HyDS Modeling Environment

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Overview

Timeline

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

Budget

- Funding for FY06
  - 100K

Barriers

- Infrastructure Analysis
- Scenario Modeling
- System Analysis

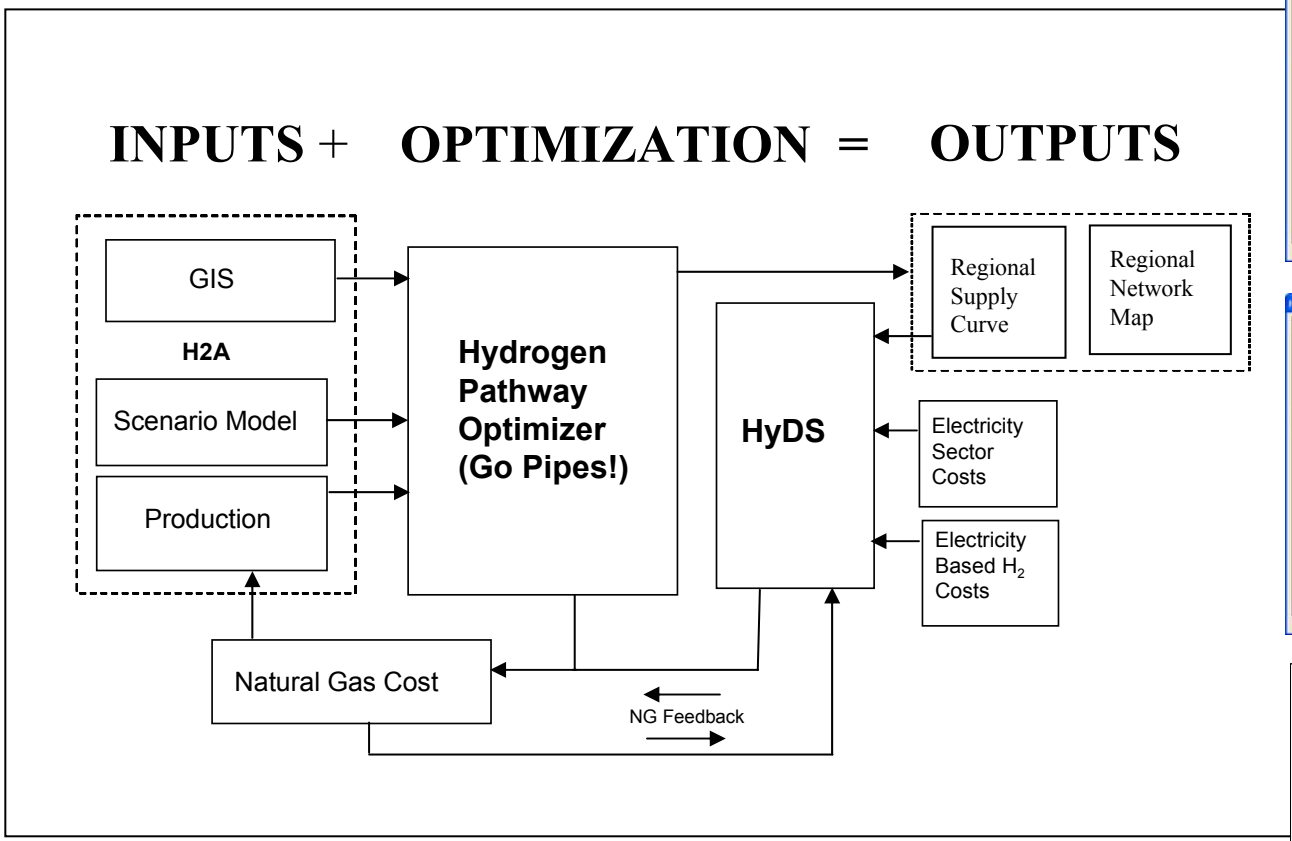
Partners

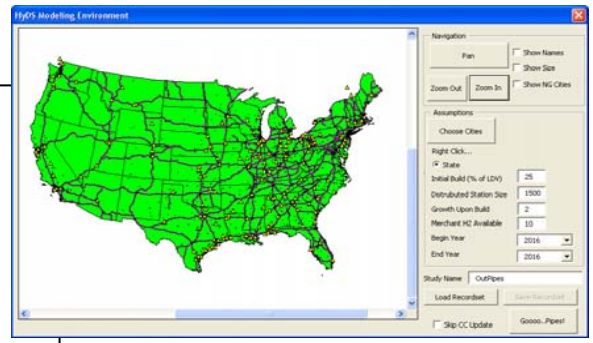
- Worked with DTI, ORNL, and ANL

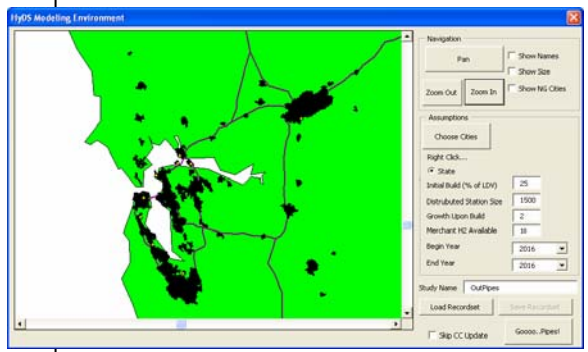
Objectives

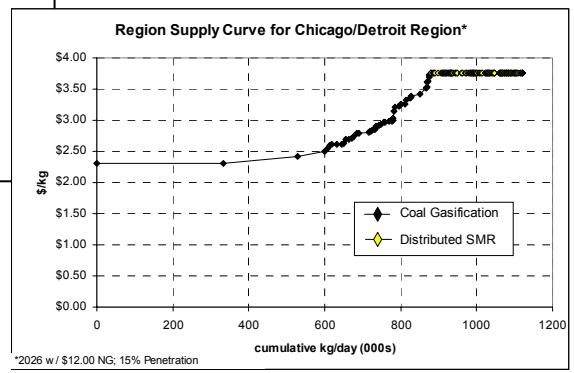
- **GIS-Based, Supply-Side Transition Analysis**
  - Cost out pathway for cities within a region
  - Determine the infrastructure layout for different production/delivery choices
  - Consider electricity sector impacts and contributions to hydrogen economy

Approach









- 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

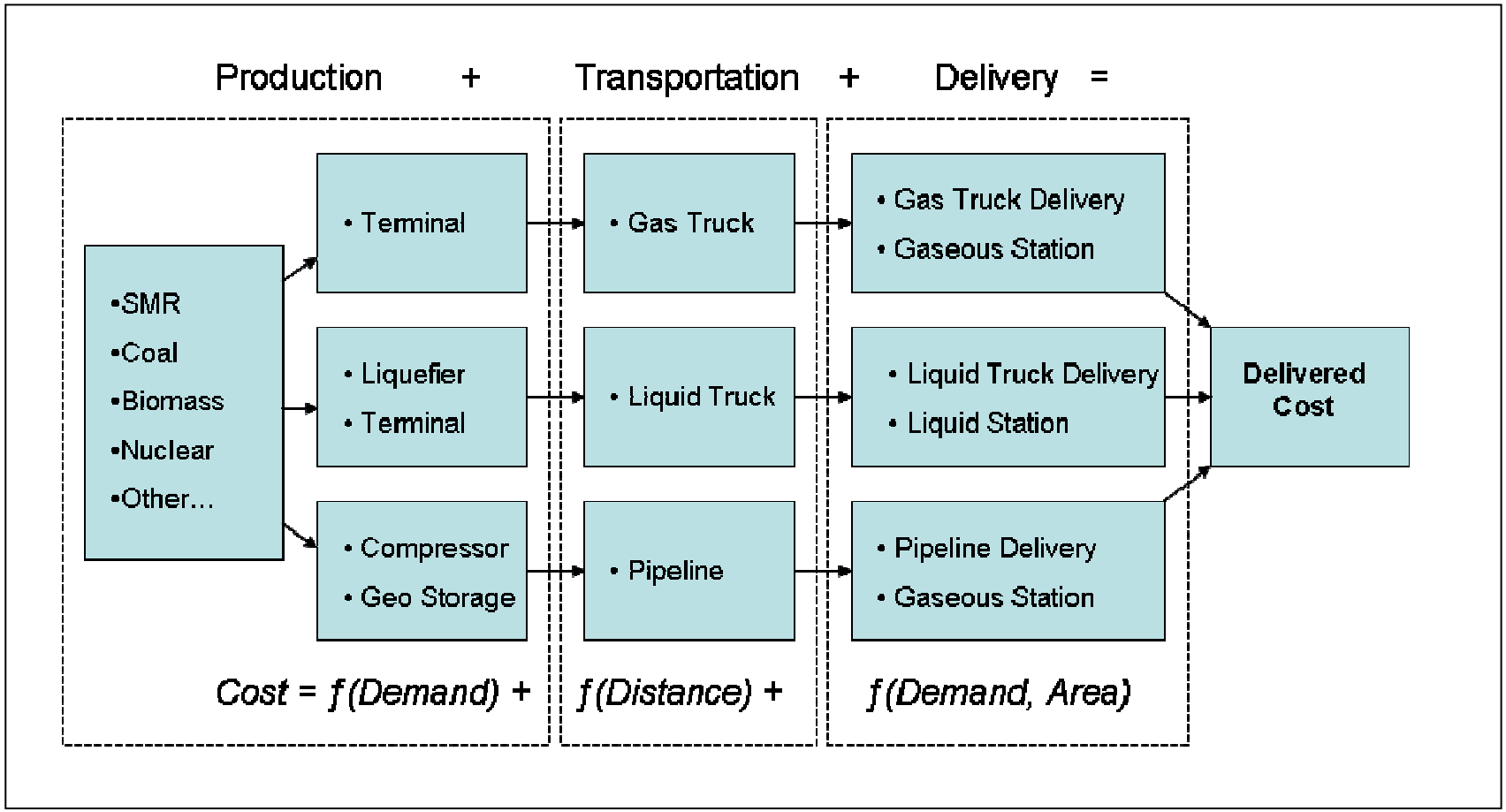
- Production Technologies
  - Central/Distributed SMR
  - Central Coal gasification
  - Central Biomass gasification
  - Wind/electrolysis
  - Distributed electrolysis
  - Nuclear

- Dynamic Link to H2A Production Model
  - Updates Fuel Costs
  - Reruns H2A Cash Flow
  - Automatically Updates Costs

Inputs – H2A Scenario Model

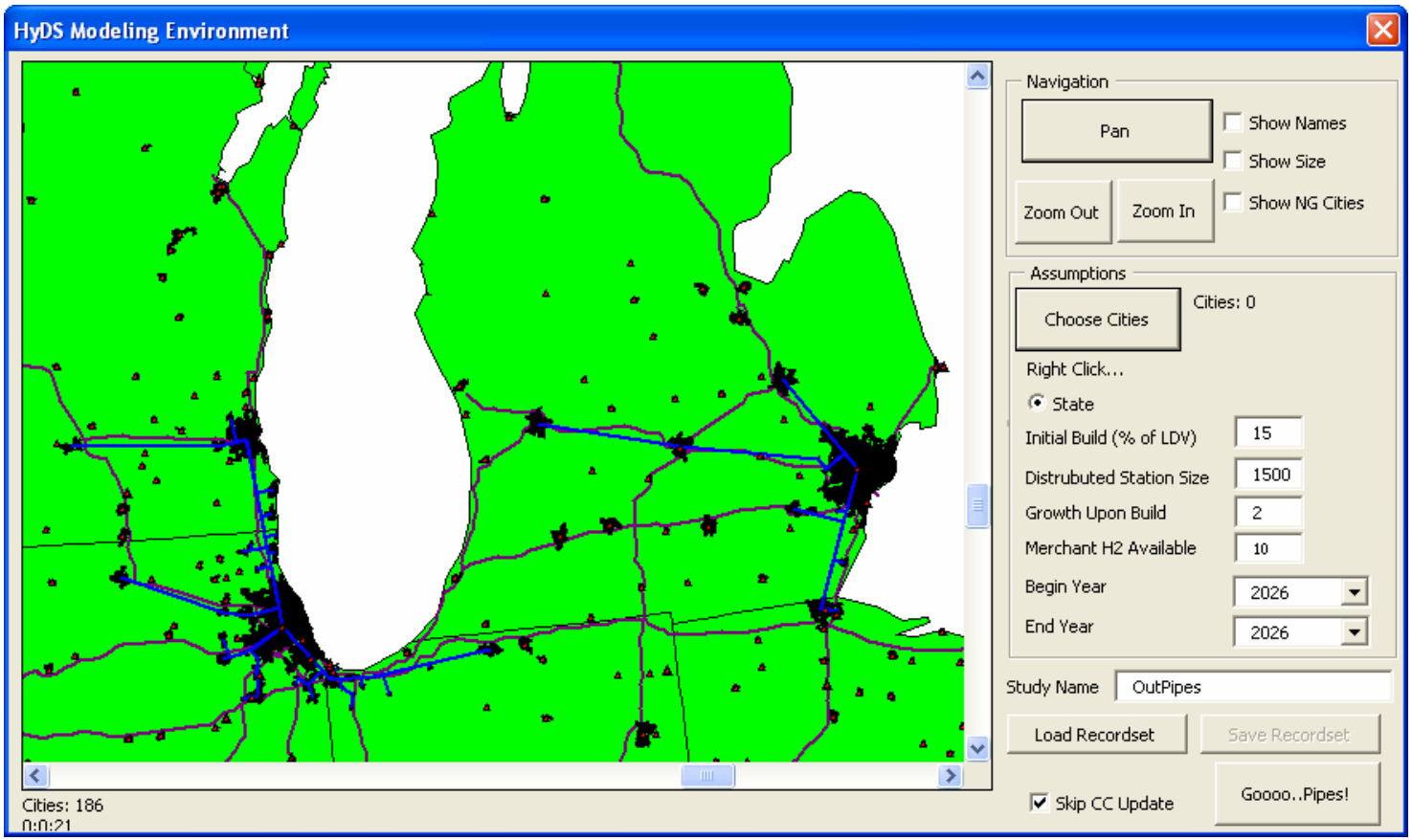
- Derived equation for **each component** (eg liquefier, compressed truck, pipelines)
  - All components influenced primarily by demand or city area, or both
  - Accuracy within $0.05 for most scenarios (R^2 of >99% for all components)
  - Equation does less well at extremes
    - at very low penetrations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

Pathway Optimization



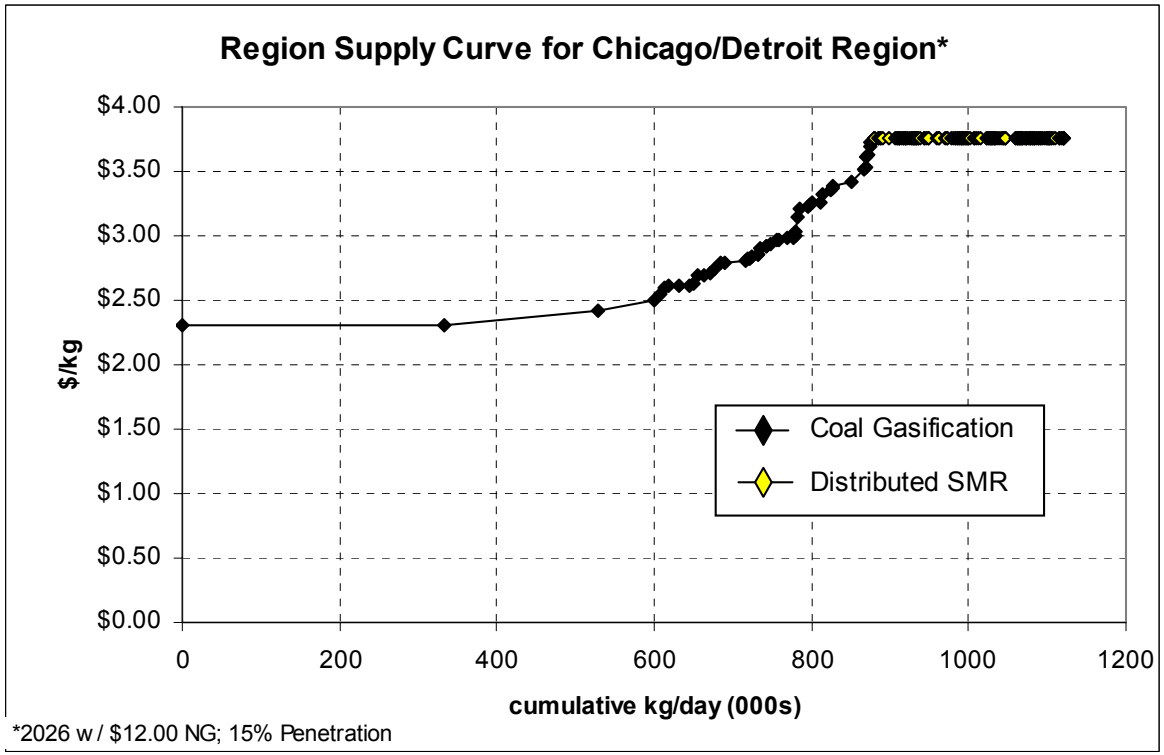
Putting It Together…

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



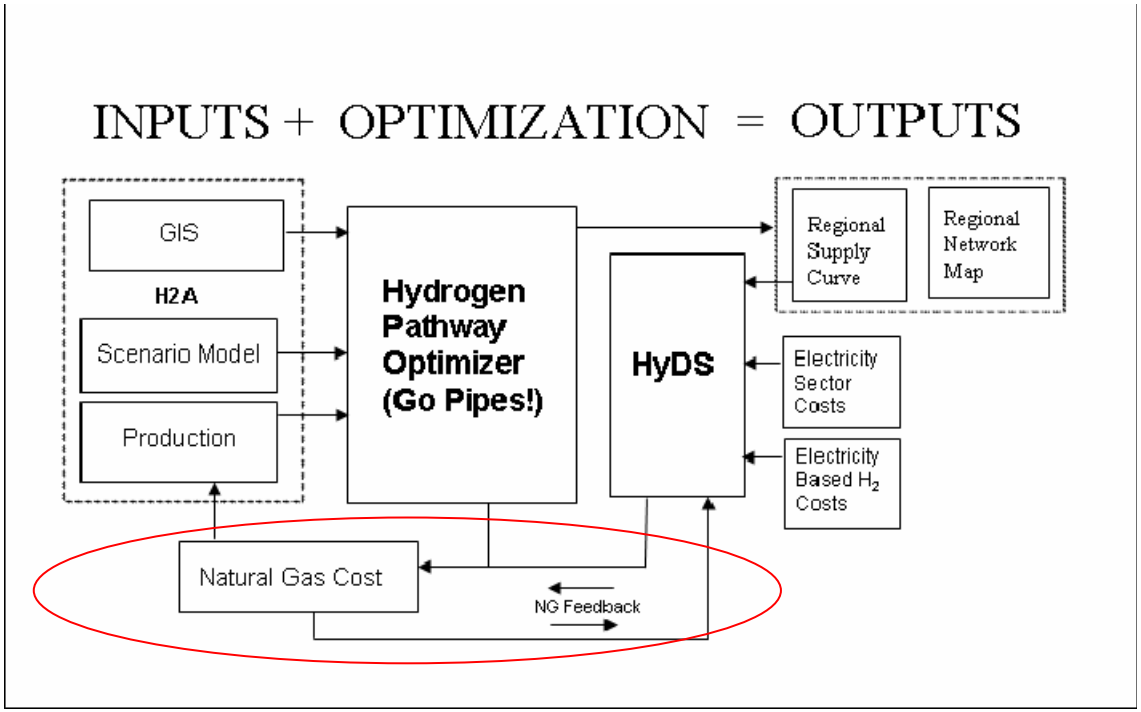
Regional Supply Curve

- Delivered Cost
- Color Coded by Production Type



Natural Gas Elasticity

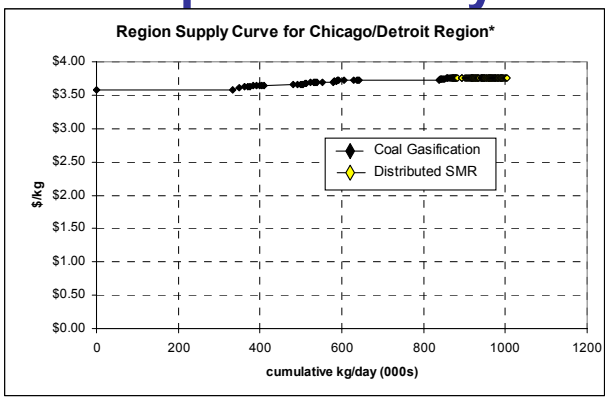
- Based on NEMS Forecasts
- Consistency between all components



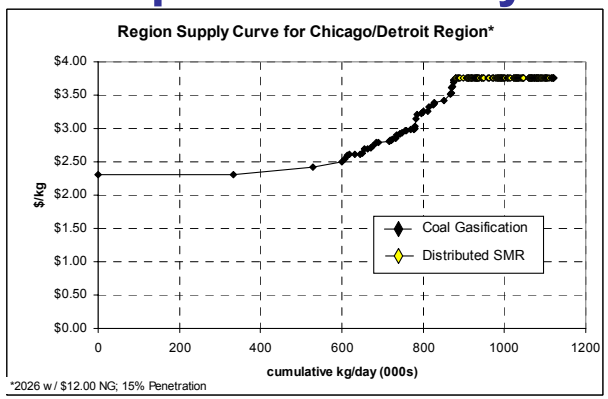
What Can We Answer?

- 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?

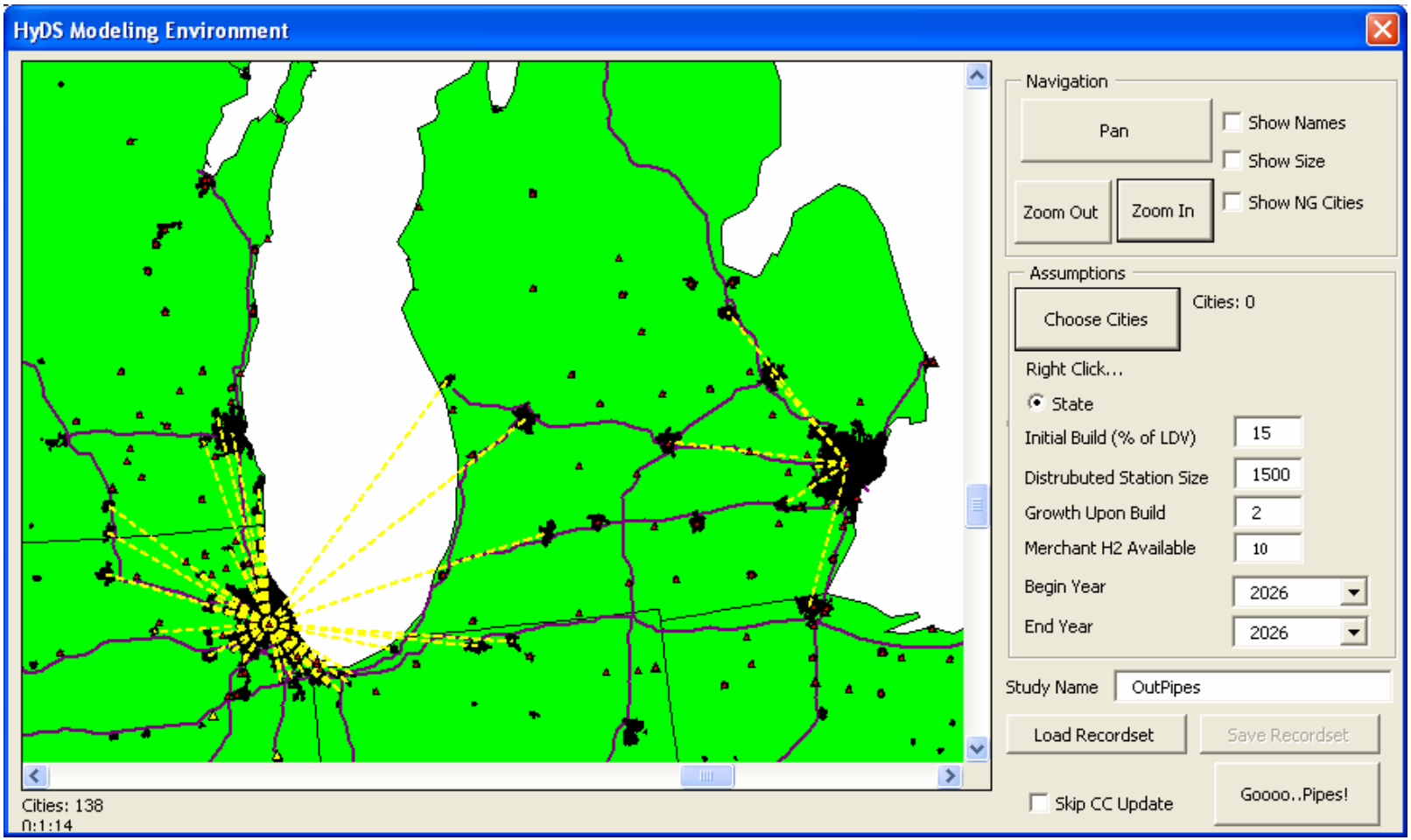
Liquid Delivery



Pipeline Delivery



Liquid Delivery Layout



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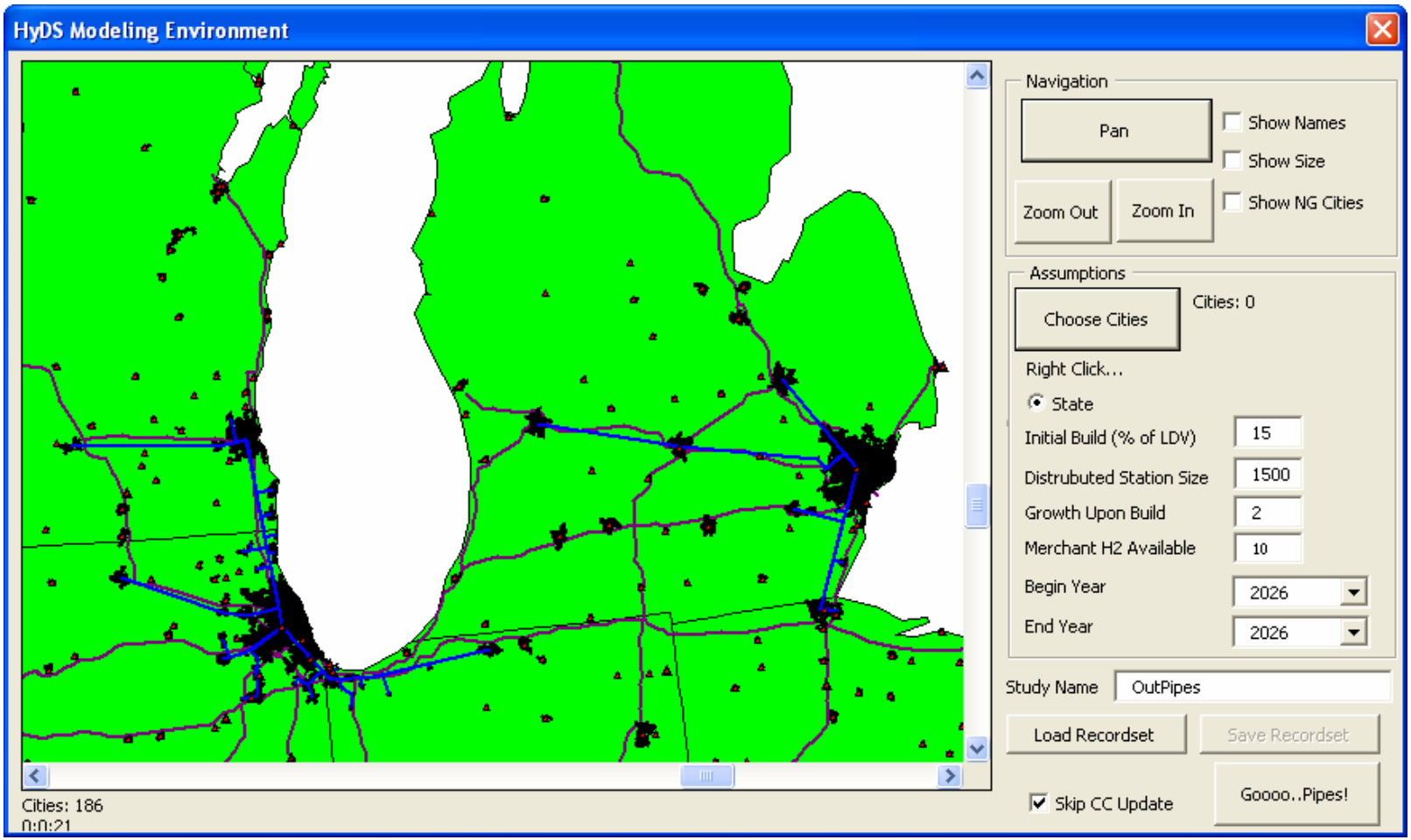
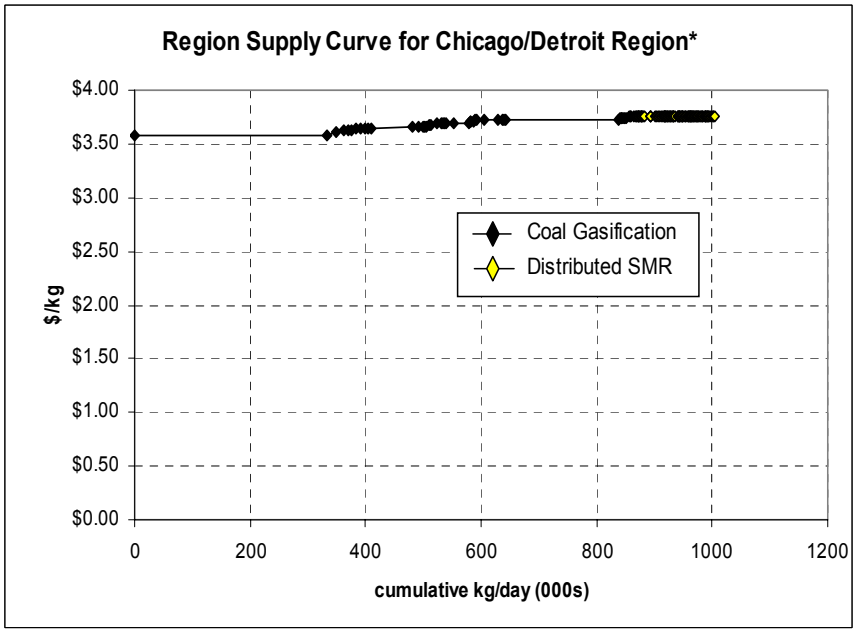
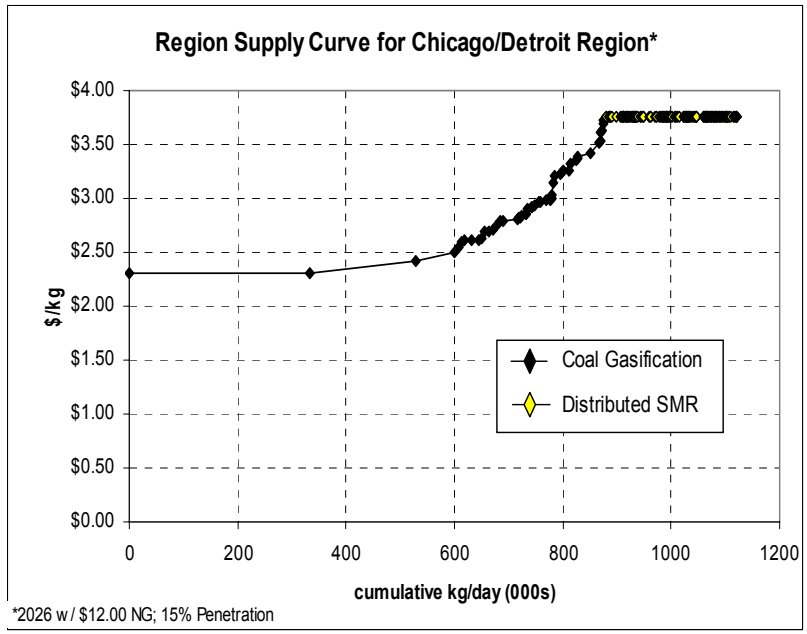


Larger Type for Delivery Scenarios

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