

THE IMPORTANCE OF WATER TO THE U.S. ECONOMY

PART 1: BACKGROUND REPORT

Public Review Draft

Office of Water
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Systems-level understanding of:

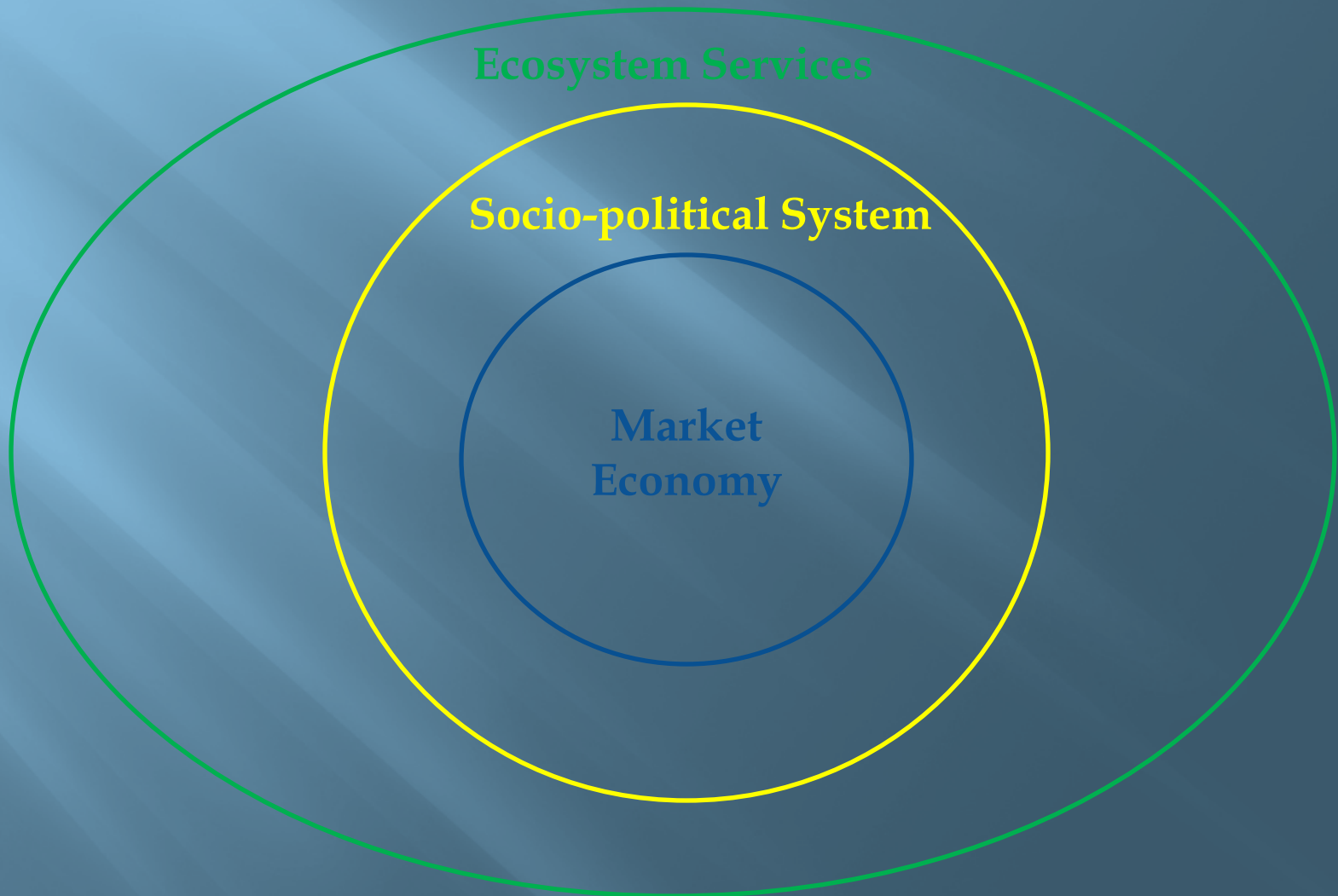
- ▣ Water's role in the economy
- ▣ Competition and interdependencies between and among various water uses
- ▣ Ways to improve water management to promote *environmentally sustainable* economic growth while *maximizing the economic value* derived from the utilization of water

Economic Perspectives

- ▣ *Microeconomic efficiency*: Relate water value to its relative scarcity, alternative uses and opportunity costs of those uses
- ▣ *Sustainability*: Consider the value of water as a function of direct and indirect impacts associated with its use both immediately and into the future within an integrated system (economic, social & environmental)

The Holistic Economy

“Spaceship Earth”



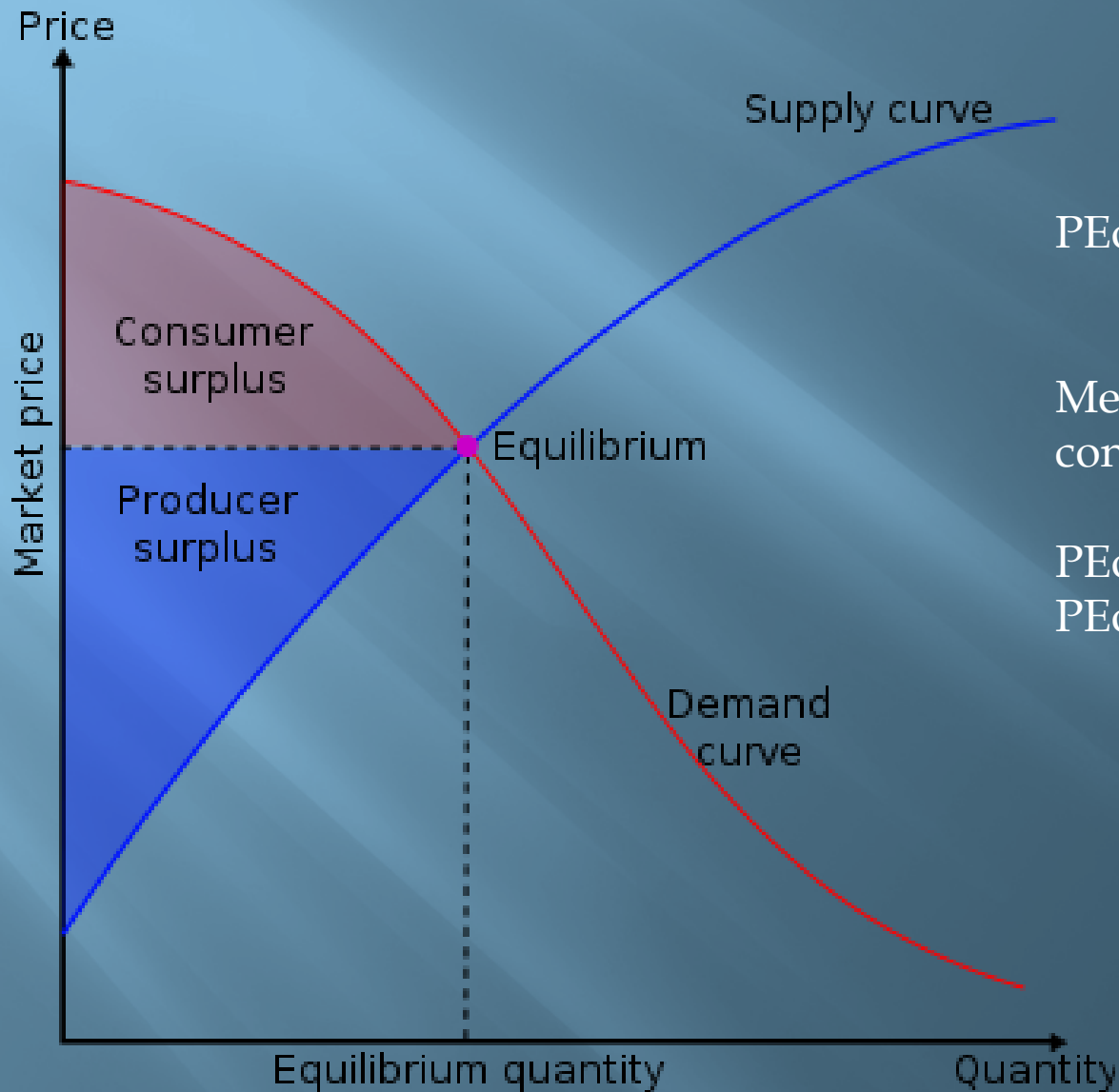
Economics

SOCIAL SCIENCE



- ▣ Analyzes production and consumption of goods and services
- ▣ Assumes
 1. Perfect Information
 2. Rational Choices
 3. Maximize utility given a budget constraint

Basic Supply and Demand



$$PEoD = \frac{\% \text{ change in } Q}{\% \text{ change in } P}$$

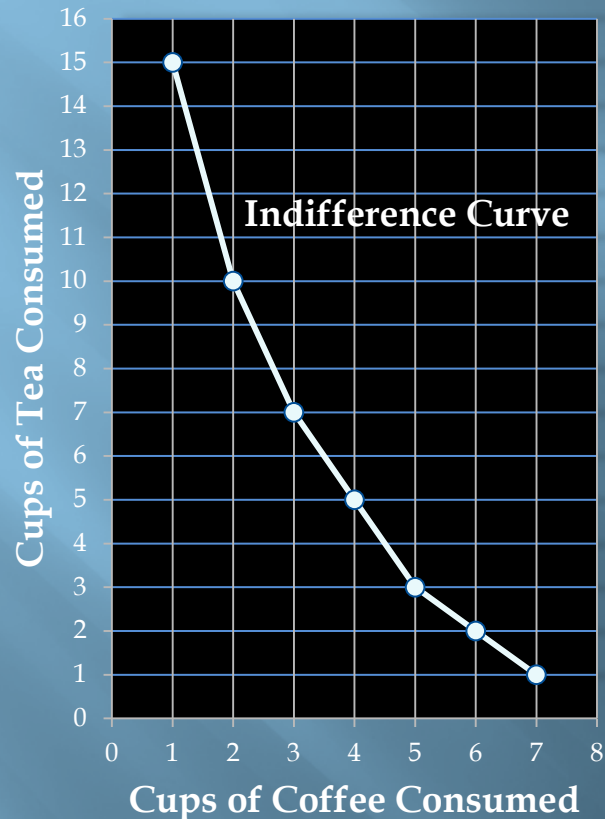
Measures how sensitive to Price consumers are

$PEoD \geq 1$ Elastic

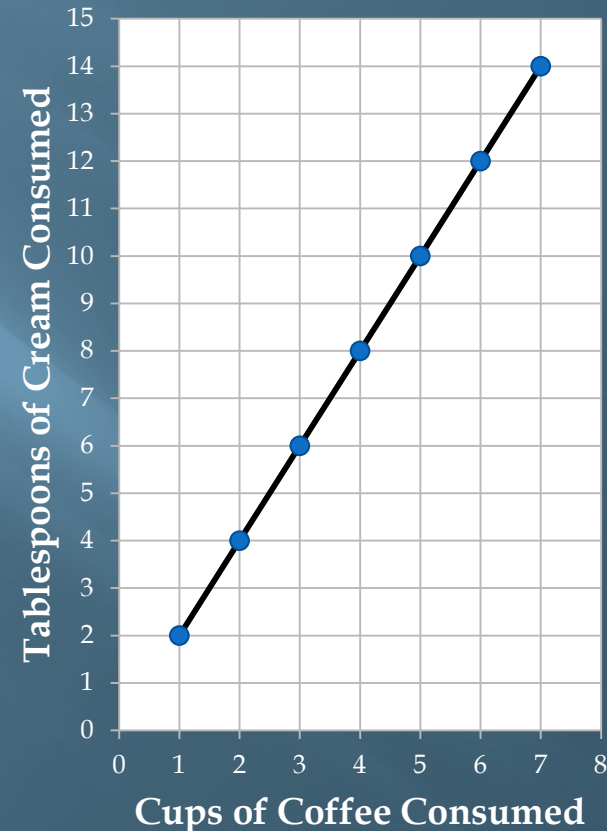
$PEoD < 1$ Inelastic

Marginal Rate of Substitution

MRS of Substitutes

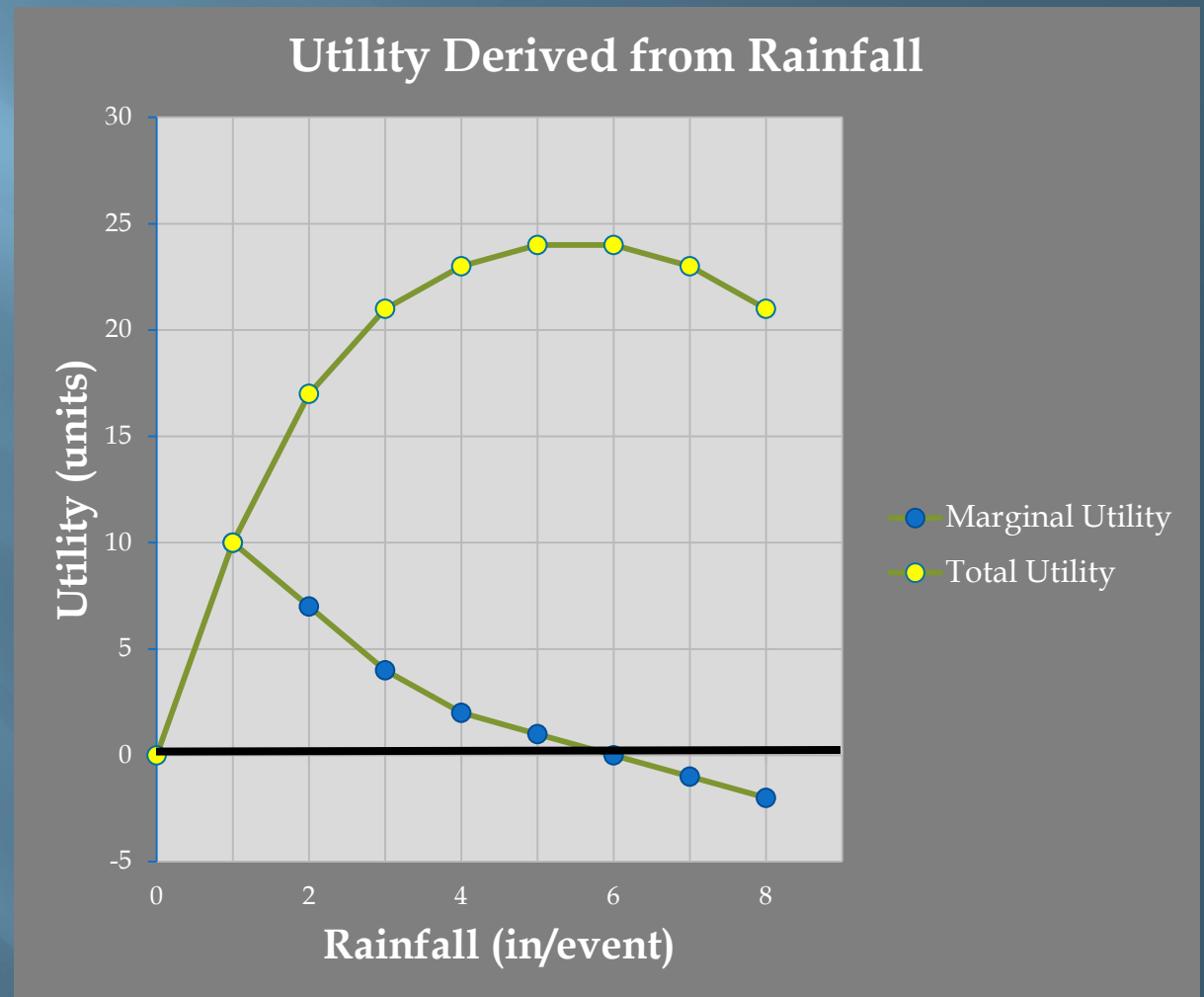


Complimentary Goods



Law of Diminishing Marginal Utility

| Inches of Rainfall per event | Total Utility, units | Marginal utility, units |
|------------------------------|----------------------|-------------------------|
| 0 | 0 | |
| 1 | 10 | 10 |
| 2 | 17 | 7 |
| 3 | 21 | 4 |
| 4 | 23 | 2 |
| 5 | 24 | 1 |
| 6 | 24 | 0 |
| 7 | 23 | -1 |
| 8 | 21 | -2 |



Tragedy of the Commons



Causes

- Owned by everyone/no one
- All have access
- Exploitation = Overpopulation

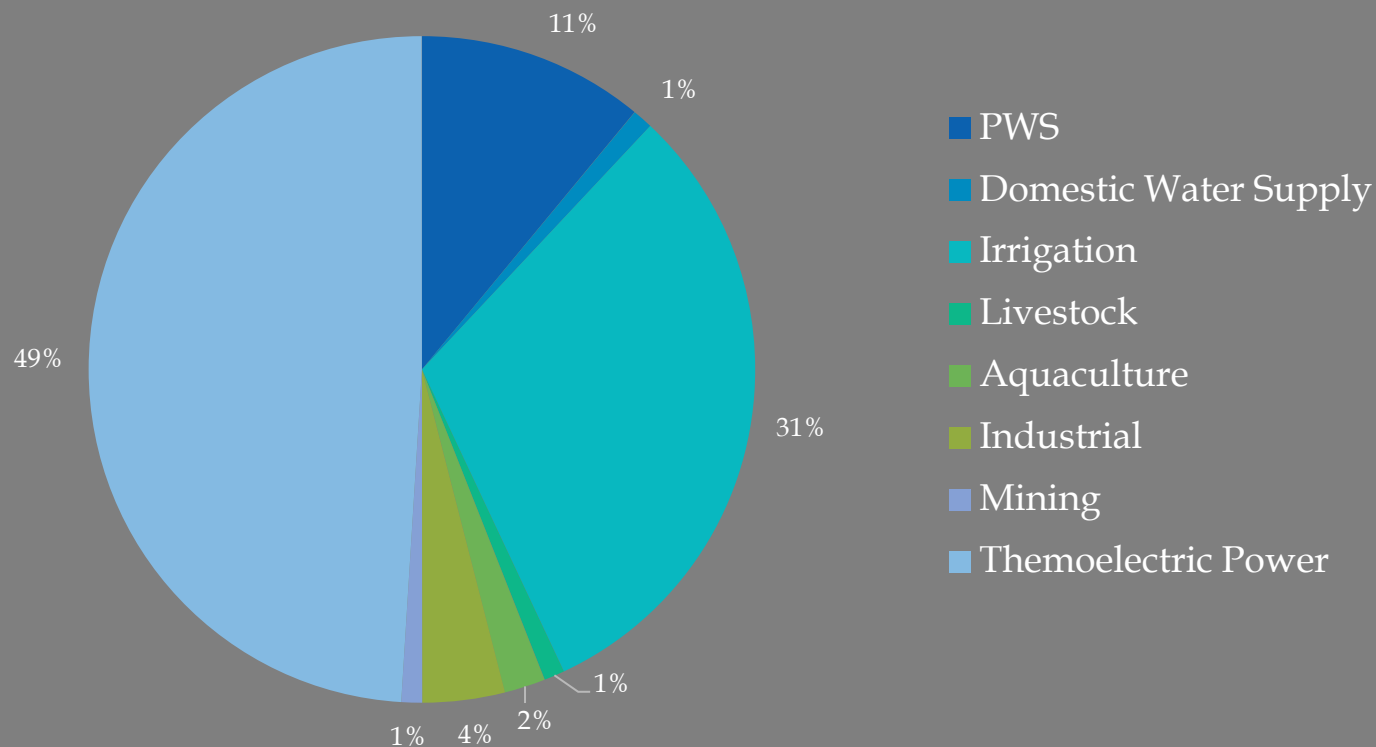
Solutions

- Government regulates
- Restrict access
- Incentives to conserve
- Change society's values



Key Sectors of the U.S. Economy

Distribution of U.S. Water Withdrawals (2005)



In-Stream Uses

- Hydropower
- Commercial Fishing
- Commercial Navigation
- Recreation & Tourism

Public Water Supply Systems

- Added Value GNP \$53 billion
 - *doesn't cover both O&M
- 7 BGD or 16% water loss due to failing Infrastructure
- Studies suggest an additional \$10-20 billion/year for 20 yrs to maintain nations PWS = D-
 - *\$1/cu-m covers O&M
 - Lincoln = \$0.71/cu-m
- Subsidies distort true S cost and politics keep P down
 - *San Antonio pays \$ 19.64/mo
 - *Lincoln pays \$20.03/mo
 - (raises Lincoln bill by 41% to \$28.31)
- MV of an additional permanent ac-ft = \$4,500
- PEOd short run = -.41 (Inelastic)
 - Long run PEOd is higher!



Agriculture

- ▣ Added Value (GNP)= \$297.2 billion
 - *Export 30% water intense crops
 - 2008 = 14.9 BGD, 3.6% of annual US water consumption

- Barriers to water transfers where there is no institutional and physical infrastructures to allow efficiency in use

- ▣ MRTS – substitute labor, equipment and practices for water

No formal market to value water

- 1950 applied 3.55 ac-ft/acre
 - 2005 applied 2.35 ac-ft/acre
 - *decrease by 1.2 ac-ft/acres
- Productivity increased by 152% & population nearly doubled
- True Value (P) is skewed by P floors & externalities

| Valuation Method | Price (ac-ft) |
|---|---------------|
| Acquisition Cost (Surface Water) | \$63.00 |
| Acquisition Cost (Groundwater) | \$94.00 |
| Factor Input Method | \$98.00 |
| Irrigation Districts (Surface Water) | \$100.00 |
| Permanent Transfer (Ag to Ag) | \$1,825.00 |
| Permanent Transfer (Ag to Municipality) | \$4,562.00 |
| Temporary Transfer (Ag to Ag) | \$30.00 |
| Temporary Transfer (Ag to Municipality) | \$119.00 |

Manufacturing

- Added Value = \$2.4 trillion
\$6.7 billion or 0.2% of that
goes to abatement cost
- Limited data indicates
MV of water \$736/ ac ft
- Water withdrawals have
decreased by 30% since
1985, attributed to increases
in efficiency & 2/3 of water
used now being reused
- MRTS using air for cooling
oppose to water
- PEO_D = -0.58, inelastic at
current prices, is different
along points on the D curve
(user have and will
continue to invest in
measures to decrease
future demand)



Mining & Energy Extraction

- 2007 value added GNP = \$417.8 billion, uses 4 BGD or 1% of US total
- Most water is self-supplied or produced: **no reliable market data is available**
 - Texas study from 1990-2003 purchased water from \$40-2,600 ac ft/yr
- Need more information to determine the value of water to mining
- Ave revenue/ metric ton extracted = \$15.42 (Iron has higher value than gold at \$93 oppose to \$27. Reflects the high ratio of material extracted to final product)



***Powder River Basin, WY
Mountain to mining for coal**

Electric Power

- Value Added GNP = \$197 billion, est. MV = \$100 ac-ft
- Largest user at 49% US total or 200 BGD withdrawals yet only 2.5% or 10 BGD consumed
- Price subject to Government regulations not markets
- CWA triggered the use of water recirculating cooling systems, dropped withdrawals from 570 to 20 G/kWh generated yet consumption increased from <1 to 8.5 G/kWh due to evaporative cooling losses
- Trends indicate a decrease in withdrawals by 4.4% yet an increase in consumption by 22.2% from 2005-2030
- 22% Thermoelectric generation capacity is located within counties at high or extreme levels of water sustainability risk (EPRI 11)



*Beaver Valley Power Station, PA
water evaporation from towers

Total value of water is infinite yet Marginal Value can be relatively low!

Water doesn't fit into typical economic analysis

- Water in the US has historically been free and plentiful and is valued incorrectly b/c scarcity is not seen, externalities aren't included and P is artificially kept low
- Marginal Value changes by location, use, competition and scarcity over time and is relative to the last unit consumed!

| Sector | Total Revenue (billions) 2010 | Ave. Est. Marginal Water Value (ac-ft) | Total Water Use (TG) | Total Marginal Water Value (trillions) | Marginal Water Value as a % of Revenue |
|----------------------------|-------------------------------|--|----------------------|--|--|
| PWS | 53 | 4,500 | 16.1 | 23.6 | 44,528.3% |
| Agriculture | 297.2 | 1,800 | 56.2 | 32.9 | 605.7% |
| Manufacturing | 2,400 | 736 | 6.6 | 1.6 | 66.7% |
| Mining & Energy Extraction | 417.8 | 202 | 1.5 | 0.1 | 23.9% |
| Electric Power | 197 | 100 | 73 | 2.4 | 1,218.3% |
| Total | Sum = 3365 | Ave = 1,468 | Sum = 153.4 | 73.3 | 2,178.8% |

EPA. "Importance of Water Study." *EPA United States Environmental Protection Agency*. 22 Jan. 2013. Web. 22 Feb. 2013.

<http://water.epa.gov/action/importanceofwater/study.cfm>