MACRO-OVERVIEW
ENERGY MARKETS & CURRENT EVENTS

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VALUATIONS

Fundamentals—

Revenue > Cost

Time

Comparatives—

Similar metrics

ENERGY MARKETS ARE NETWORKS

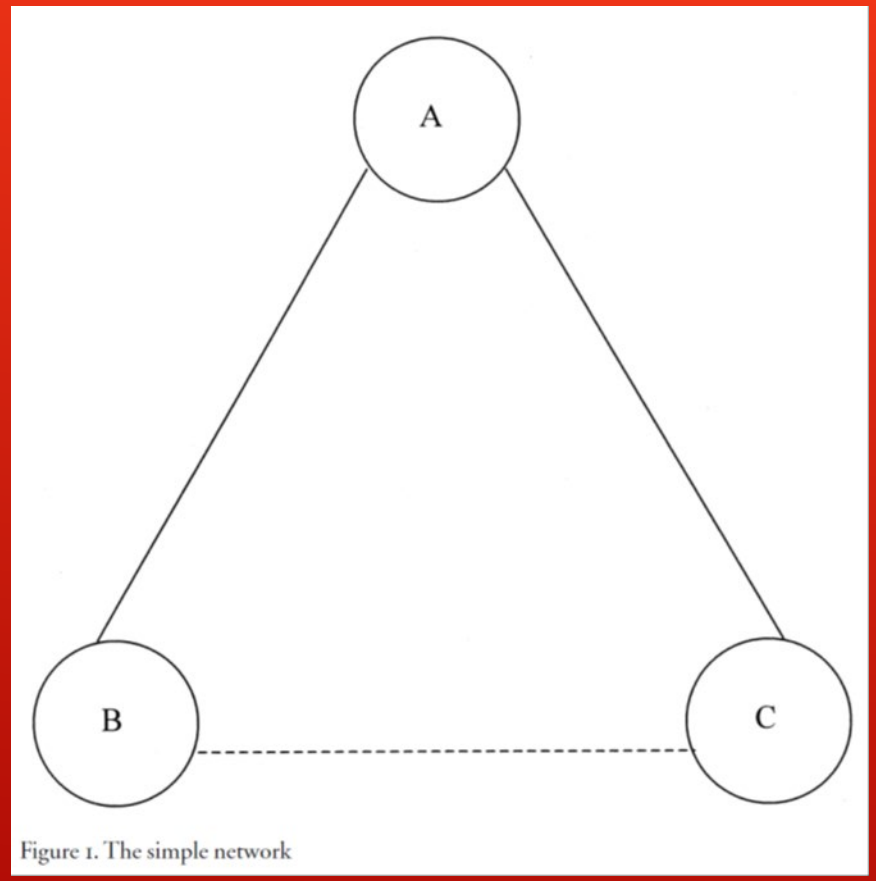
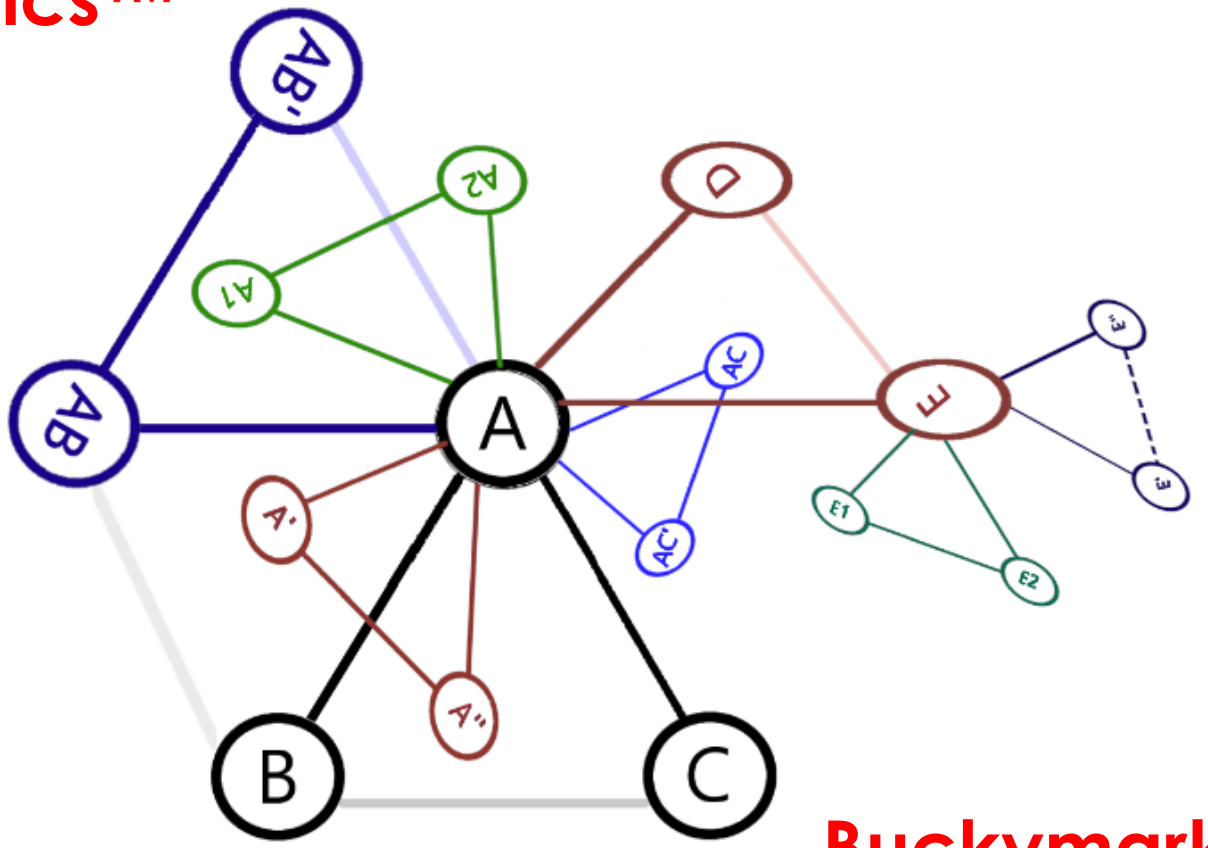


Figure 1. The simple network

Paul W. MacAvoy

ENERGY MARKETS ARE NETWORKS

Buckynomics™



Buckymarkets™

ENERGY PROVIDES MEANS TO AN END

CONSUMERS SURPLUS

PRICE OF GASOLINE VS. STARBUCKS

Rate of Return

Matching Assets to Liabilities

EVERY ENERGY SUPPLY CHAIN IS STRAINED

BECAUSE OF GOVERNMENT ACTIONS

U.S. CONSUMER IS PAYING FOR IT

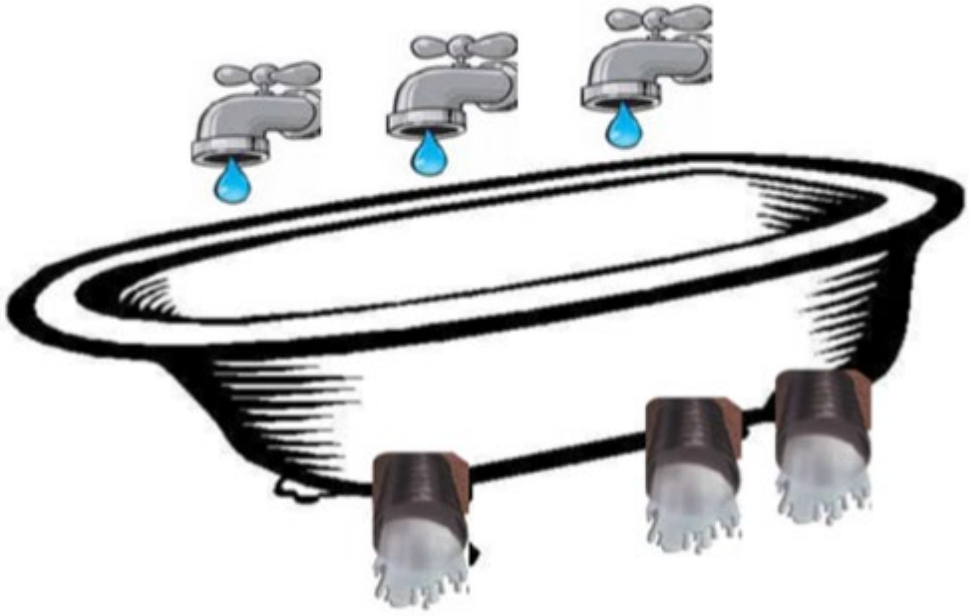
World Crude Market

The Crude Oil Market is NOT a Free Market

80% of world crude reserves held by sovereign nations

RAND estimates the probability of a major, negative supply shock of at least 8% over the next decade.

WORLD CRUDE MARKET



William Nordhaus

Figure 1. The World Oil Market à la Magritte

VENEZUELA AND IRAN

BLOCKADE OF STRAIT OF HORMUZ

Oil price elasticity of demand = -0.047

About 10% of global supply offline

MACROECONOMIC CONSEQUENCES

IMPACT ON U.S.

Higher fuel prices

Higher electricity prices

Higher inflation

IMPACT ON U.S.

Positive for GDP

Positive for LNG

Negative for consumers

Negative for incumbents

MORE NEGATIVE SUPPLY CHAIN IMPACTS

Tariffs war

ICE enforcement

NOT ALL OIL COMPANIES BENEFIT

THE INVESTMENT DECISION

$$NPV = \sum_0^N CFi/(1+r)^i$$

Where: NPV is Net Present Value

CF_i is the Cash Flow, negative or positive at time *t*

r is the discount rate or required return on capital

(*r* can be risk-adjusted for the risk of the project)

OIL & GAS

Sovereign Risk

- Taxation
- Laws
- Gunboats
- Market Manipulation
- Royalties
- Environmental

OIL & GAS TRANSPORT

Pipelines

Crude by rail

Crude and products by trucks

Tankers

LNG

U.S. ELECTRICITY GRID

3,500+ entities make up the “grid”

Everything is regulated

U.S. ELECTRICITY SUPPLY CHAIN

Fuel source

Generators

Transmission

Local Distribution

Retail

U.S. ELECTRICITY SUPPLY CHAIN

Needed $2 trillion before transition

How to meet new Demand

U.S. ELECTRICITY SUPPLY CHAIN

Government oversight

or

Government operated

ELECTRICITY MARKETS GOVERNMENT OVERSIGHT

Vertically integrated—generation to meter

1. Generators +
2. Transmission +
3. Local Distribution Company +
4. Retail Electricity Provider

Regulated Rate of Return—Cost of Service Model

ELECTRICITY MARKETS—GOVERNMENT OPERATION

Restructured markets—Separated by segment

- Generators—*Government Operated*
- Transmission—Regulated Rate of Return
- Local Distribution Company—Regulated Rate of Return
- Retail Electricity Provider—*Government Licensed*

RESTRUCTURED MARKETS

Generators

Transmission

Local Distribution Company

Retail Electricity Provider

ADDING NEW DEMAND TO A MARKET

WHY ARE VALUATIONS DIVERGING?

“Better to be vaguely right than exactly wrong”

Carveth Read, *Logic, Deductive and Inductive (1898)*

Natural Gas Power Plant 1.0 GW

Solar Farm 1.0 GW

Solar Farm 1.0 GW

4 Hour Battery 1.0 GW

4 Hour Battery 1.0 GW

4 Hour Battery 1.0 GW

Assume 100% efficiencies and 12-hour days

“Better to be vaguely right than exactly wrong”

Carveth Read, *Logic, Deductive and Inductive (1898)*

Natural Gas CC Power Plant 1.0 GW

~$3 billion

Solar Farm 1.0 GW

Solar Farm 1.0 GW

~$2 billion

4 Hour Battery 1.0 GW

4 Hour Battery 1.0 GW

4 Hour Battery 1.0 GW

~$3.0 billion

Assume 100% efficiencies and 12-hour days

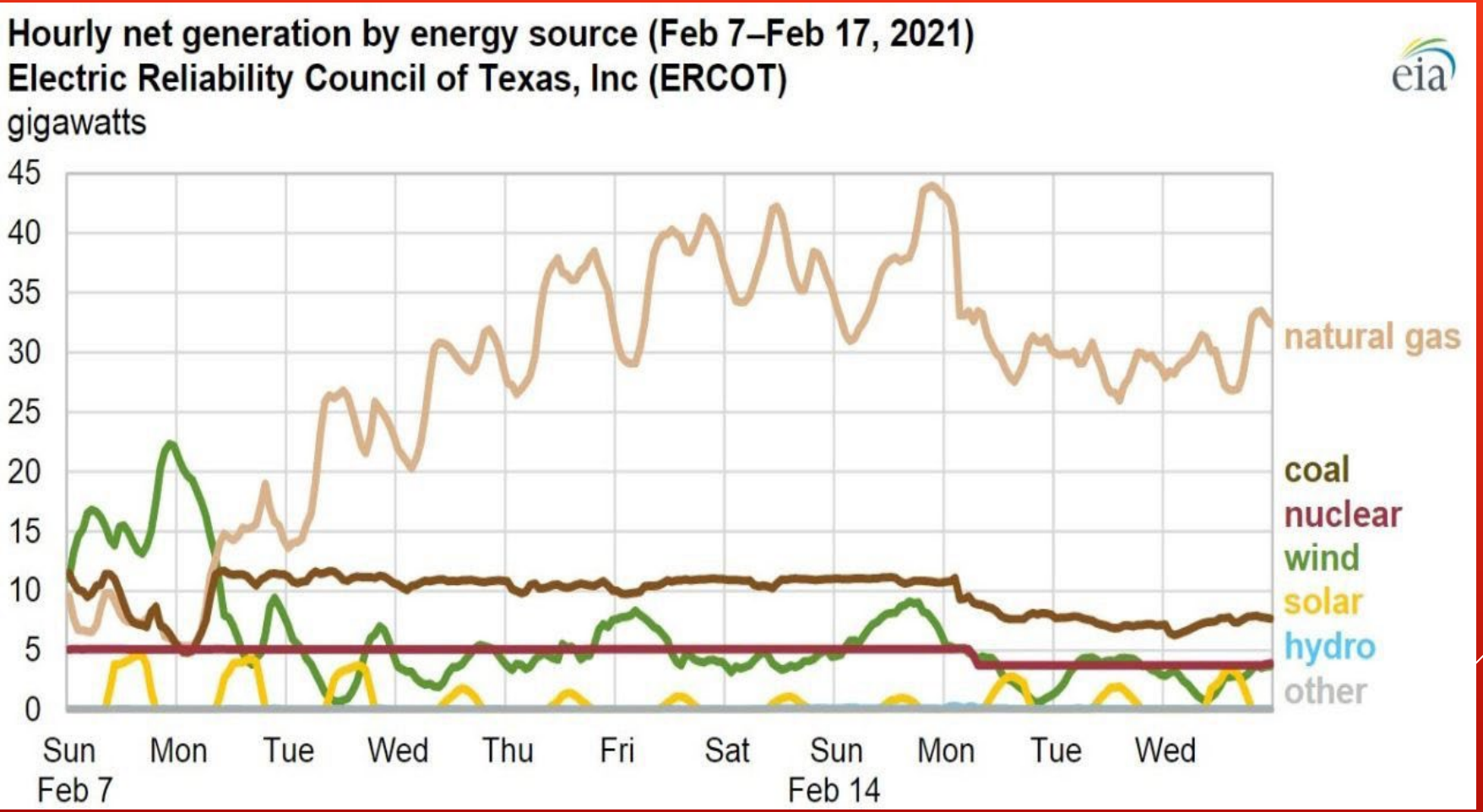
Constituents of restructured markets have little accountability to customers or government

Electricity Only

ERCOT MARKET CHARACTERISTICS

ERCOT

WHAT HAPPENED IN ERCOT?



FERC/NERC Staff Report on the 2011 Southwest Cold Weather Event

While the probability of a winter event in the predominantly summer peaking Southwest appears to be low, shedding load in the winter places lives and property at risk. The task force recommends that all entities responsible for the reliability of the bulk power system in the Southwest prepare for the winter season with the same sense of urgency and priority as they prepare for the summer peak season.

TEXAS WAS WARNED IN 2011

ERCOT MARKET CHARACTERISTICS

- Restricted entry
- Restricted information
- Pricing controlled by ERCOT
- Monopsonist facing generators
- Monopolist facing consumers
- Characterized by price manipulation
- Lack of accountability
- State mandated bailout—$2+ billion
- “arm of the state”

ERCOT

OPINION // OUTLOOK

Texas suffers from Soviet-style electricity distribution system

Edward A. Hirs III and Paul W. MacAvoy

Feb. 22, 2013 | Updated: Feb. 22, 2013 7:45 p.m.

Is the Electricity Reliability Council of Texas repeating the central planning failures of the late Soviet Union?

ERCOT MARKET CHARACTERISTICS

- For 8 of the 10 years prior to 2021, for the generators, P < ATC
- WSJ: Texans paid $28 billion more than they would have in old-style regulated electric utility market prior to 2021

TEXAS ECONOMY & ERCOT

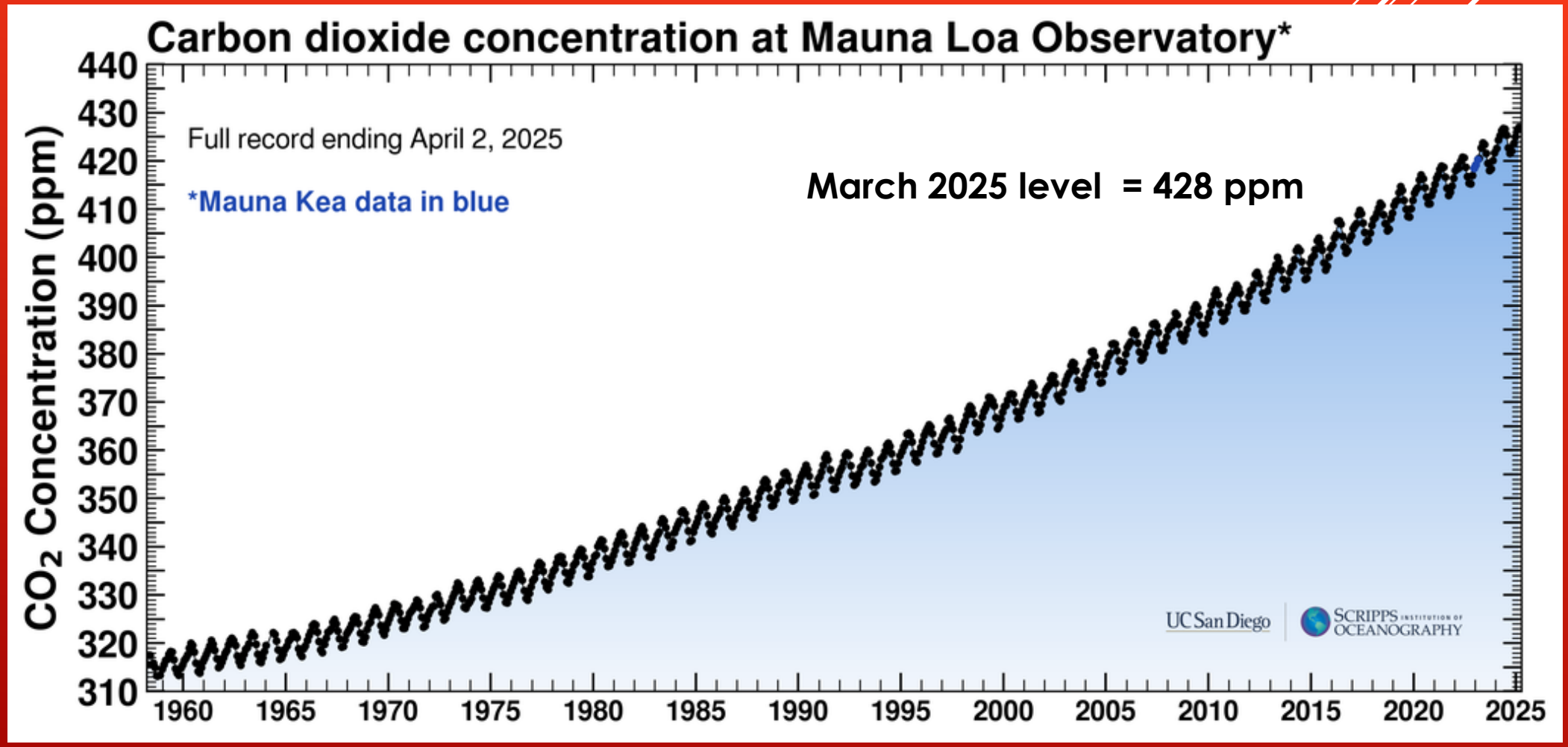
- From 2010 to 2021, the Texas economy grew from $1.25 trillion to $1.99 trillion
- From 2010 to 2021, the ERCOT fleet of dispatchable generation shrank
- Overcharged $12 billion in 2023
- Cryptocurrency miners have raised the price by 5%

ERCOT MARKET INCENTIVES

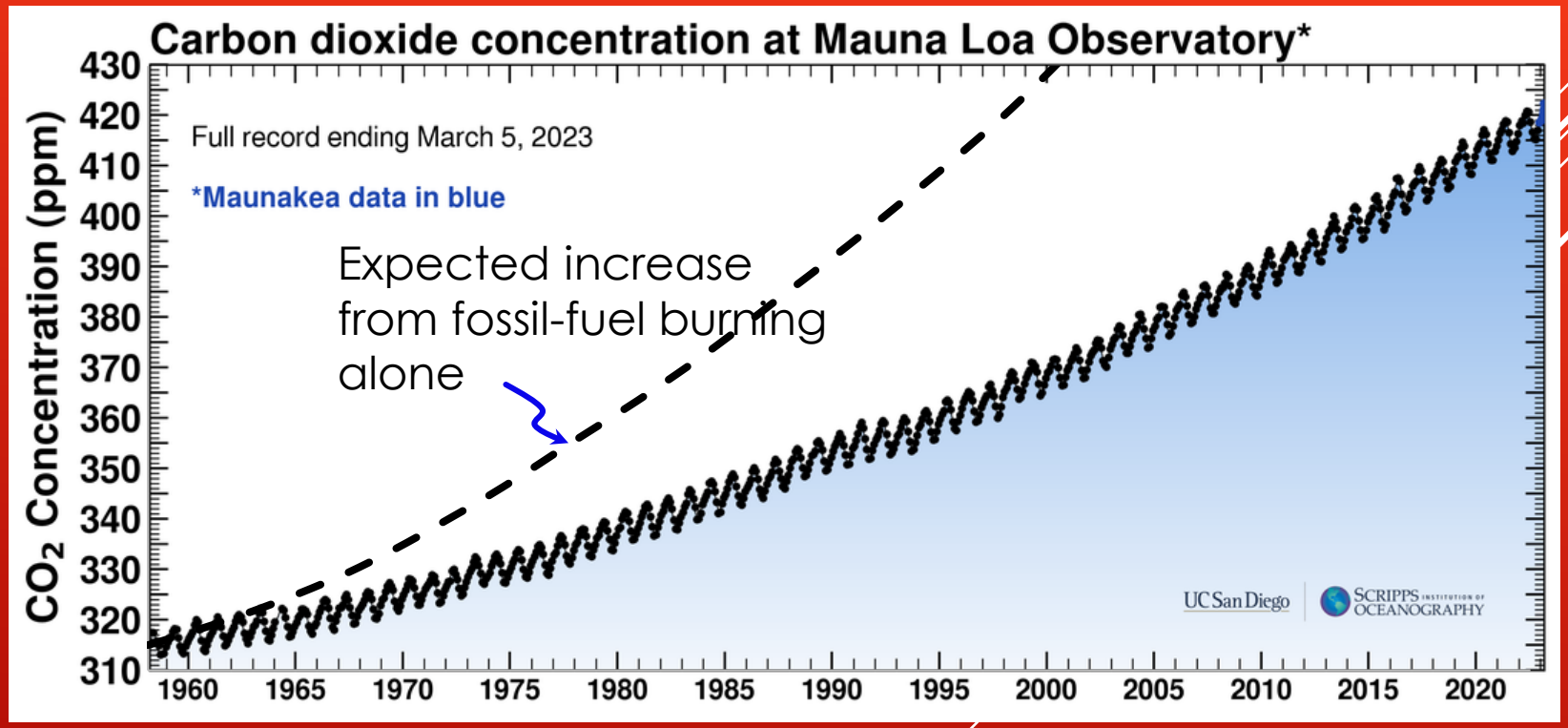
- Nash (*A Beautiful Mind)* oligopoly behavior
- Commodities traders
- LMP, Locational Marginal Pricing fails. Short-term price "signals" do not encourage long-term investment

IMPACT OF CLIMATE CHANGE

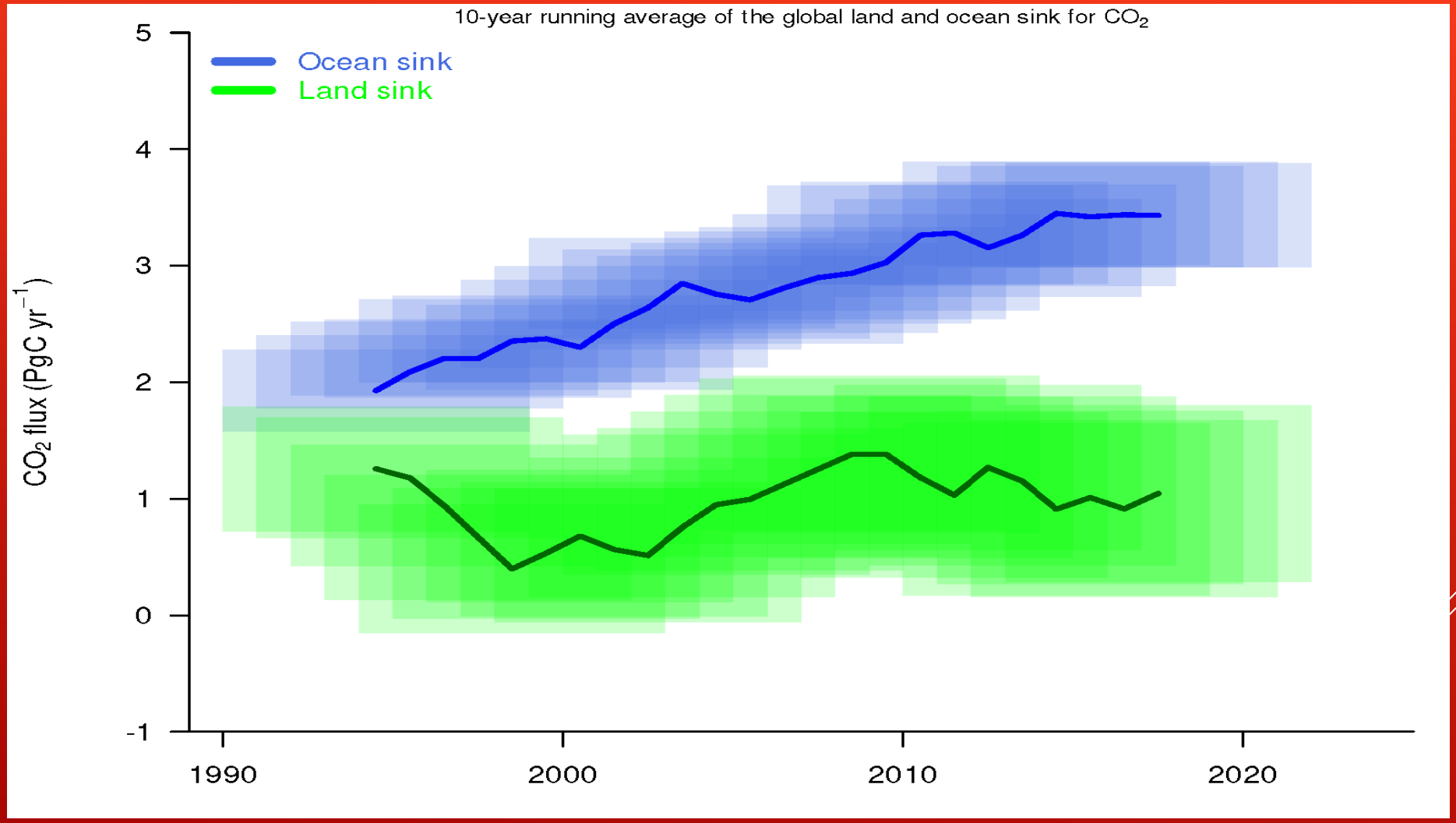
Keeling Curve



Keeling: What's causing the CO_2 rise?

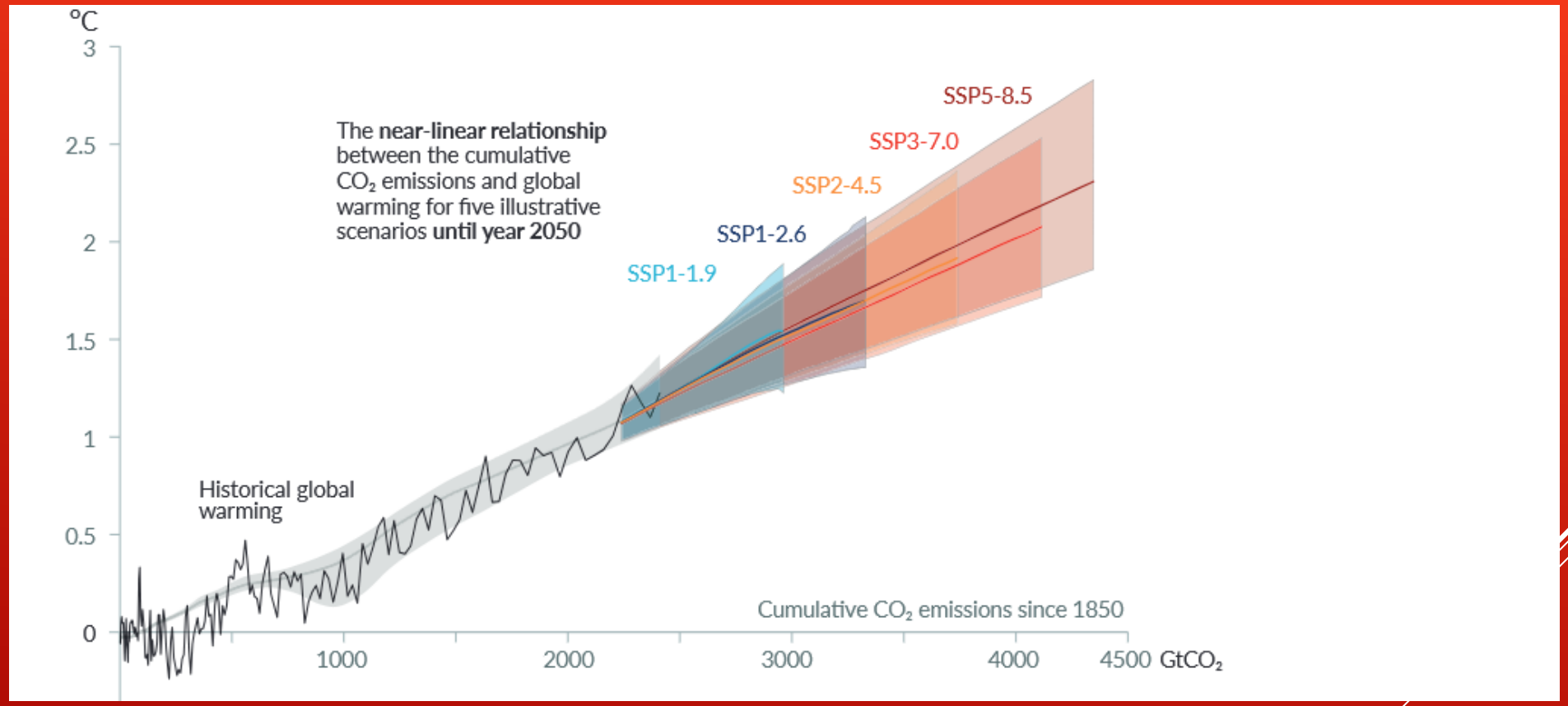


KEELING: *Trends in global ocean and land sinks*



Based on global trends in atmospheric O_2 and CO_2

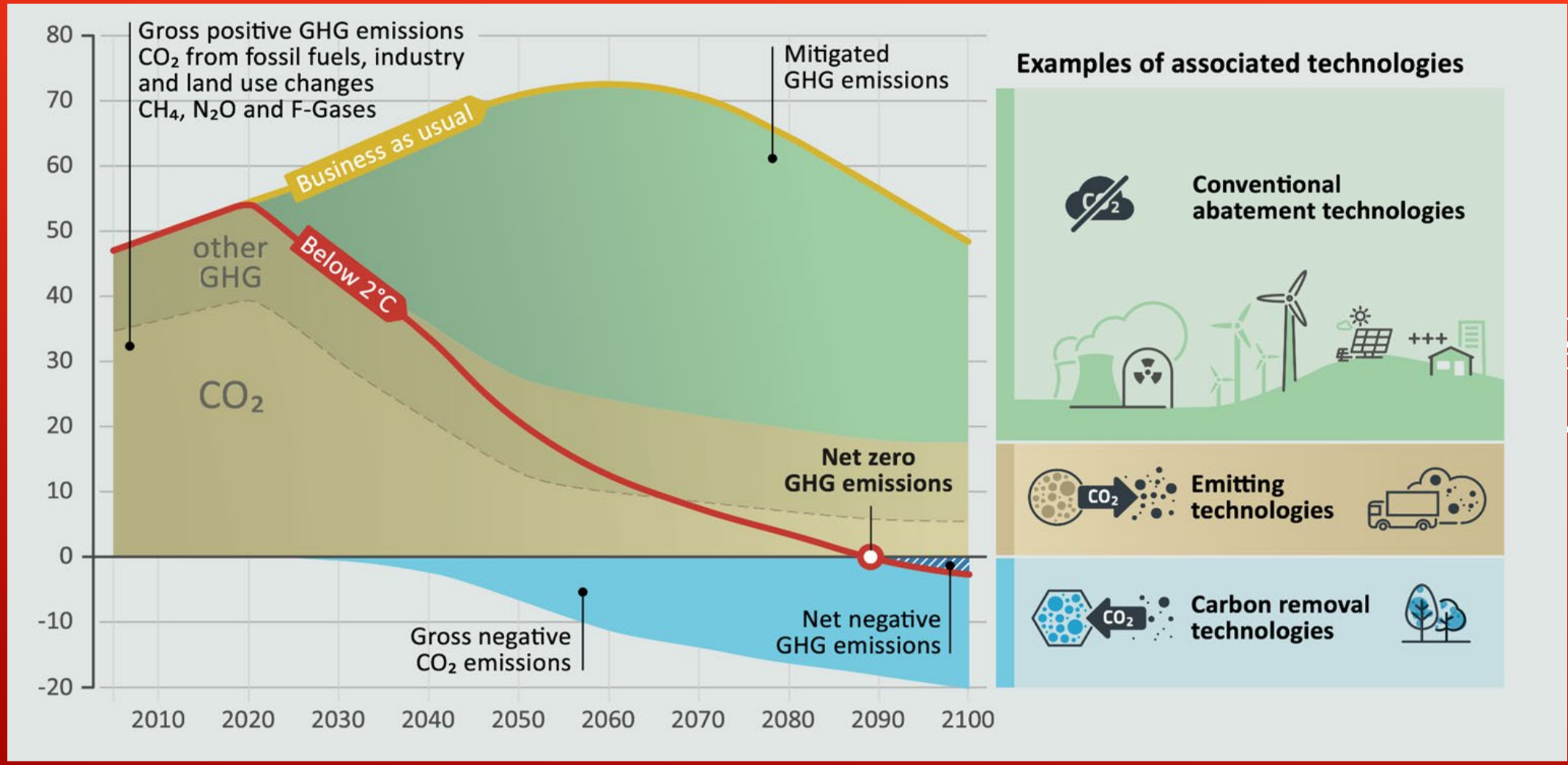
KEELING: *Link to Cumulative Emissions*



IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the

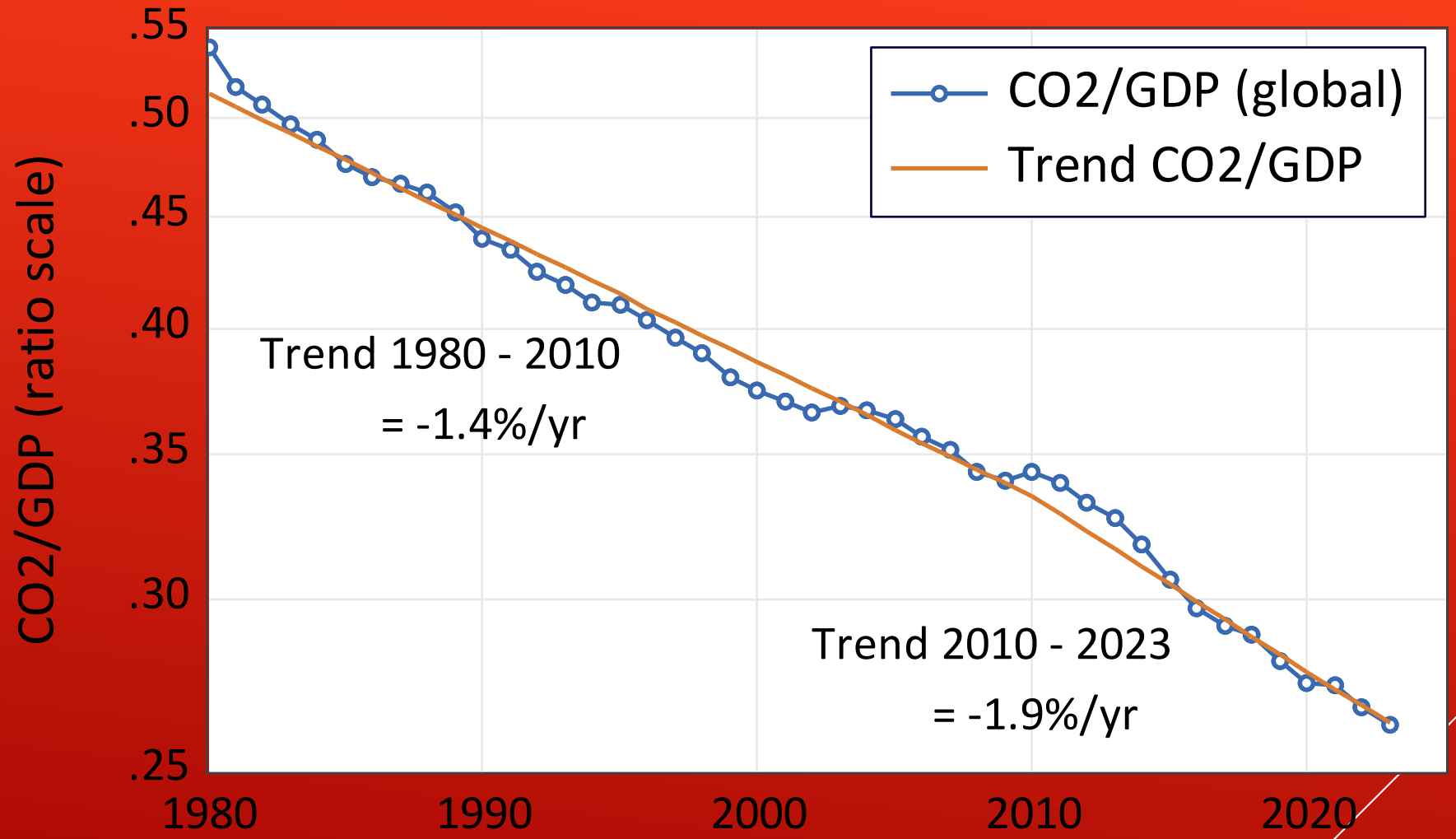
KEELING: *CARBON DIOXIDE REMOVAL IS REQUIRED*

Net greenhouse gas emissions ($GtCO_2e$/year)



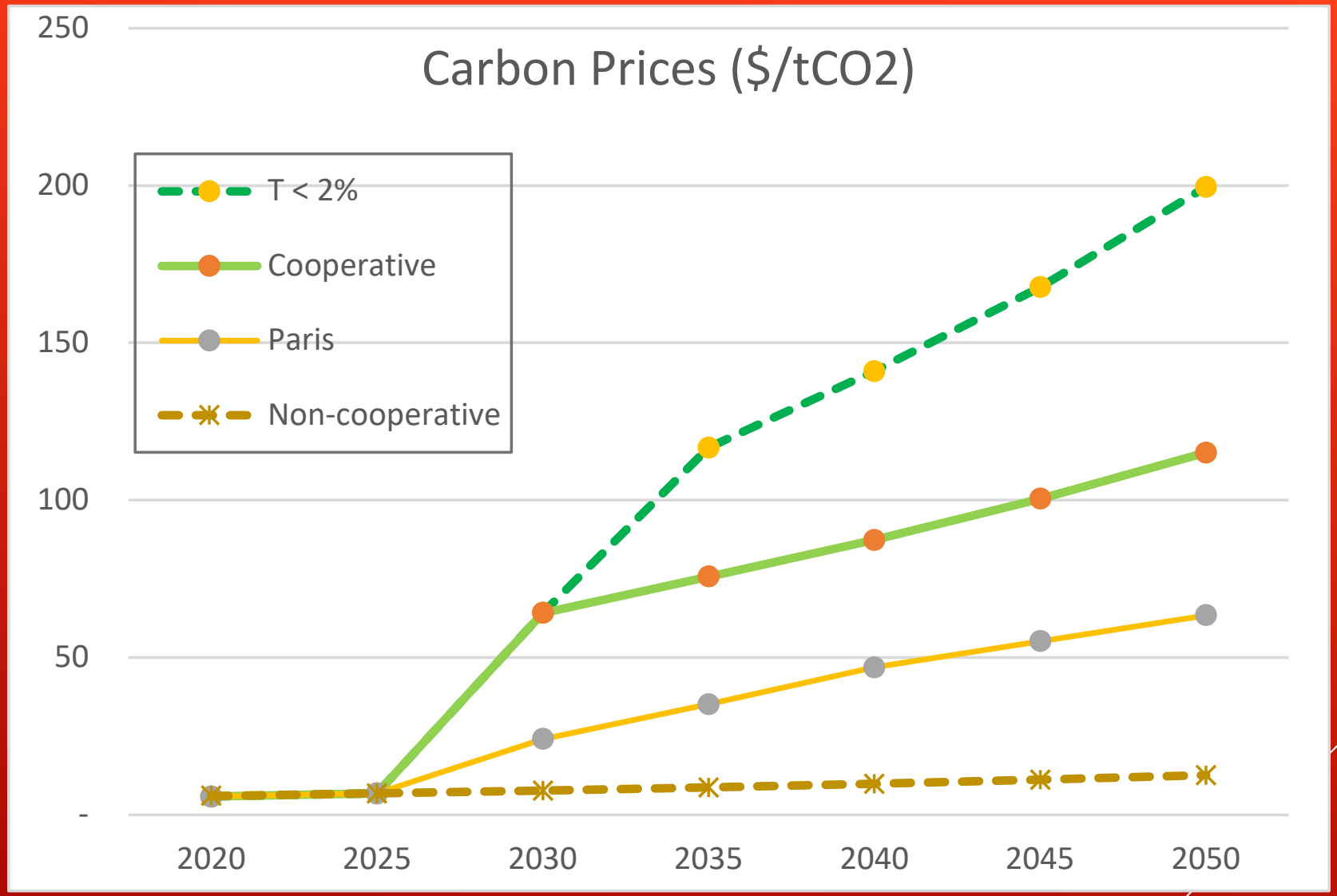
United Nations Environment Programme: *Emissions Gap Report 2017*

NORDHAUS: *Trends in decarbonization*



William Nordhaus, 2025

COOPERATIVE V NONCOOPERATIVE CARBON PRICES



Source: Nordhaus and Barrage, DICE Model, PNAS 2023 revised.

"What Will An American Carbon Tax Cost You?"

Ed Hirs, *Forbes,* July 21, 2020

Cost of Carbon—The Consumer Version

Let's calculate the cost of carbon for everyday activities so that you can look at your bills and estimate what the added expense of a carbon tax will be. Again, at 4.54 pennies per pound, the consumer will face the following carbon taxes for transportation and home heating—with heat content noted—

	Pounds CO_2 emitted	Carbon Tax	Btu
1 gallon gasoline:	19.6	$0.89	120,286
1 gallon heating oil:	22.4	$1.02	137,381
1,000 cubic feet natural gas:	117.1	$5.31	1,037,000

Consumer Carbon Tax HIRS

At $100 per metric ton—

	Pounds CO2 per 2,000 kWh	Carbon Tax
Coal	4,420	$200.49
Natural gas	1,840	$83.46
Wind, Solar, Nuclear	0	$0.00

Rate of Return

Matching Assets to Liabilities

Risk

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