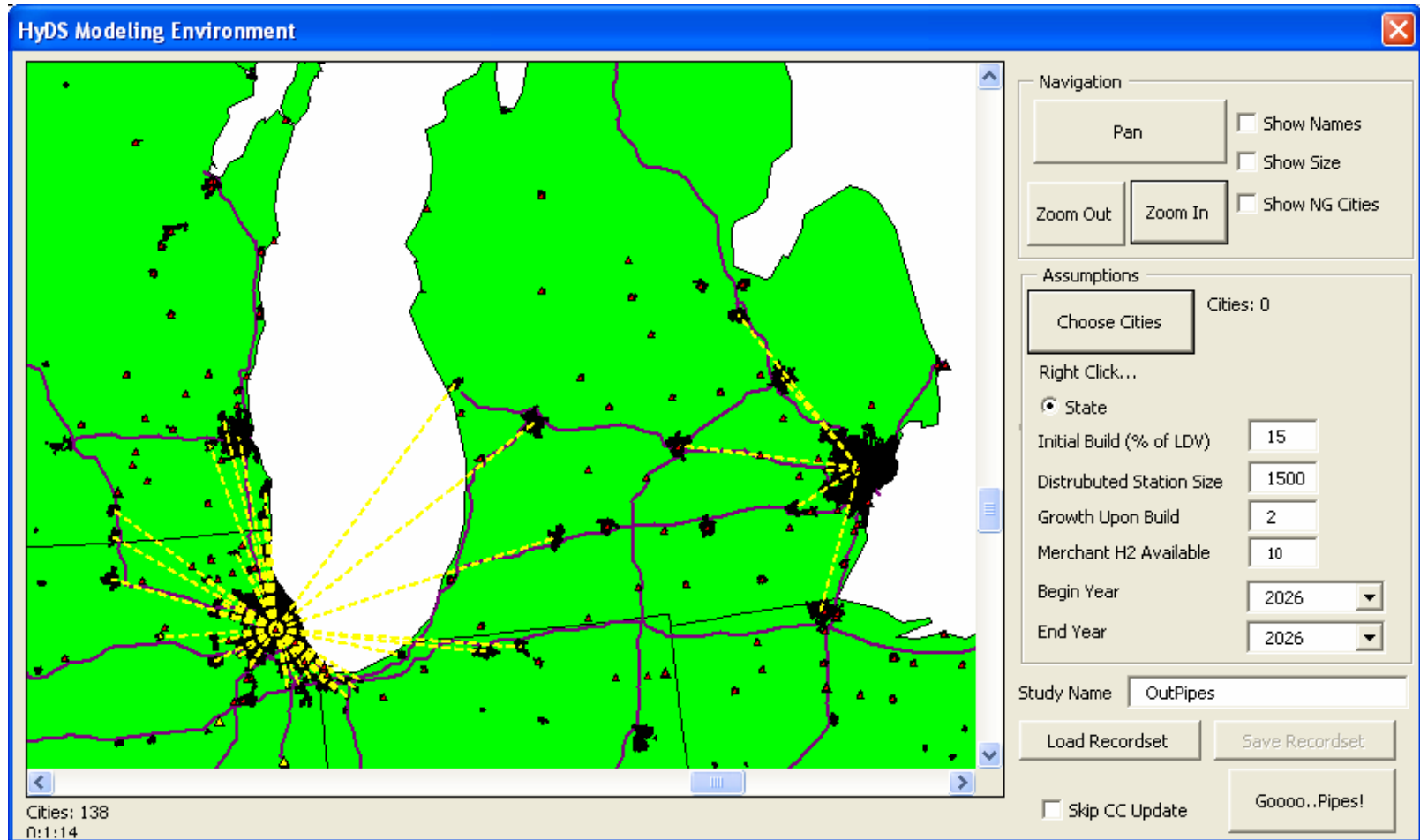
Liquid Delivery



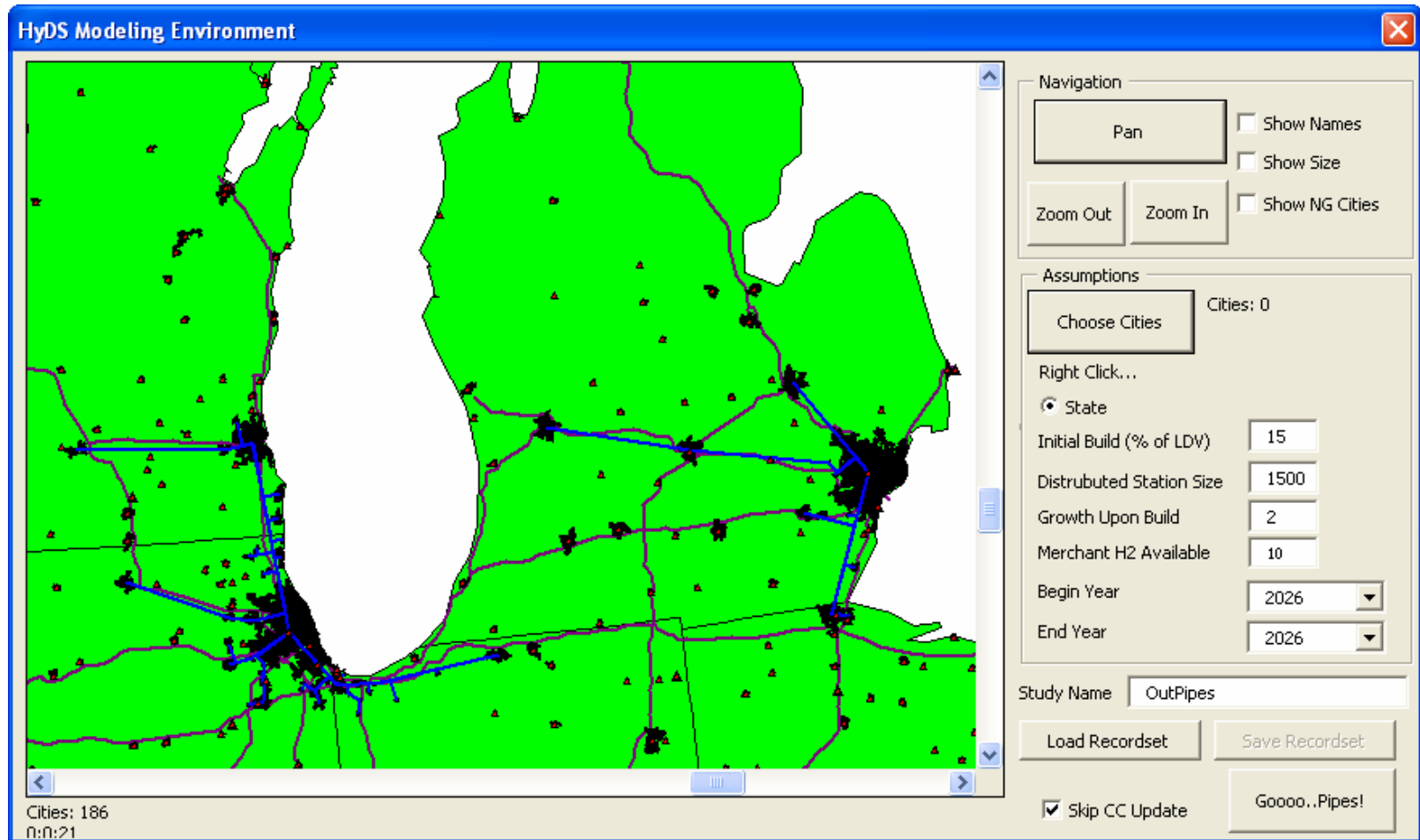
Pipeline Delivery



Liquid Delivery Layout

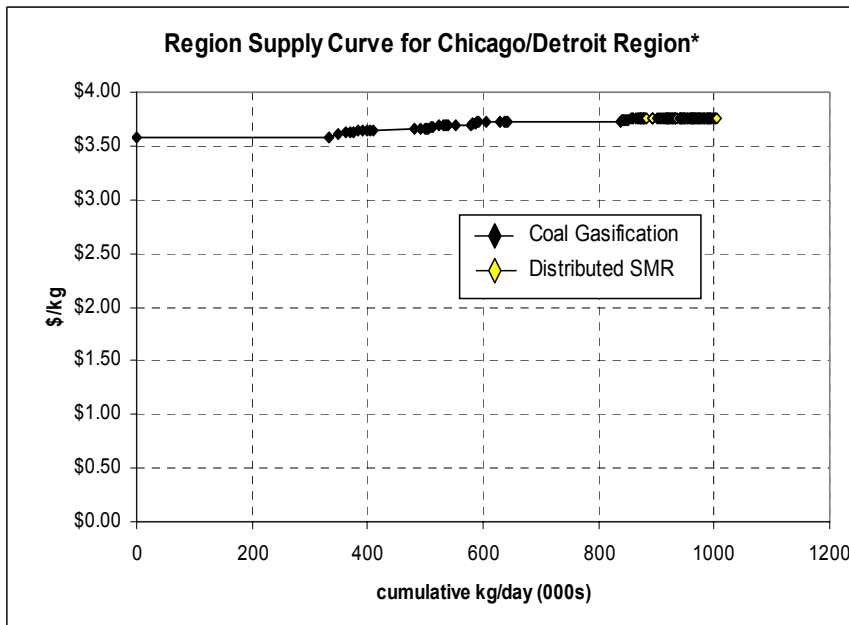


Pipeline Delivery Layout

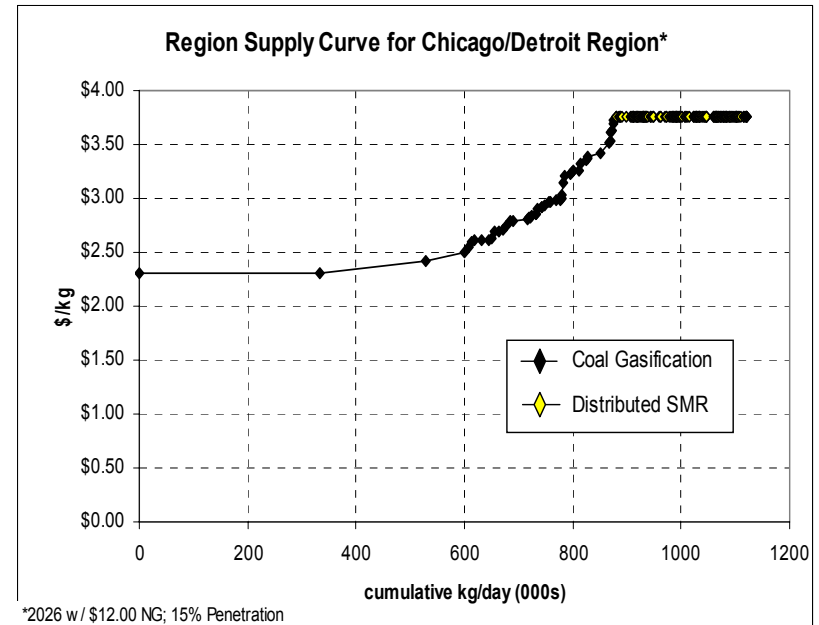


Larger Type for Delivery Scenarios

Liquid Delivery



Pipeline Delivery



Future Work

- Running scenarios for Final Draft FY06 Report due July 2006
 - AEO 2006 Feedstock Price Scenario
 - Natural Gas Price Sensitivity
 - Demand Sensitivity
 - Assumptions and Findings

Summary of the Strengths/Weaknesses

- Strengths
 - Spatial; addresses urban/rural interface
 - Consistency through integration of models and price paths
 - Fast, simple operation for static scenarios
 - Electricity sector integration
- Weaknesses
 - No Foresight/Hindsight (ie Static Model)
 - No demand side component – must be entered

Publications and Presentations

FPITT Review - Oct 2005

Annual Review 2005 (HyDS)

Annual Review 2006

Critical Assumptions and Issues

- Inherits all H2A Production and Scenario Model Assumptions
- Uses the “Urbanized Area” definition for city boundaries
- Competes three production technologies at a time
- Always competes distributed vs central