



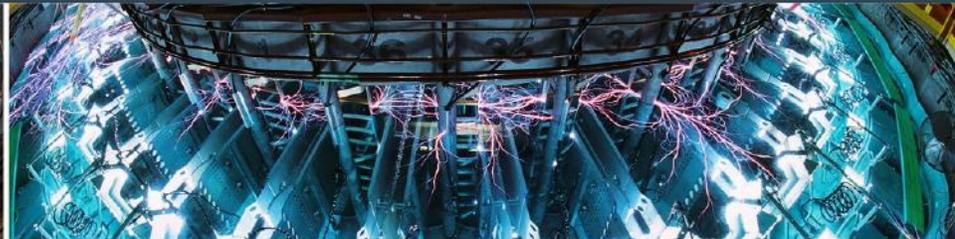
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# Tool for Assessing the Economic, Societal and Environmental Tradeoffs in Oil & Gas Produced Water Management and Reuse



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NM Produced Water Consortium



THE UNIVERSITY OF  
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MindsEye Computing, LLC

Visualizing the Future



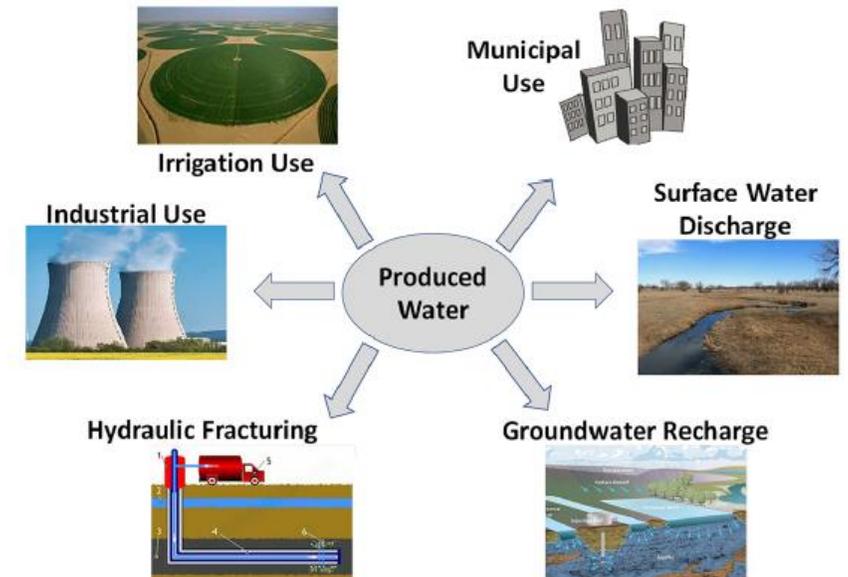
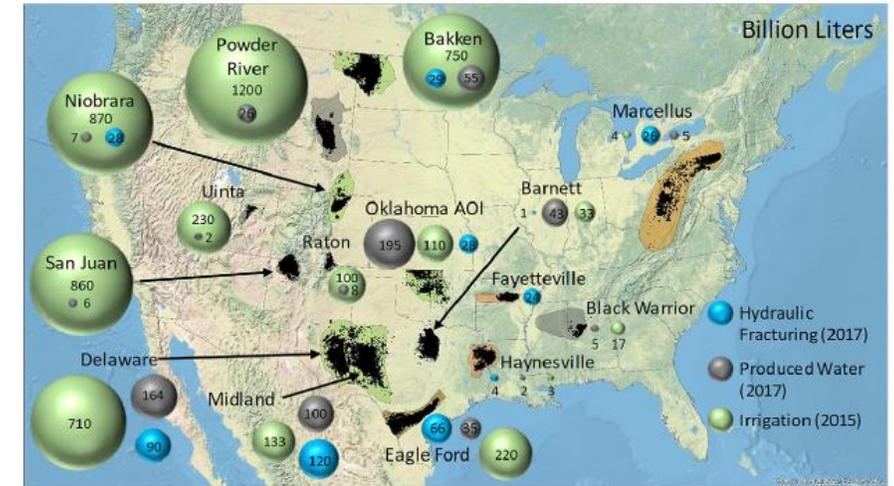
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# Tool for Assessing the Economic, Societal and Environmental Tradeoffs in Oil & Gas Produced Water Management and Reuse

**Goal:** Develop an integrated model for assessing the economic, societal and environmental tradeoffs associated with alternative produced water management and fit-for-purpose treatment and reuse.

**Problem:** While many oil producers are considering qualitative Environmental, Social, and Governance (ESG) strategies to assess the general cost and benefits of the reuse of produced water, there is no comprehensive tool for quantitatively assessing the full costs and benefits of alternative produced water management and reuse strategies

## Oil and Gas Water Management



## *Produced Water-Economic, Socio Environmental Simulation Model (PW-ESESim)*

- Assess tradeoffs in ESE for alternative water management strategies
- Publicly available
- Easy to Use
  - GUI controls selection scenario design
    - ❖ Source water selection,
    - ❖ Produced water disposition,
    - ❖ Treatment and other system criteria.
  - GUI renders results for analysis and comparison
- Model resolution
  - Township/Range-scale over Lea and Eddy Counties in SE New Mexico
  - Monthly timestep over multiple decades

The screenshot displays the PW-ESESim software interface. On the left, a sidebar contains navigation and control elements, including a 'Beneficia' button and a 'Step 1 - Select Water' section with a 'PRODUCED WATER > 100,000 mg/L' indicator. Below this is a 'Return to Map' button and a table for selecting a map and township. The main area features a map of Eddy and Lea counties, with two areas highlighted in blue and labeled 'Eddy' and 'Lea'. On the right, there are several data tables and control panels. The top right shows a comparison table for 'Project 2' and 'Project 3'. Below that is a '15 mgd' control panel, followed by a table of values including '0.17', '5,161,700', '601,600', '398,900', '1,000,500', '1,922,100', and '211,200'. Further down are three 'PROJECT' control panels, each with a '0.00 gal/da' setting and a scale bar. At the bottom right, a 'Year' selector shows dates from 1/1/1960 to 1/1/2050, and a 'Total GW depletion' indicator shows a value of -3,158,833.64 AF.

Project 2	Project 3
50	186
4.28	-104.28
.83	32.65
5	5
1	1
,126	343,365
,477	1,599,294
,306	1,907,929
6,010	2,850,899

Label
Township
Longitude
Latitude
Basin
County
Fresh water
Produced water
Brackish water
Water demand
Average monthly PW b
Average Annual PW ga
Average annual PW bb

Label	Project 1
Economic benefit	
Health impact	
Treatment cost	

**System Dynamics Model:**  
Several *hundred* variables  
Several *dozen* feedbacks

Feedback to water supply, land use, waste streams

Feedback to operational costs, local economy, jobs

Feedback (+ or -)

**Environment**

**Economic**

**Oil & Gas  
Water  
Management**

*Subsystem Interaction*

Feedback (+ or -)

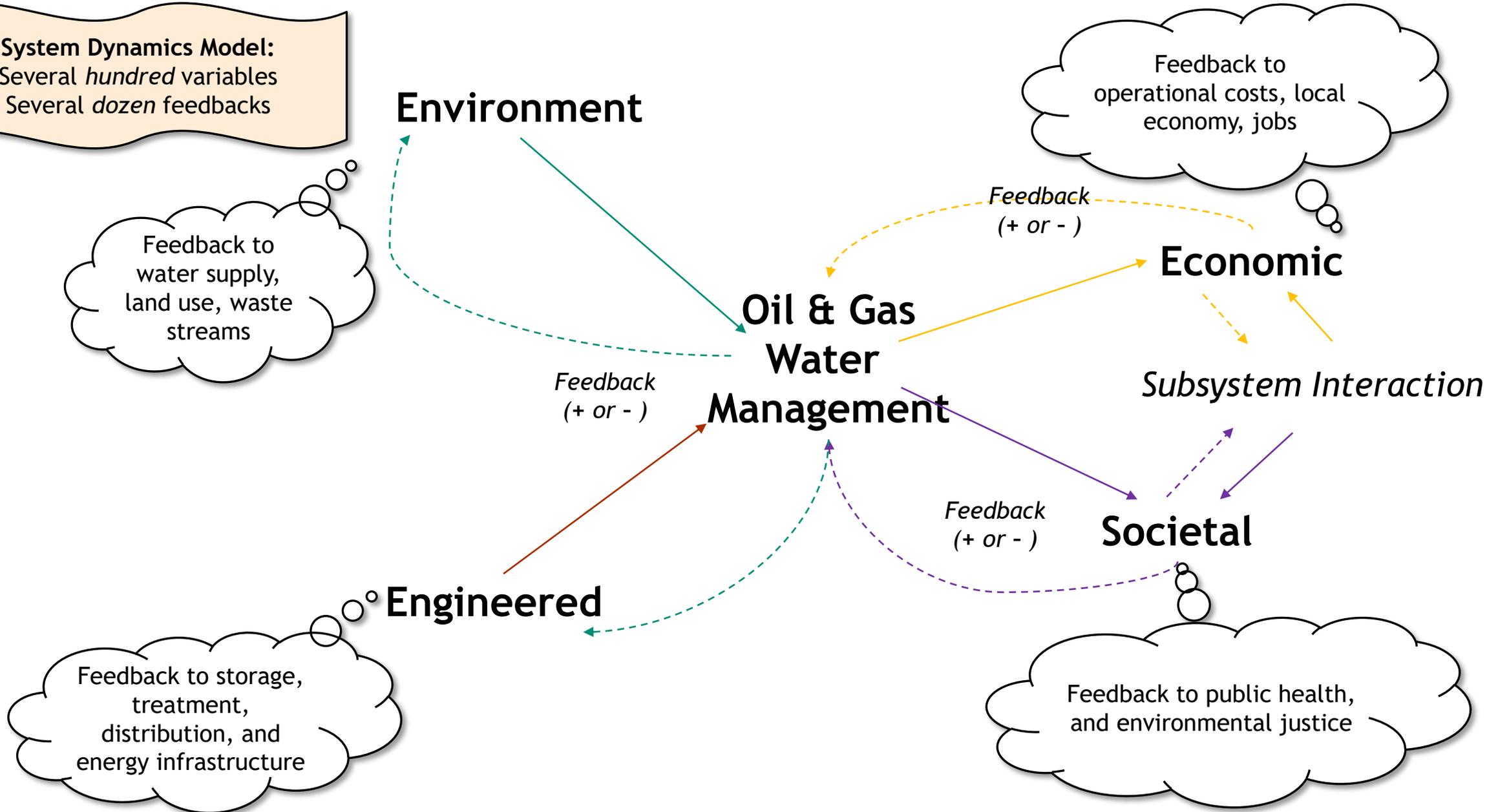
Feedback (+ or -)

**Engineered**

**Societal**

Feedback to storage, treatment, distribution, and energy infrastructure

Feedback to public health, and environmental justice



# Stakeholder Engagement



*Leverage New Mexico Produced Water Research Consortium network of industry, regulators and developers*

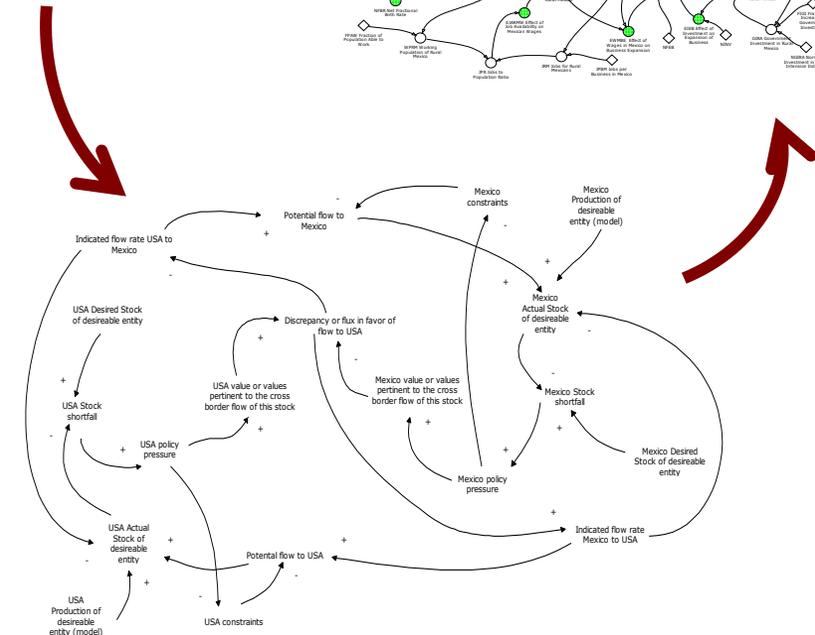
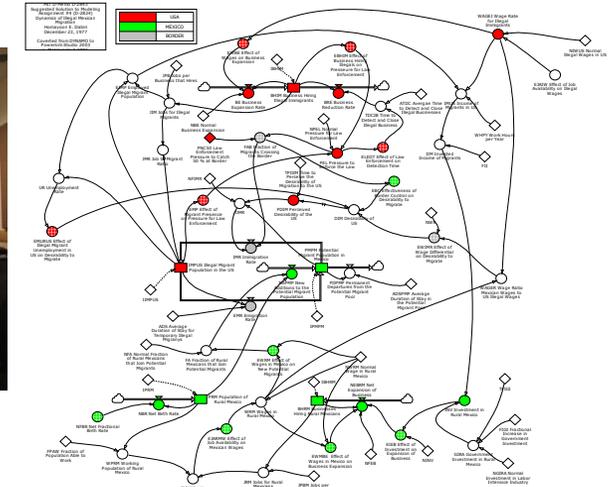
Process of engaging decision-makers and stakeholders in:

- Model development, and
- Decision analysis.

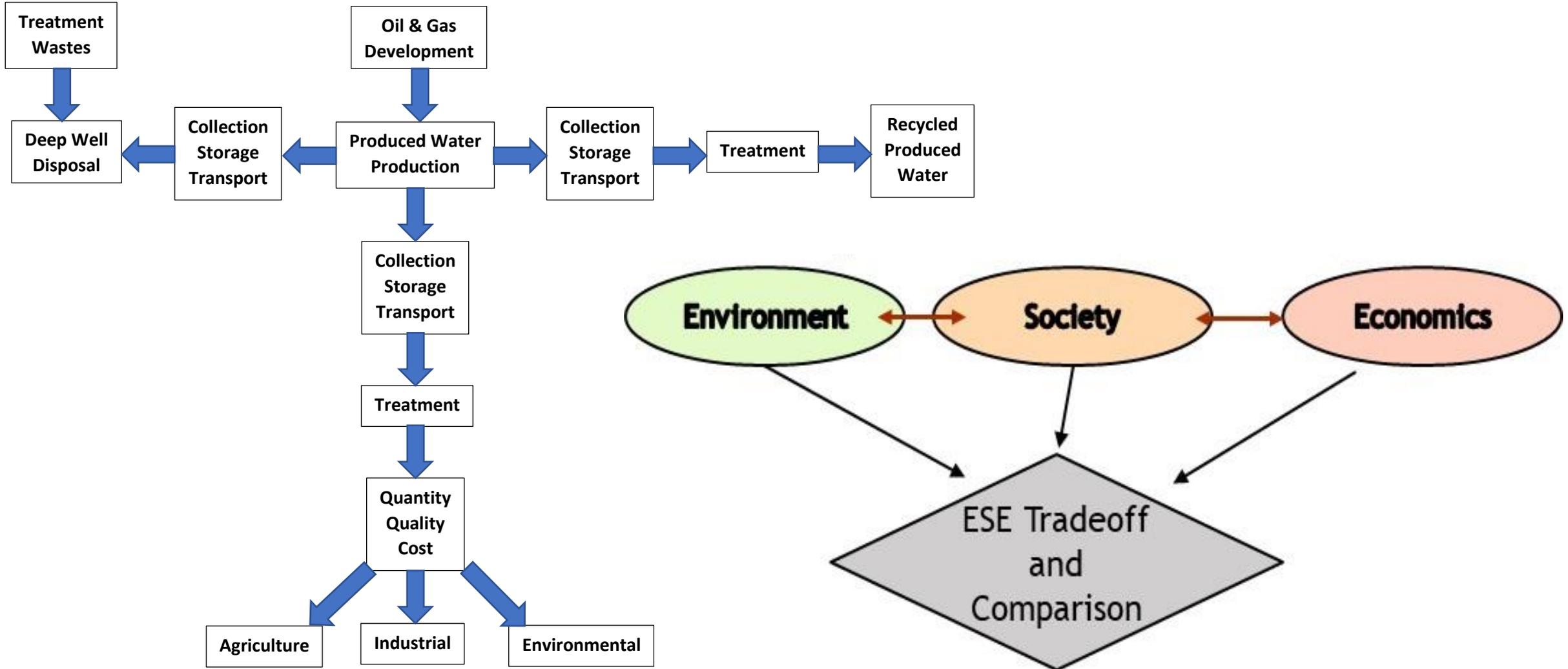
Conducted events on the following topics:

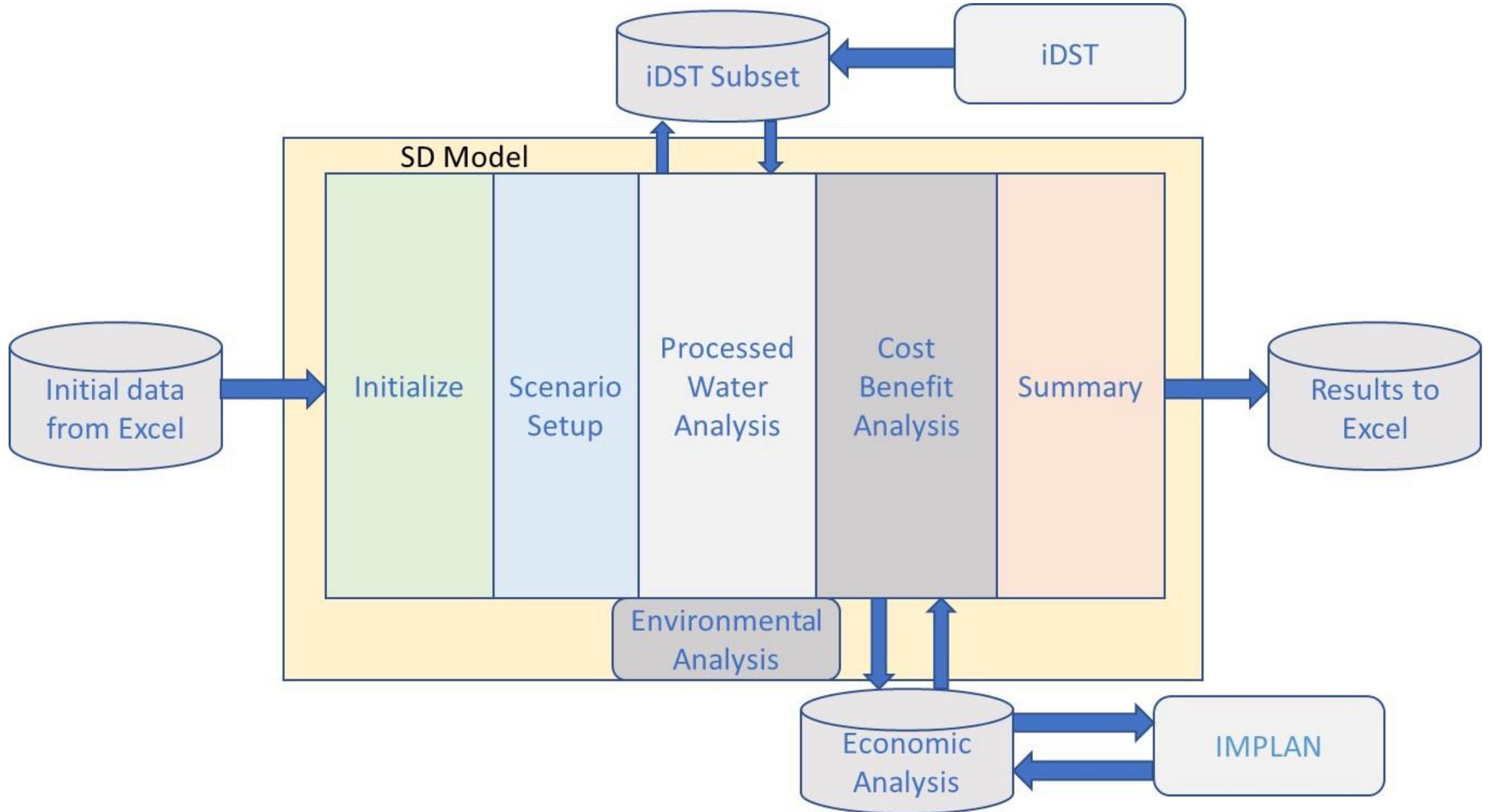
- Data resources,
- Overarching model structure,
- Oil & gas water disposal,
- Oil & gas production, transport and storage (3),
- Southeast NM water resources,
- Economic impacts and water use, and
- Public health effects (2).

Bi-weekly meetings with NMPWRC social-economic working group



## PW-ESESim Conceptual Model





## Economics

### Economic Benefits

Model Inputs

1. Toxicity Levels and Regulation Thresholds
2. Quantity of Water Available by Toxicity Level
3. Economic Sector Water Demands

### Economic Sectors

Agriculture

Industrial

Oil and Gas

Environment

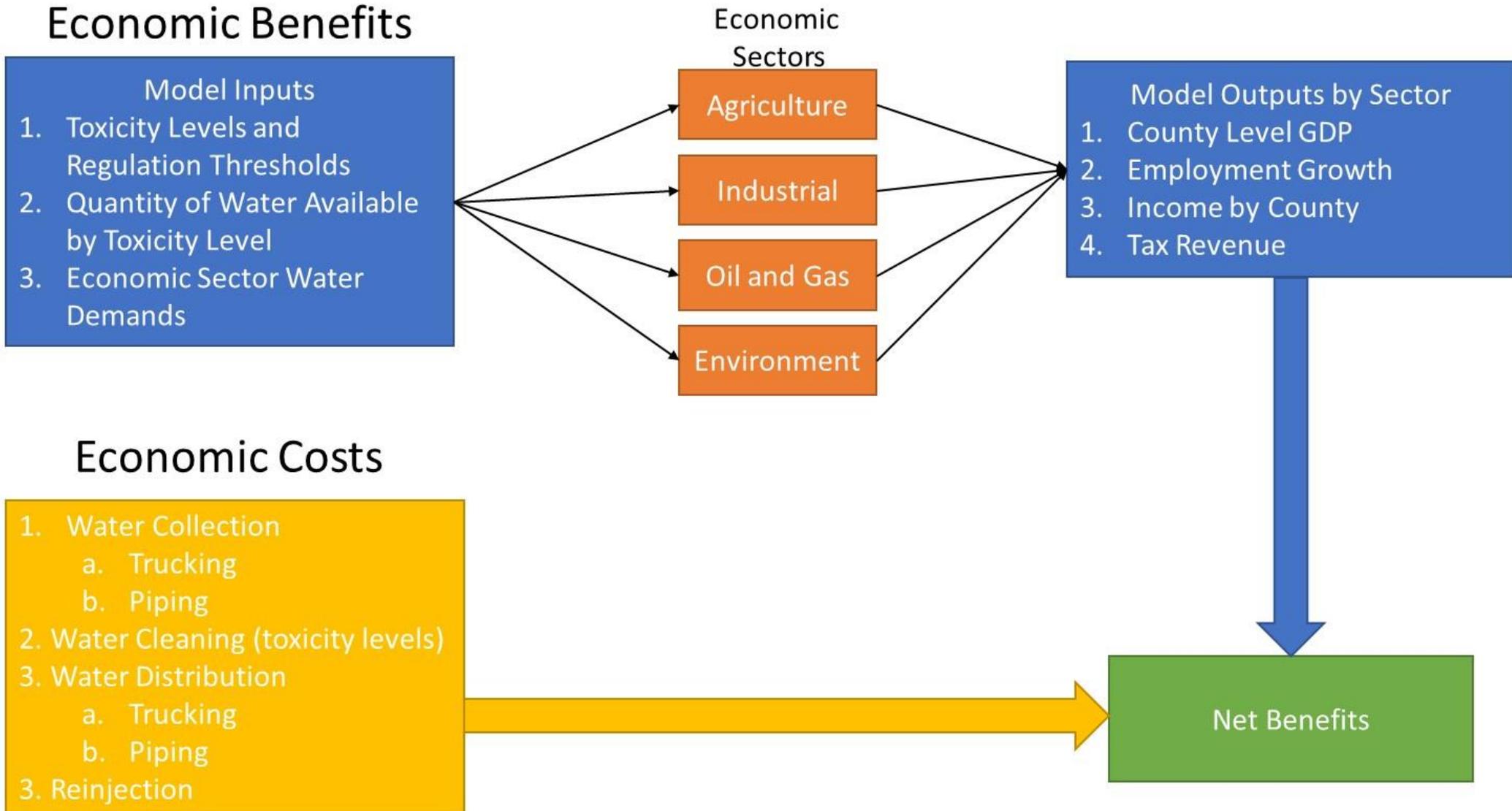
Model Outputs by Sector

1. County Level GDP
2. Employment Growth
3. Income by County
4. Tax Revenue

### Economic Costs

1. Water Collection
  - a. Trucking
  - b. Piping
2. Water Cleaning (toxicity levels)
3. Water Distribution
  - a. Trucking
  - b. Piping
3. ReInjection

Net Benefits



Baseline 2019		
	Lea	Eddy
Year	2019	2019
Population	71,070	58460
Employment	42,931	42,370
Households	24,870	22,274
Number of Industries	219	224
<b>Output</b>	<b>\$ 11,371,733,109.45</b>	<b>\$ 13,255,494,023.61</b>
Petroleum refineries (154)	\$ 1,701,018,709.52	\$ 2,031,646,600.35
Oil and gas extraction (20)	\$ 1,485,051,628.79	\$ 2,843,265,088.37
Support oil and gas (36)	\$ 1,472,959,279.30	\$ 1,553,607,229.90
Drilling oil and gas (35)	\$ 808,963,799.61	\$ 199,653,274.53
Truck Transportation (417)	\$ 378,795,634.15	\$ 249,368,960.42
Dairy Cattle and milk (12)	\$ 135,590,690.21	\$ 36,494,504.57
Beef Cattle ranching (11)	\$ 64,361,679.78	\$ 26,361,063.63
Hospitals (490)	\$ 127,892,636.10	\$ 171,821,432.72
Construction of highways and streets (54)	\$ 52,382,836.20	\$ 53,024,065.51
Construction of new manufacturing (51)	\$ 27,956,647.13	\$ 27,414,251.43
Power and transmission (47)	\$ 156,428,560.27	\$ 219,700,566.88
<b>Value Added (GDP)</b>	<b>\$ 5,988,885,717.74</b>	<b>\$ 7,593,747,168.19</b>
Employee Compensation	\$ 2,522,451,767.30	\$ 2,825,860,351.46
Propieter Income	\$ 363,961,674.85	\$ 184,401,716.23
Other Property Income	\$ 2,447,875,785.99	\$ 3,852,781,464.56
Taxes on Production and Imports	\$ 654,596,489.61	\$ 730,703,635.93

## *Benefitted Sectors*

- Agriculture
  - Non-food crops
  - Carbon Sequestration
  - Tree-nuts
  - Livestock
- Industry
  - Potash
  - Data Centers
  - Oil & Gas Equipment
- Environmental
  - Stream Augmentation



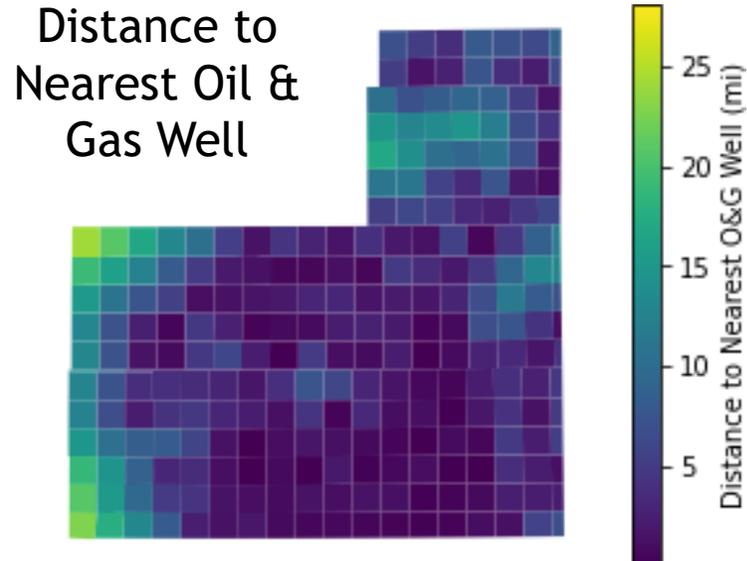
## Social: Human Health

- Based on EPA's Exposure and Fate Assessment Screening Tool (E-FAST)
- Determine change in dose rate for both acute and chronic exposure:
  - Pecos River (incidental contact)
  - Fish Ingestion
  - Groundwater contamination
  - Inhalation (spray irrigation)
- Compare to exposure with current water quality.
- Index to Concentration of Concern levels



## Social: Environmental Justice

- Metrics adapted from:
  - California Environmental Protection Agency's Environmental Justice Screening Tool (CalEnviroScreen 4.0), and
  - Washington State Department of Health's (WaDOH) Environmental Health Disparities tool



### Metrics and State

<u>Aa</u> Indicators	▼ Variable Type	▼ Status
Proximity to oil and gas activity	Environmental Exposure	Static
Proximity to PW disposal	Environmental Exposure	Static
Proximity to heavy traffic	Environmental Exposure	Static
Decreased air quality due to traffic	Environmental Exposure	Dynamic
Decreased water quantity	Environmental Exposure	Dynamic
Impaired waters	Environmental Exposure	Dynamic
Poverty rate	Socioeconomic	Dynamic
Unemployment rate	Socioeconomic	Dynamic
Household affordability	Socioeconomic	Static
Historic cultural sites	Cultural	Static