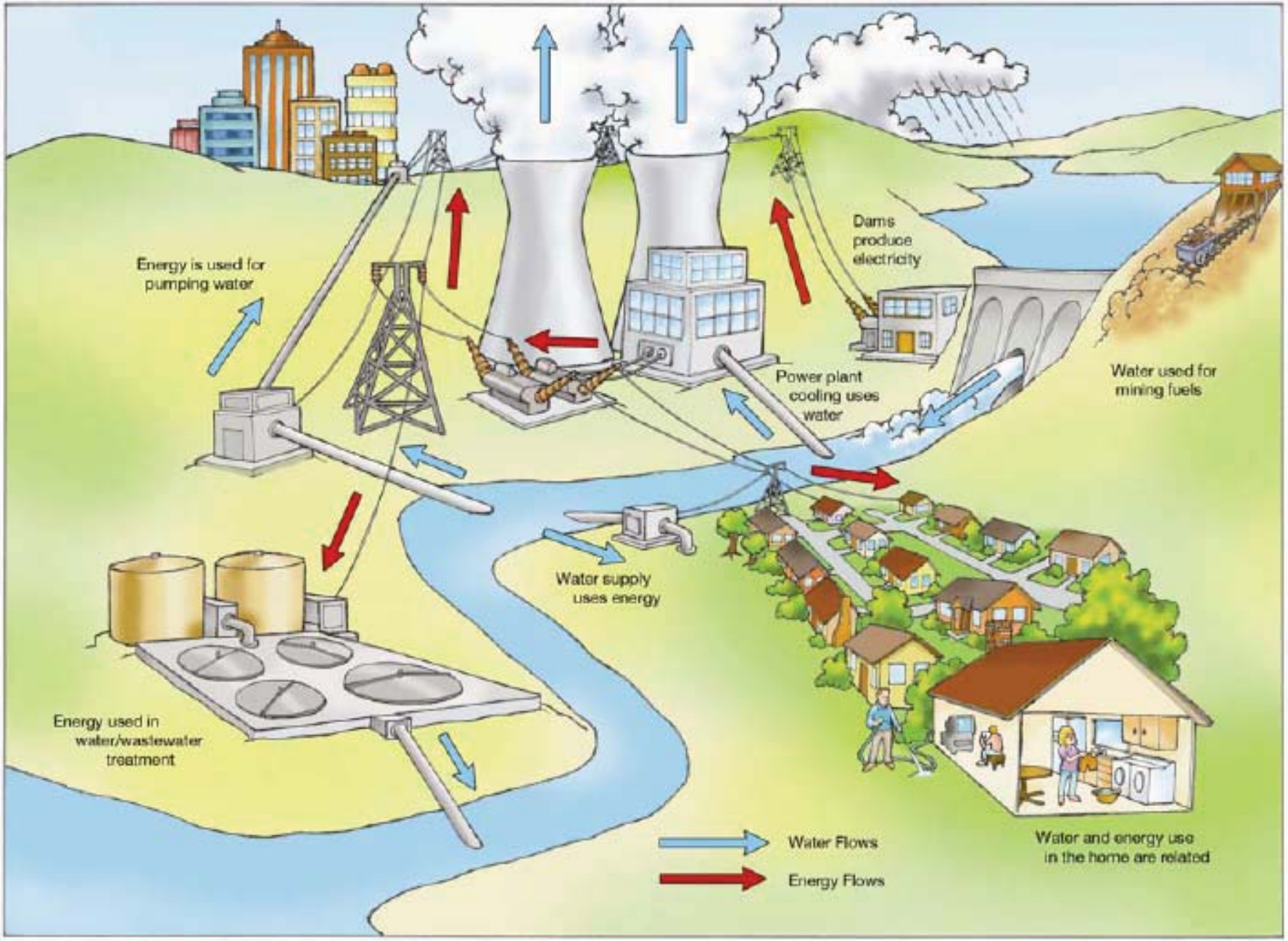
Water, Energy and the New Carbon Economy

Amy Hardberger

ENVIRONMENTAL DEFENSE FUND

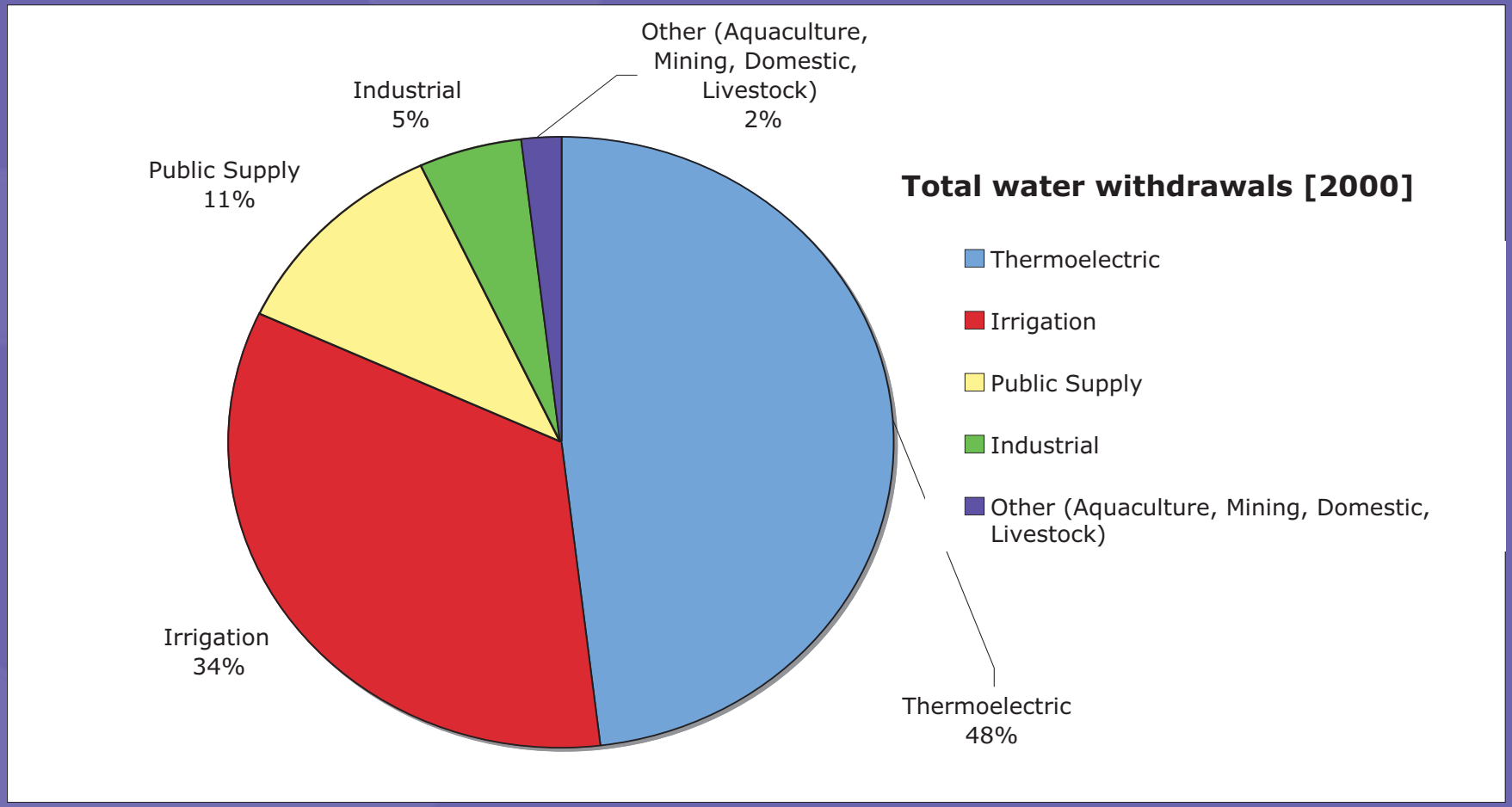
finding the ways that work


Energy is used for pumping water
Dams produce electricity
Power plant cooling uses water
Water used for mining fuels
Water supply uses energy
Energy used in water/wastewater treatment
Water Flows
Energy Flows
Water and energy use in the home are related

The Big Picture

1. Energy and water are interrelated
   - we use energy for water and water for energy
2. Trends imply growth in total demand for energy and water
   - primarily driven by population growth
3. The energy and water relationship is already under strain
5. Global climate change will intensify this strain
6. Trends imply growing water-intensity of energy and energy-intensity of water
   - primarily driven by policy shifts
7. Carbon Constrained Economy

US Water Withdrawals



Water for Cooling

			Cooling Technologies – Water Consumption (gal/MWh)				
			Open-Loop	Closed-Loop Reservoir	Closed-Loop Cooling Tower	Hybrid Cooling	Air-Cooling
Fuel Technology	Thermal	Coal	300	385 (±115)	480	between	60 (±10)
		Nuclear	400	625 (±225)	720	between	60 (±10)
		Natural Gas Combustion Turbine	negligible	negligible	negligible	negligible	negligible
		Natural Gas Combined-Cycle	100	130† (±20)	180	between	60† (±10)
		Integrated Gasification Combined-Cycle	not used	not used	350† (±100)	between	60† (±10)
		Concentrated Solar Power	not used	not used	840 (±80)	between	80† (±10)
	Non-Thermal	Wind	none	none	none	none	none
		Photovoltaic Solar	none	none	none	none	none

†Estimated based on withdrawal and consumption ratios

Energy-Water Nexus in Texas

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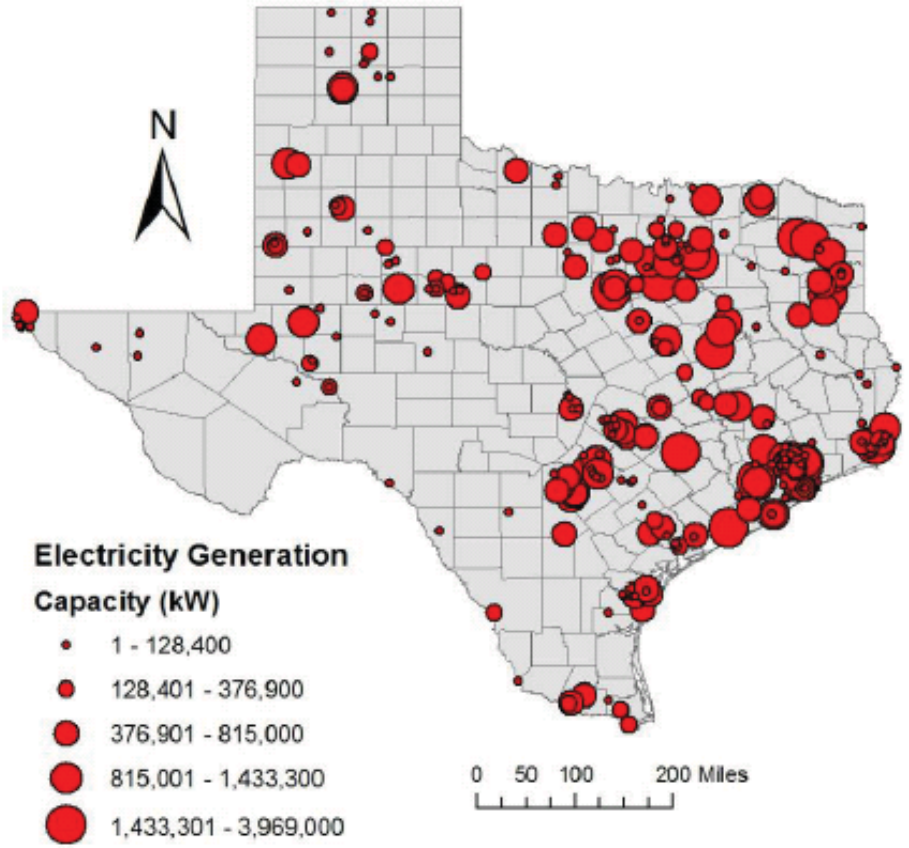
Water for Energy

- Fuel type
  - Natural Gas
  - Coal
  - Nuclear
  - Solar
- Cooling technology
  - Open loop
  - Closed loop
  - Dry or air
  - Hybrid

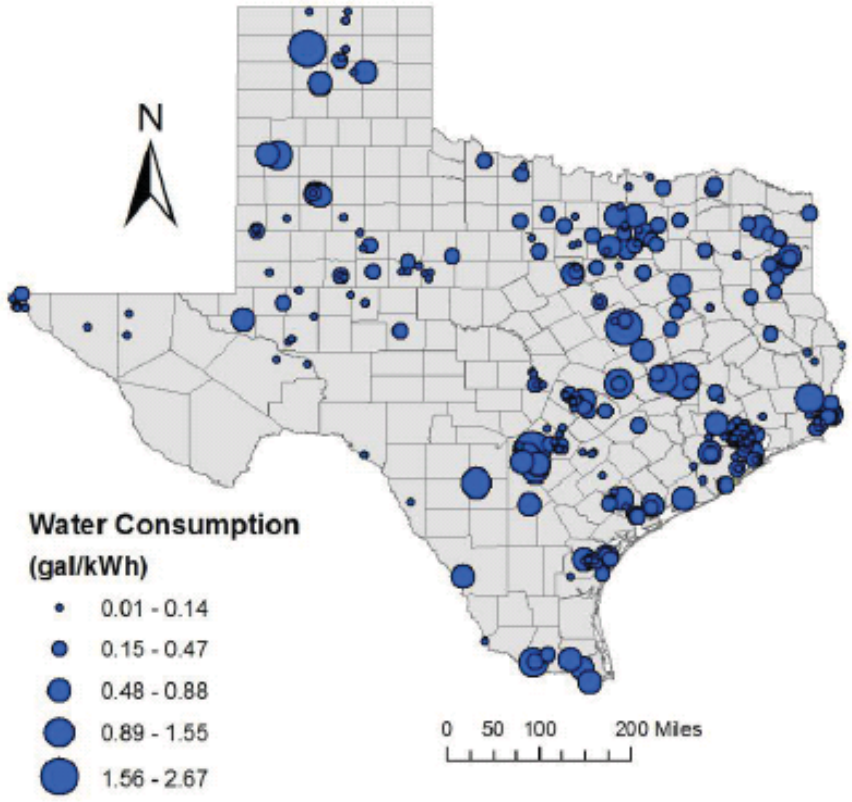
Not included

- Mining
- Transportation

Capacity for Electricity Generation in Texas Power Plants



Water Consumption for Cooling of Texas Power Plants



Texas' 258 power plants have capacity = 110 GW

Actual Generation – 400 terawatt-hours

What about Texas?

- 157,000 million gallons (482,100 acre-feet) of water annually.
  - enough water for over 3 million people for a year, each using 140 gallons per person per day
  - Not total capacity
- Power plants are responsible for an estimated 2.5% of the total water consumption for Texas (consumption only)
- Data and Reporting Gaps
  - Withdrawal amounts
  - Evaporative losses

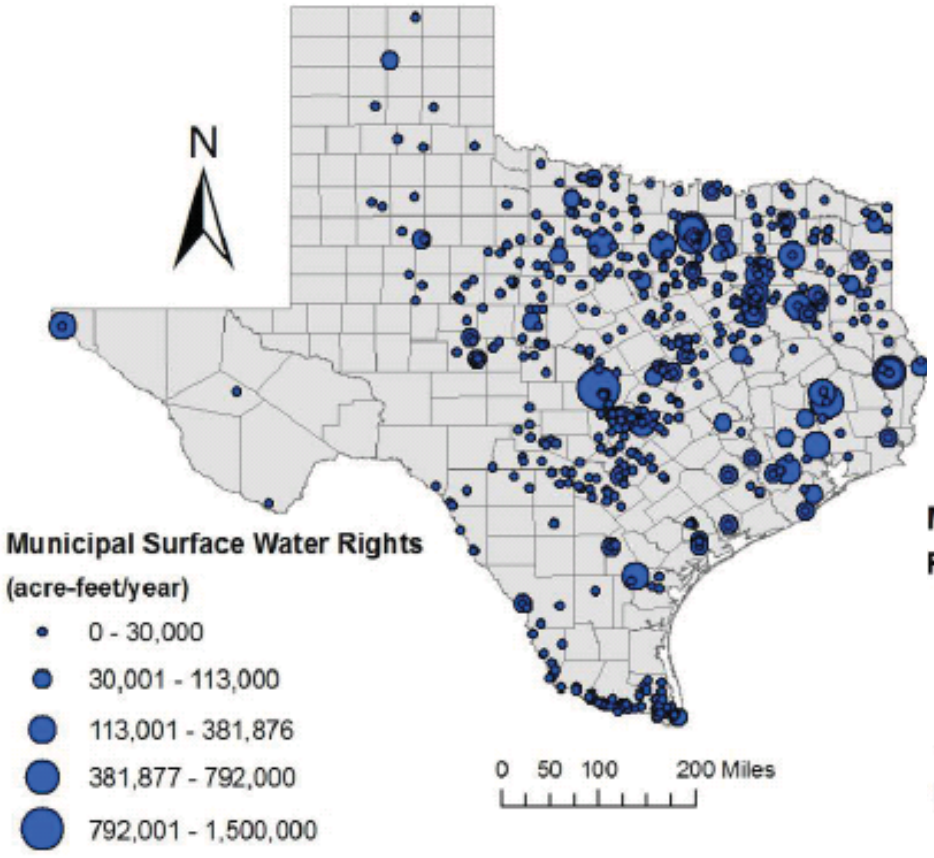
Energy for Water

- Treatment
- Wastewater Treatment

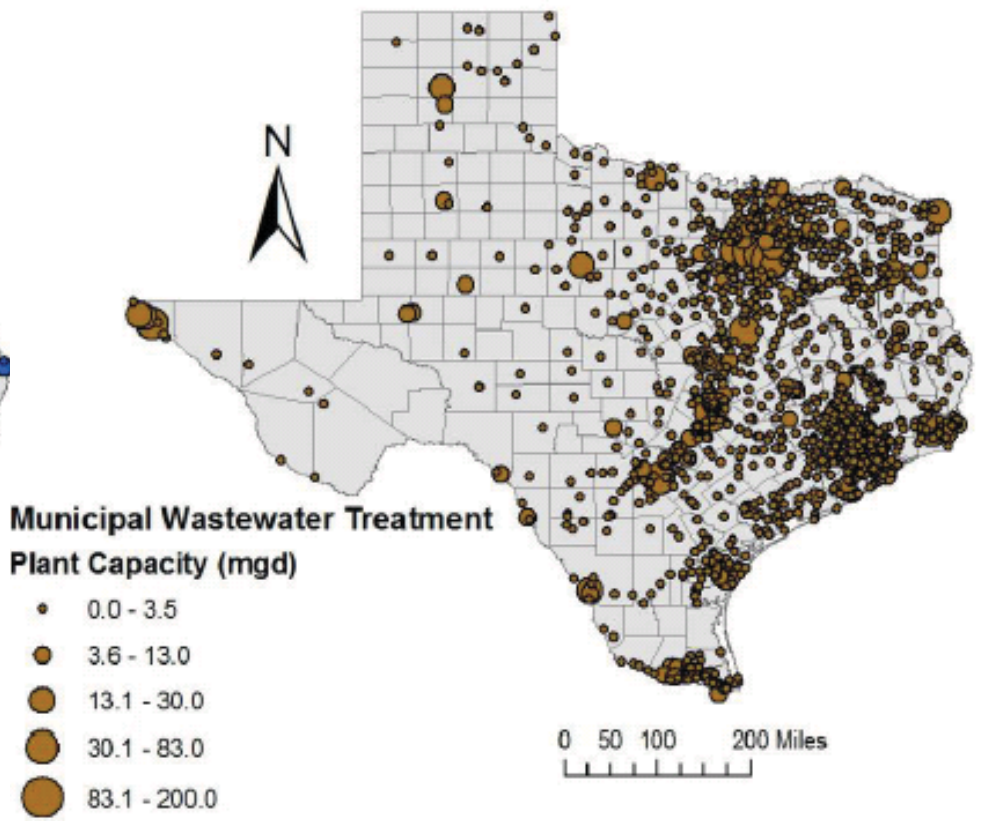
Not included

- Collection and Conveyance
  - Groundwater v surface water
- Distribution
- In-home Uses
- Irrigation

Municipal Surface Water Rights in Texas



Municipal Wastewater Treatment Plants in Texas



ient at the low end to advanced treatment with

Texas public water supply = 4.5 million acre-feet/yr

On the Water side . . .

- 2.1 to 2.7 TWh of electricity for water systems and
- 1.1 to 2.2 TWh for wastewater systems each year –
  - enough electricity for about 100,000 people for a year.
- Together 0.8 to 1.3% of total Texas electricity and 2.2 to 3.4% of industrial electricity use annually.
- Data Gaps
  - Water treatment plant power usage
  - Wastewater treatment plant power usage
  - End Use Energy requirements
  - Pumping and conveyance

The Energy-Water Relationship Is Already Under Strain

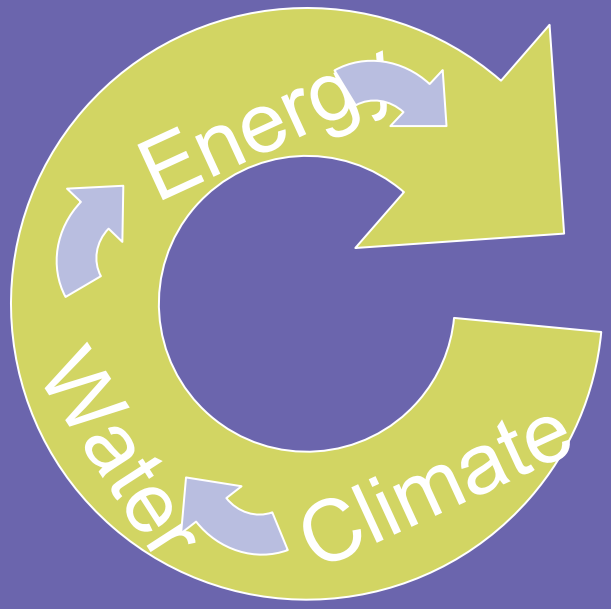
- Record heat wave in France in 2003
  - nuclear power plants had to dial back because of inlet water temperatures (less cooling capability) and rejection water temperature limits
- "Droughts could close nuclear power plants: Southeast water shortage a factor in huge cooling requirements"
  - *Associated Press*, January 23, 2008
- Civil War Between Georgia and Tennessee?
  - "Georgians want access to Tennessee water"
  - *The Tennessean*, February 8, 2008

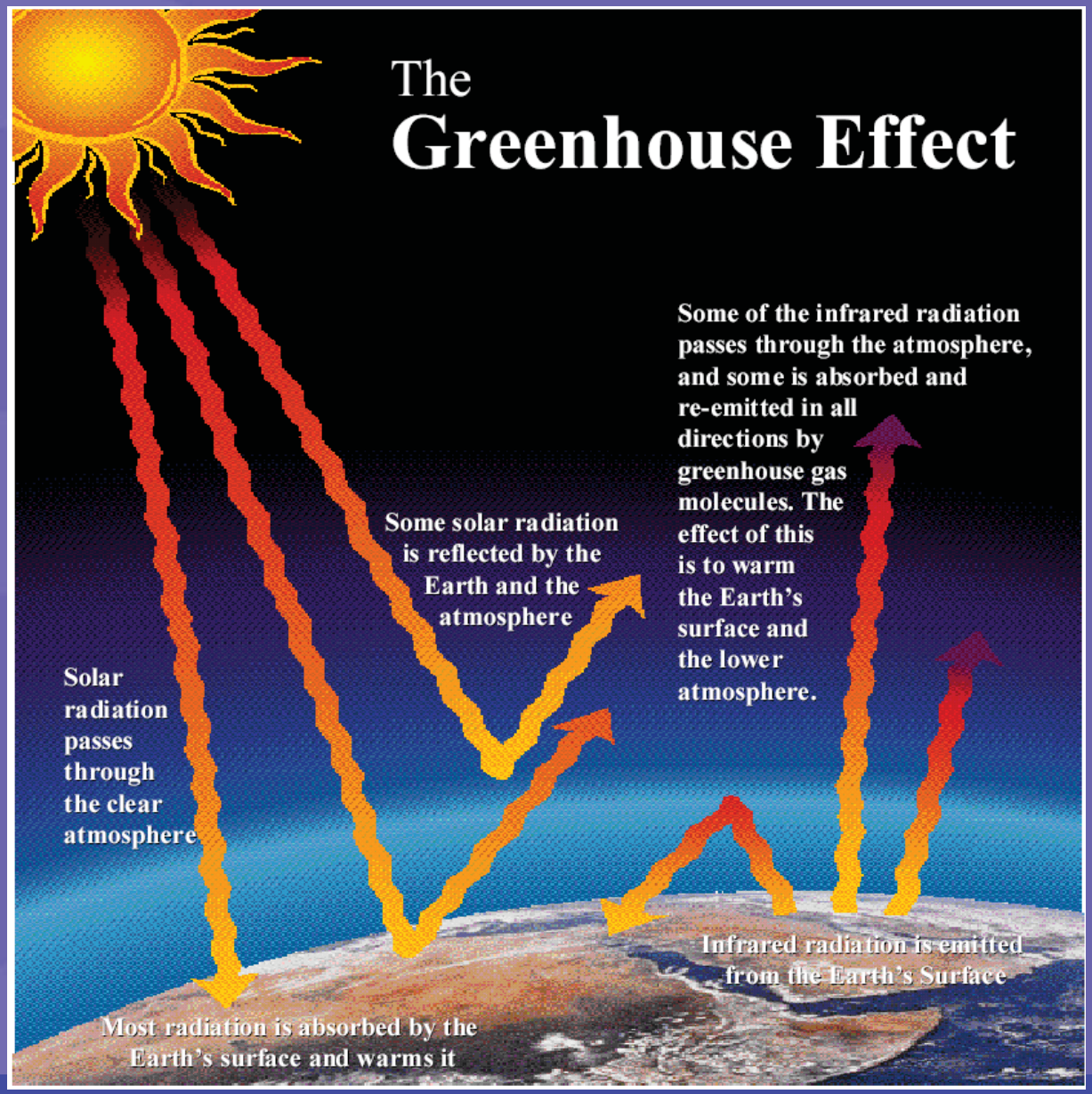
Increasing the Strain

- Population growth
- Fuel Mix & CCS
- Air quality considerations
- Technology
- Water supply proposals
- Climate change

The Role of Climate Change

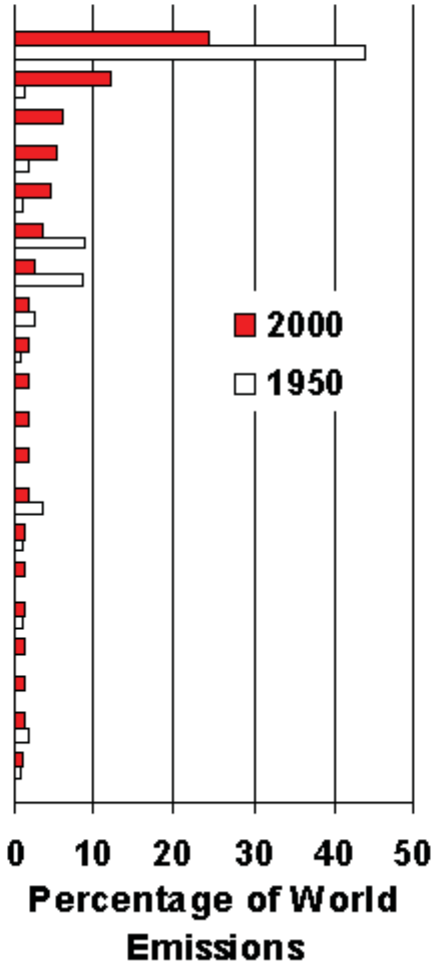
- Energy releases greenhouse gases, which cause global climate change
- Global climate change strains water resources
- Strained water resources require more energy
- More energy causes more climate strain…which causes more water strain…and so forth…

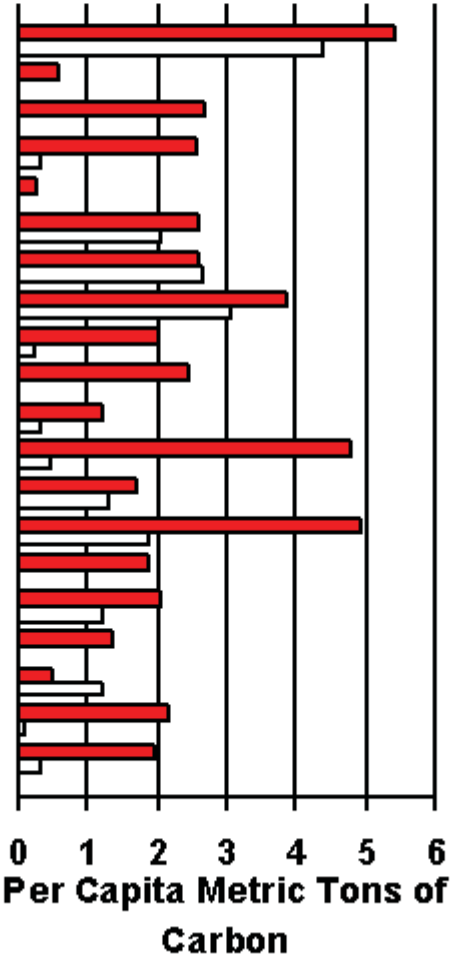



The
Greenhouse Effect
Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Some solar radiation is reflected by the Earth and the atmosphere
Solar radiation passes through the clear atmosphere
Infrared radiation is emitted from the Earth's Surface
Most radiation is absorbed by the Earth's surface and warms it

Top 20 (2000 total CO_2 emissions)

2000 Rank		1950 Rank
(1)	USA	(1)
(2)	China	(9)
(3)	Russia	(FSU=2)
(4)	Japan	(8)
(5)	India	(12)
(6)	Germany	(3)
(7)	UK	(4)
(8)	Canada	(6)
(9)	Italy	(16)
(10)	South Korea	(57)
(11)	Mexico	(19)
(12)	Saudi Arabia	(47)
(13)	France	(5)
(14)	Australia	(14)
(15)	Ukraine	(FSU=2)
(16)	South Africa	(13)
(17)	Iran	(28)
(18)	Brazil	(24)
(19)	Poland	(7)
(20)	Spain	(18)





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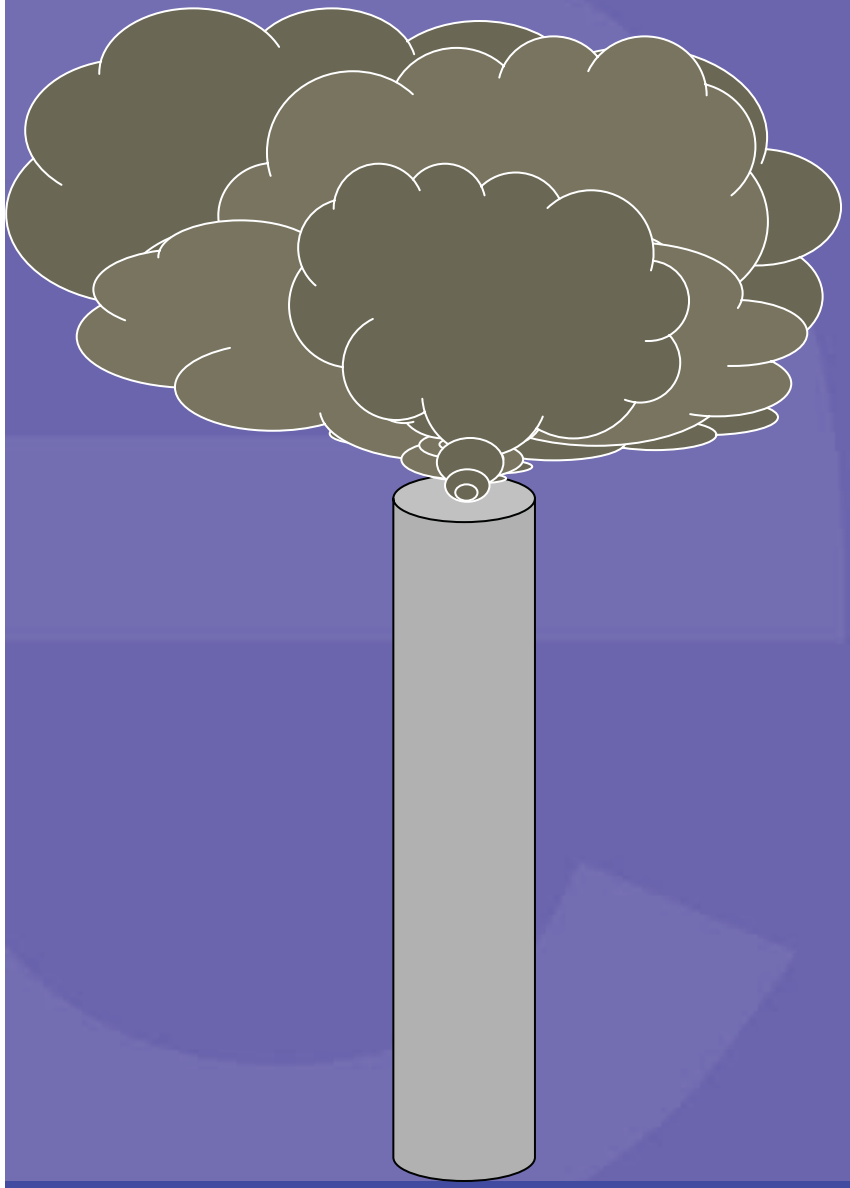

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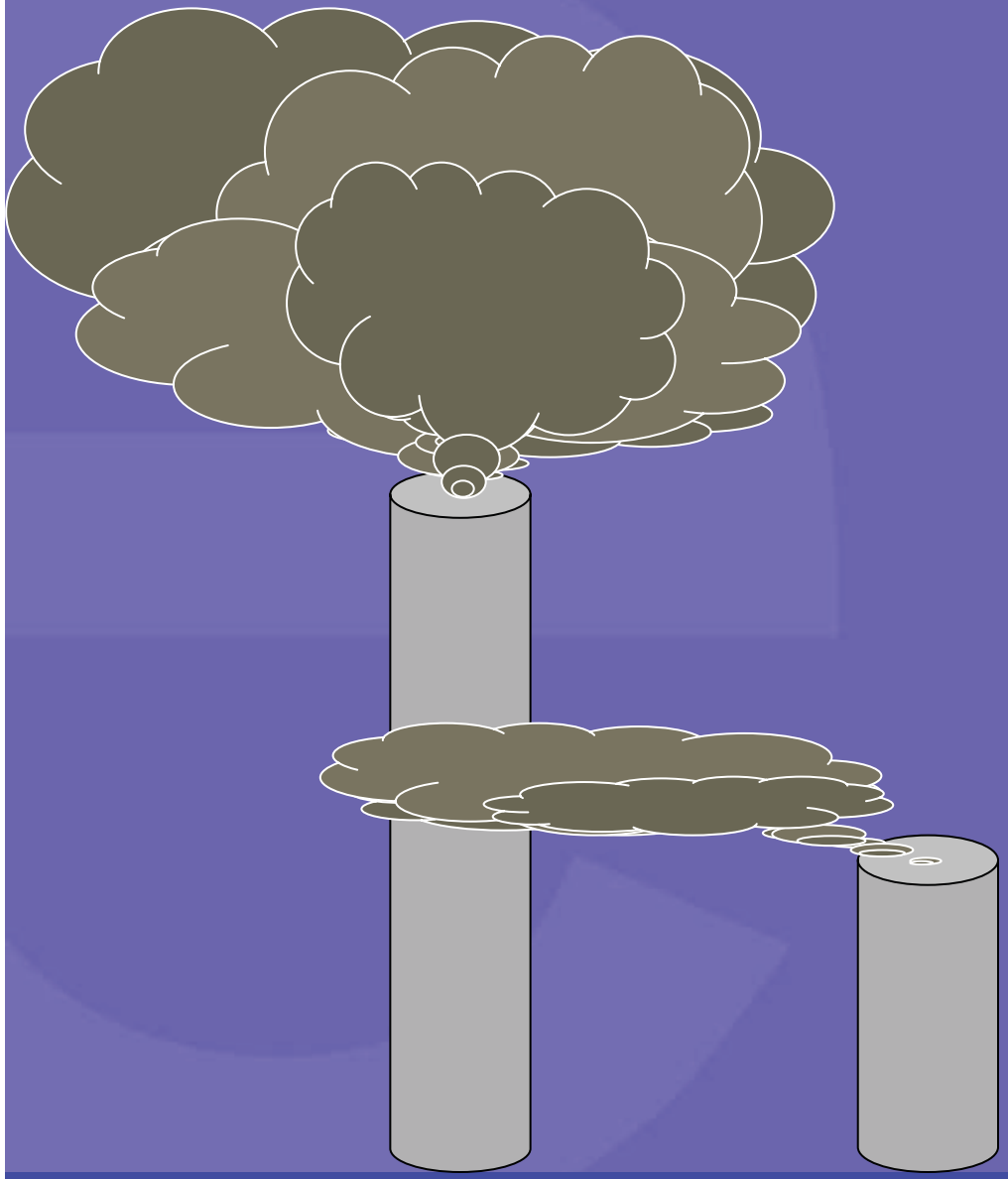

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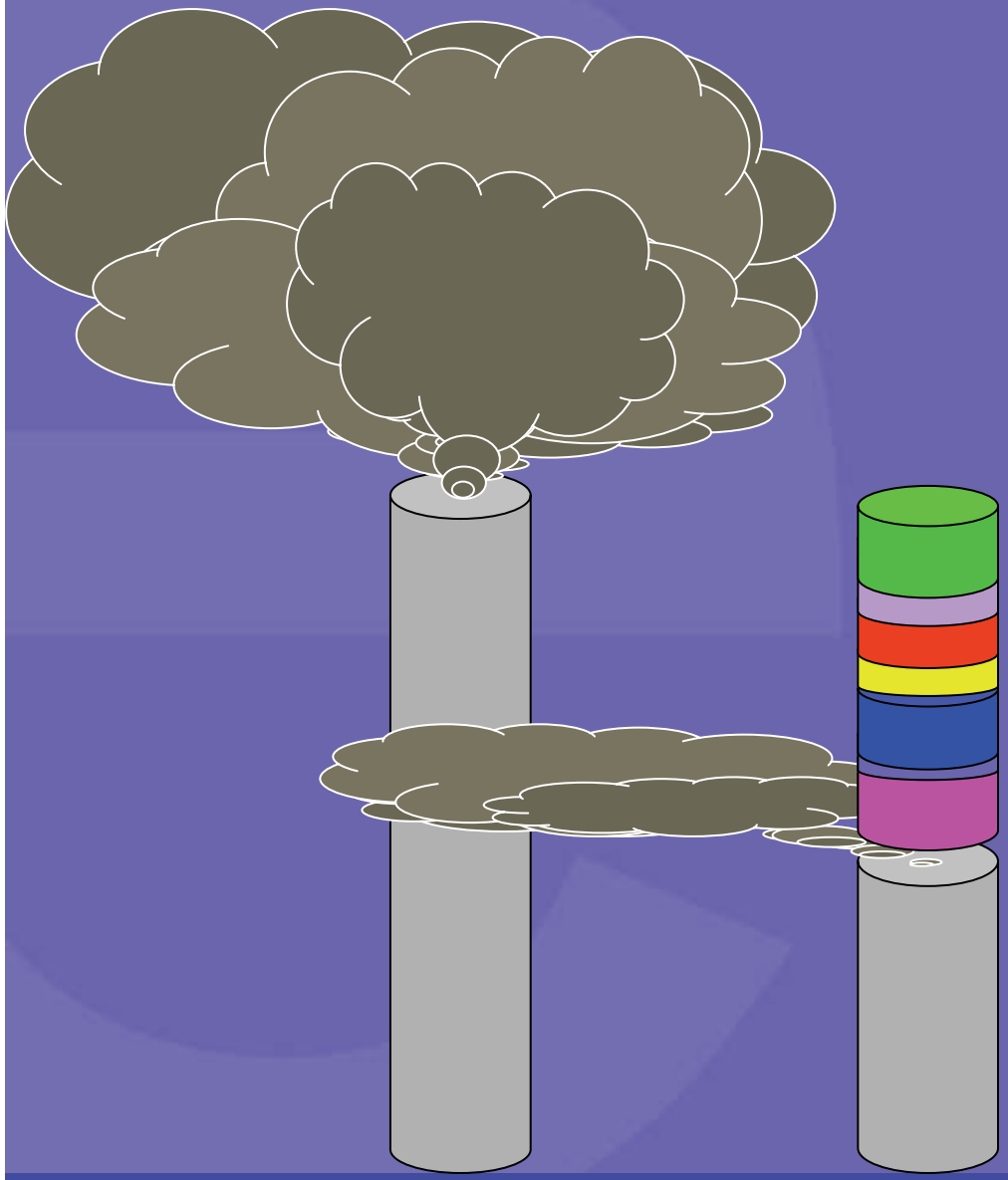

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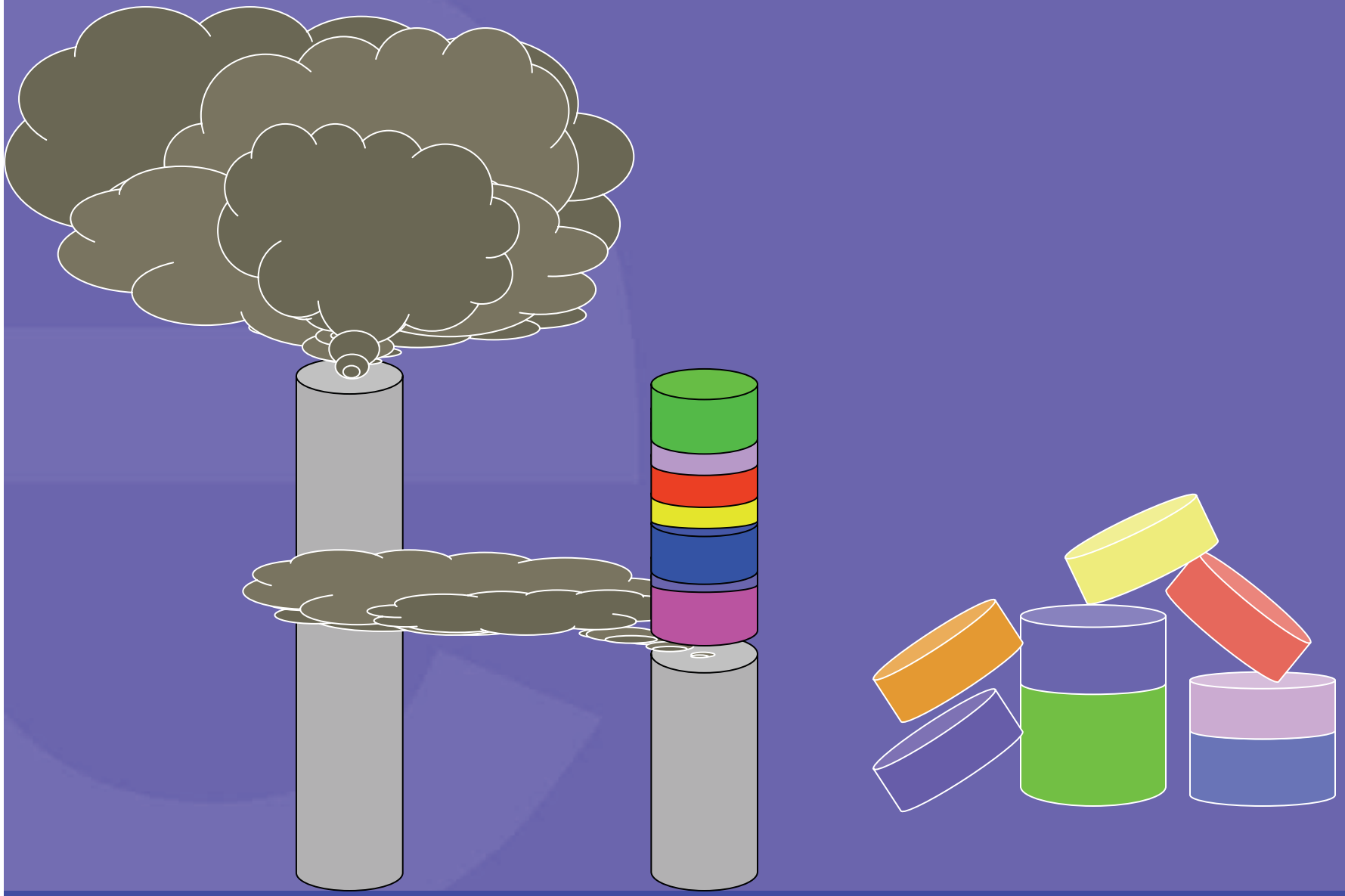

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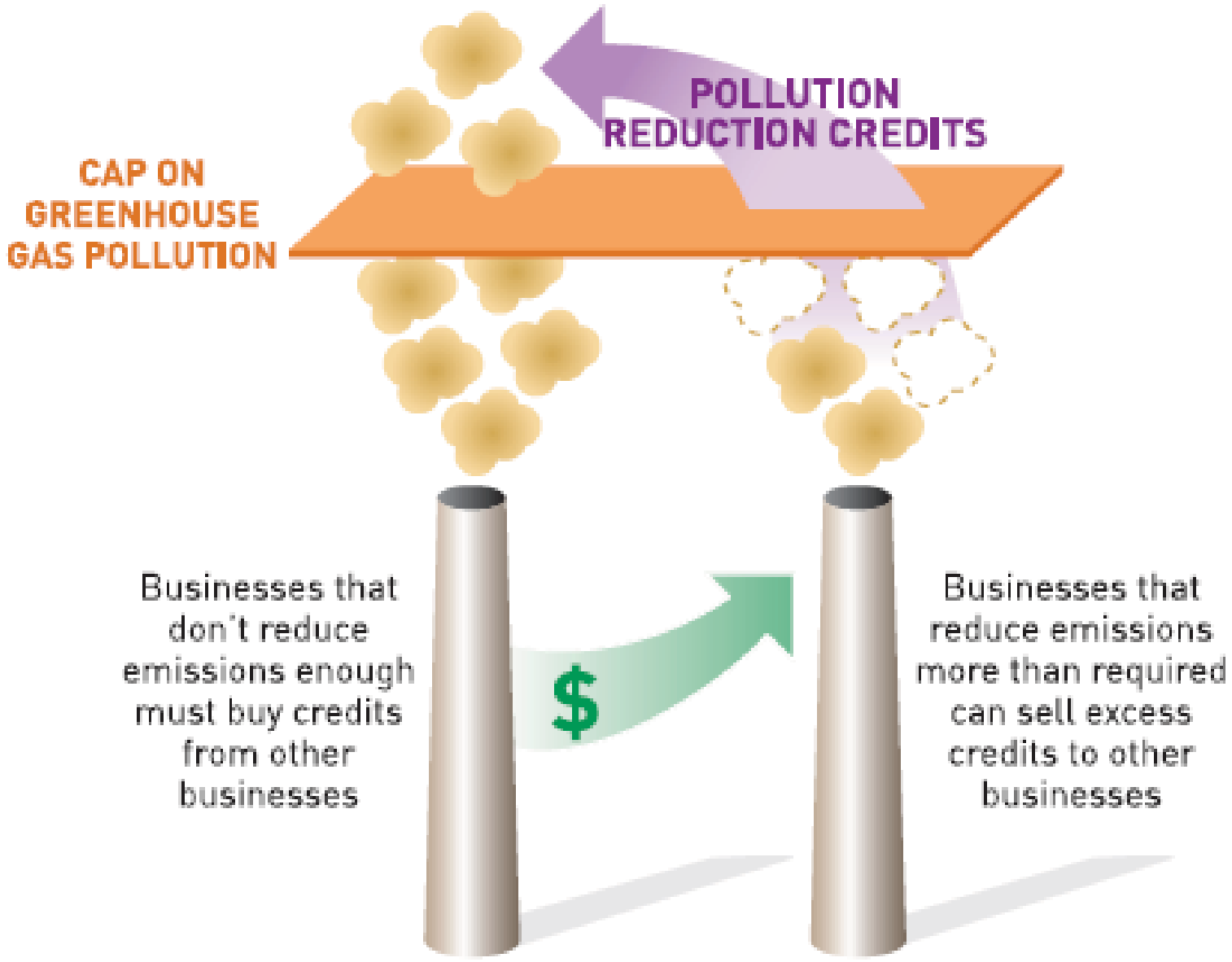
HOW CAP AND TRADE WORKS



Offsets and More

- What is an offset?
- Who would pay?
- Why would they pay?
- How much would they pay?
- How can water be an offset?

What makes an offset an offset?

EDF Gold Standard

- Net reduction is GHG emissions
  - Measurable and Quantifiable
  - Additionality
  - Leakage
  - Permanence

Thank you

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