Reinhold Environmental Ltd.

2009 APC Round Table & Expo Presentation

July 12-14, 2009, in The Woodlands, TX

The Defining Issue of Our Time

Bob Malone
Vice President, Technical Services
July 2008

View From the Top

For every generation there is a defining issue. An issue it must resolve if society is to continue and thrive. An issue it cannot ignore. For the Greatest Generation, the challenge was defeating the Axis and overcoming a worldwide depression. After World War II, the challenge was civil rights. For our generation, I believe the defining issue is climate change resulting from human activity—activity that produces hugely escalating amounts of greenhouse gases (GHGs).

J. Wayne Leonard, Entergy Chairman and CEO

For Entergy, There Are Four Guiding Principles for Carbon Policy

- At present, there is no low-cost “silver bullet” technology to reduce carbon emissions, and we need to face up to that. Carbon control will not be cheap. So we have to be as smart as possible about how we go about it.

- Spending on research and development—particularly for coal retrofit technology—is essential. Otherwise, our options will be more limited and more expensive. But it takes time, and we are already behind.

- We must be prepared for, and willing to accept, significant carbon prices. If we are lucky, under a cap-and-trade model, CO2 allowance prices will not be more than $50 a ton—but they could easily go higher. And whether we are “lucky” or not depends principally on successful development of coal retrofit technology.

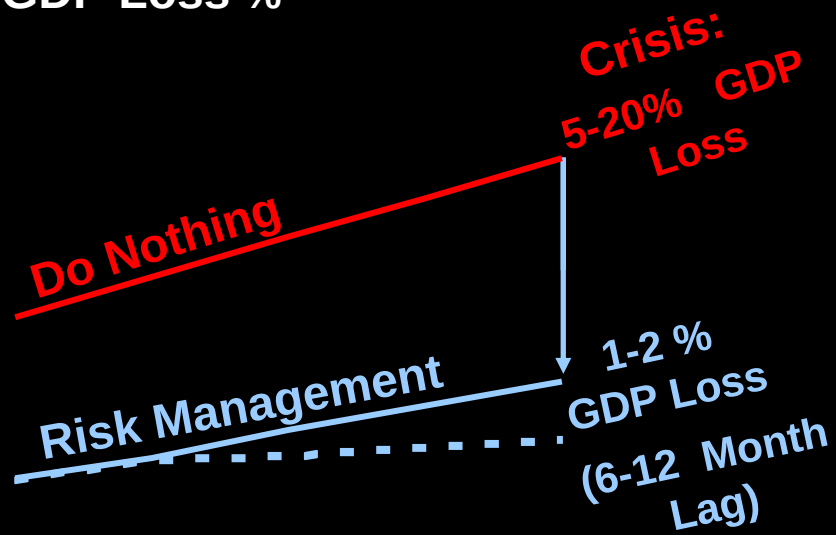
- At home and around the world, we cannot let the brunt of the damage—economic and climatic—fall on the poorest among us.

The Cost of Doing Nothing

Cost of Not Dealing With Climate Change Now:

- Creating a 5ºC warmer world by 2100
- Irreversible commitment to sea level rise inundating low lying coastal areas
- Increased coastal flooding impacting up to 30 million people/year
- Increased damage from storms impacting up to 15 million people/year
- Global food shortages as adaptive capacity exceeded in low latitudes and yield decreases in higher latitudes
- Increased burden on health from malnutrition, cardio-respiratory and infectious diseases
- Water scarcity for up to 15 million people
- Catastrophic events

Illustrative

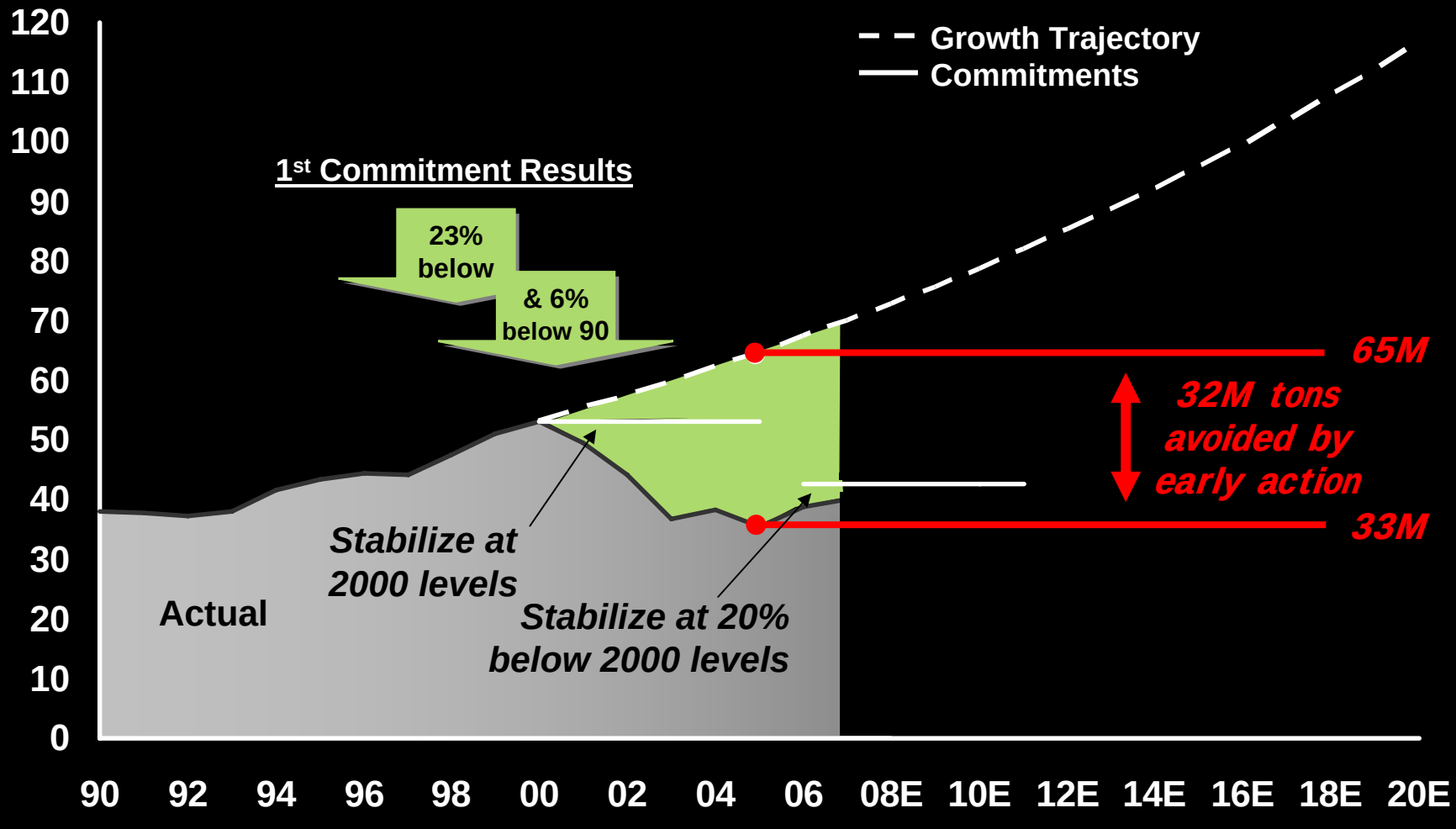


What is the cost of doing nothing?

Early Action Resulted in Emission Reductions Below 1990 Levels

Entergy's CO_2 Emissions – Actual Emissions
1990 – 2020E; million tons CO_2

Illustrative



Three Concerns in the Electric Sector

Understanding the Economics of Coal

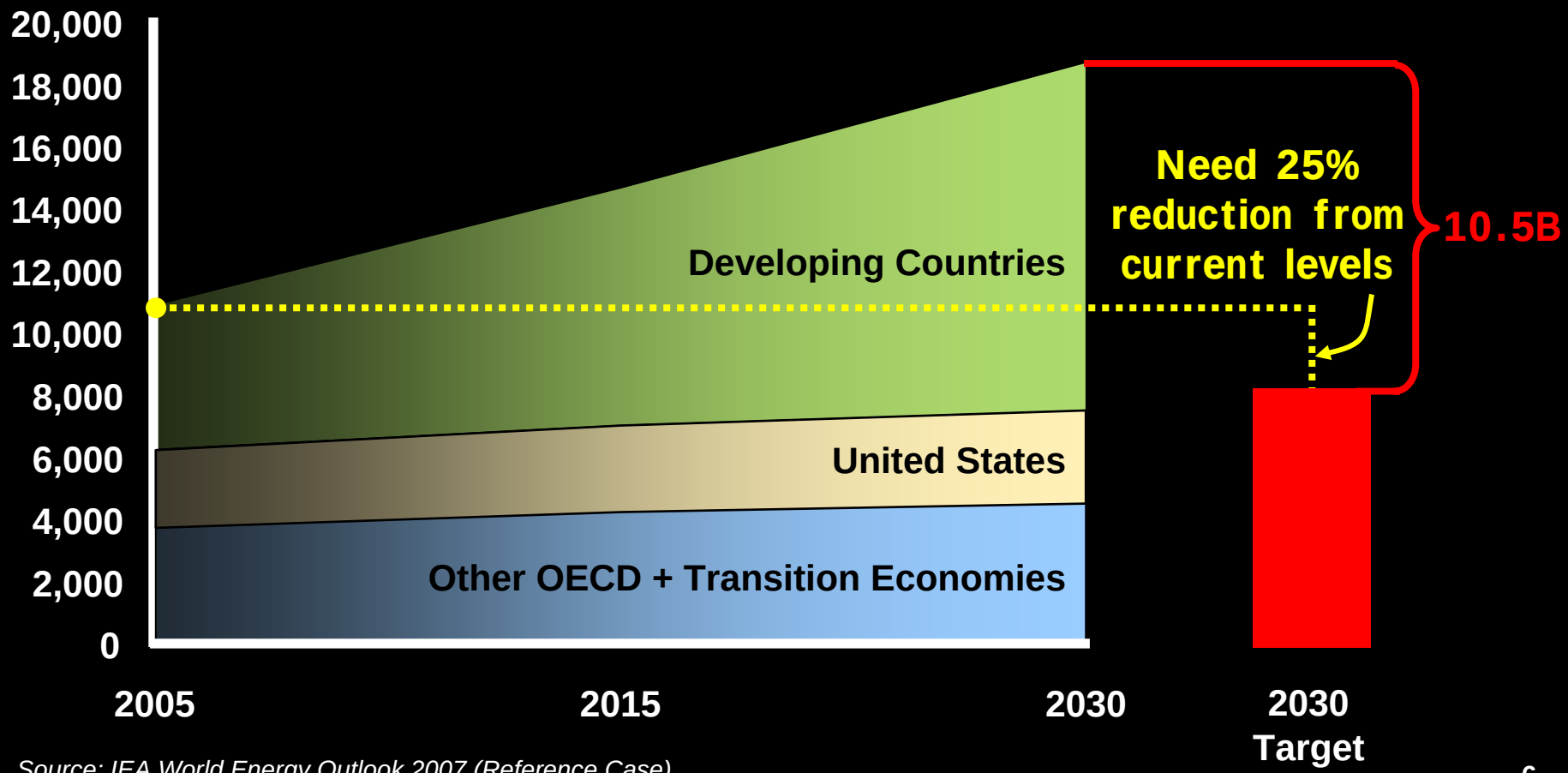
Getting the Price Signal Right

Mitigating the Effects on Families

The Path We Are On – Global Electric

We can't solve the problem without the developing world.

Global Electric Sector
CO_2 Emissions Forecast: BAU – No CO_2 Regulation
Million Metric Tons CO_2

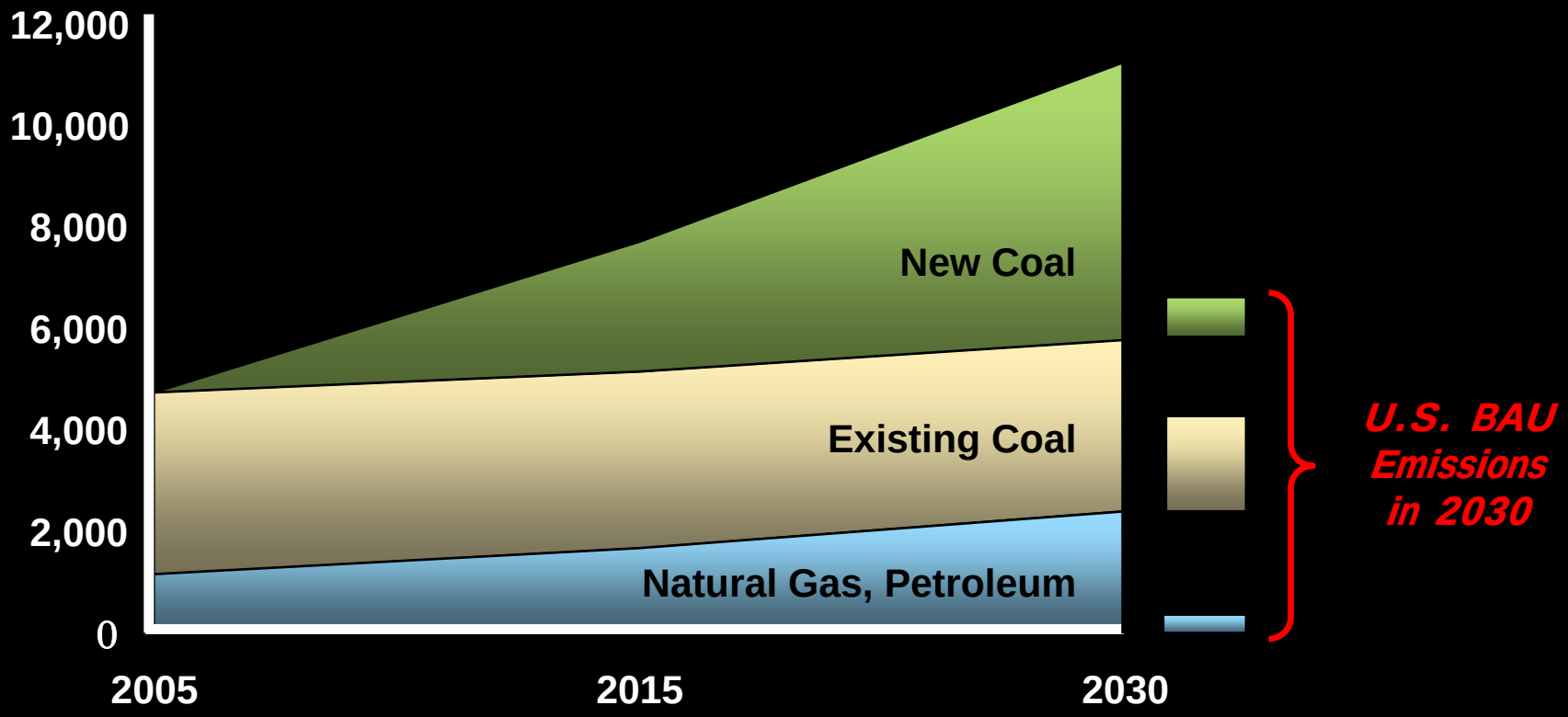


Source: IEA World Energy Outlook 2007 (Reference Case)

The Elephant in the Room

Developing world's installed coal base is huge and growing.

Developing World Electric Sector
CO_2 Emissions Forecast: BAU
Million Metric Tons CO_2

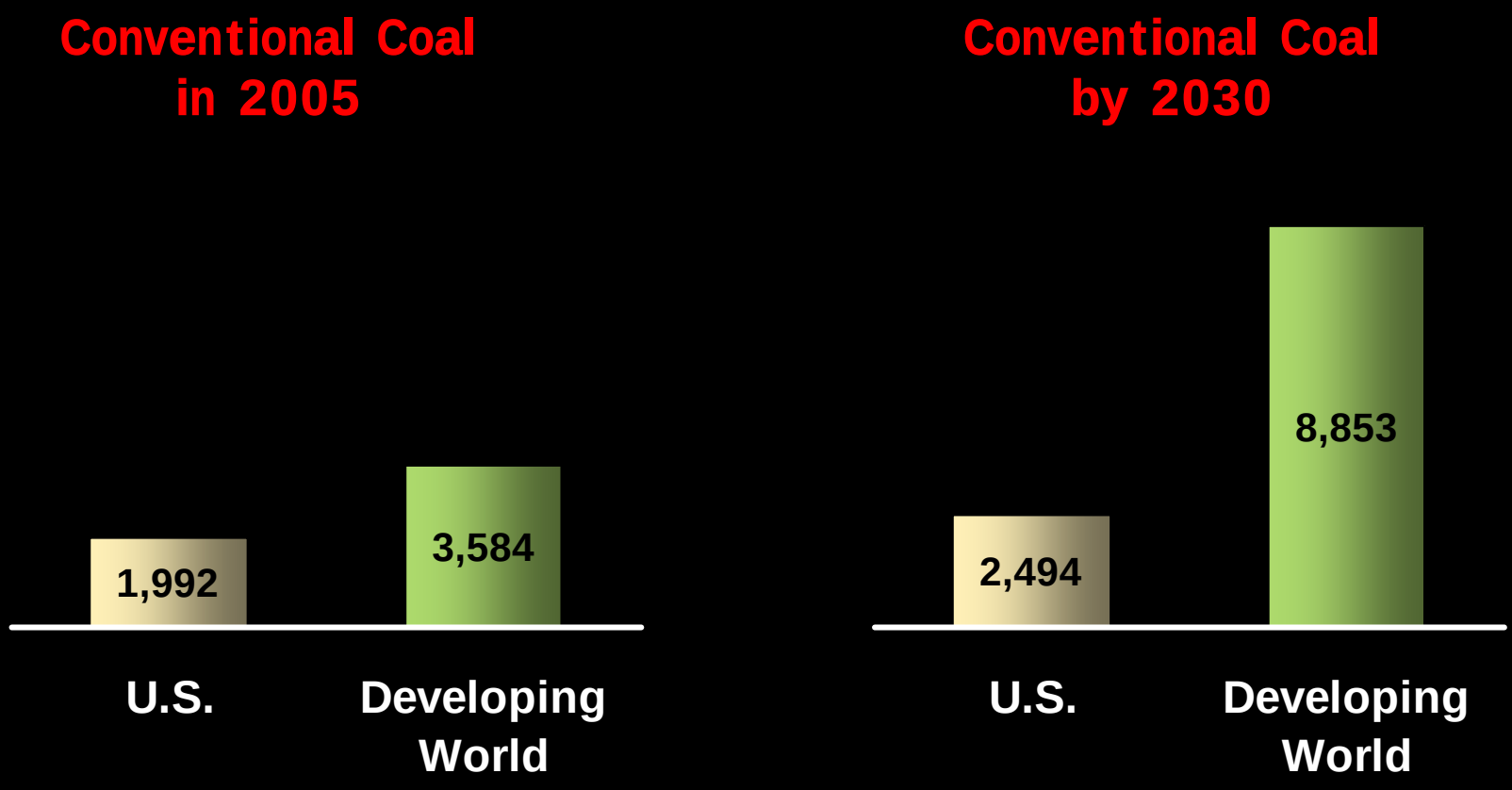


Source: IEA World Energy Outlook 2007 (Reference Case); NorthBridge Analysis

The Challenge

We Don't Control Our Own Destiny

U.S. and Developing World Electric Sector
CO_2 Emissions Forecast: BAU
Million Metric Tons CO_2



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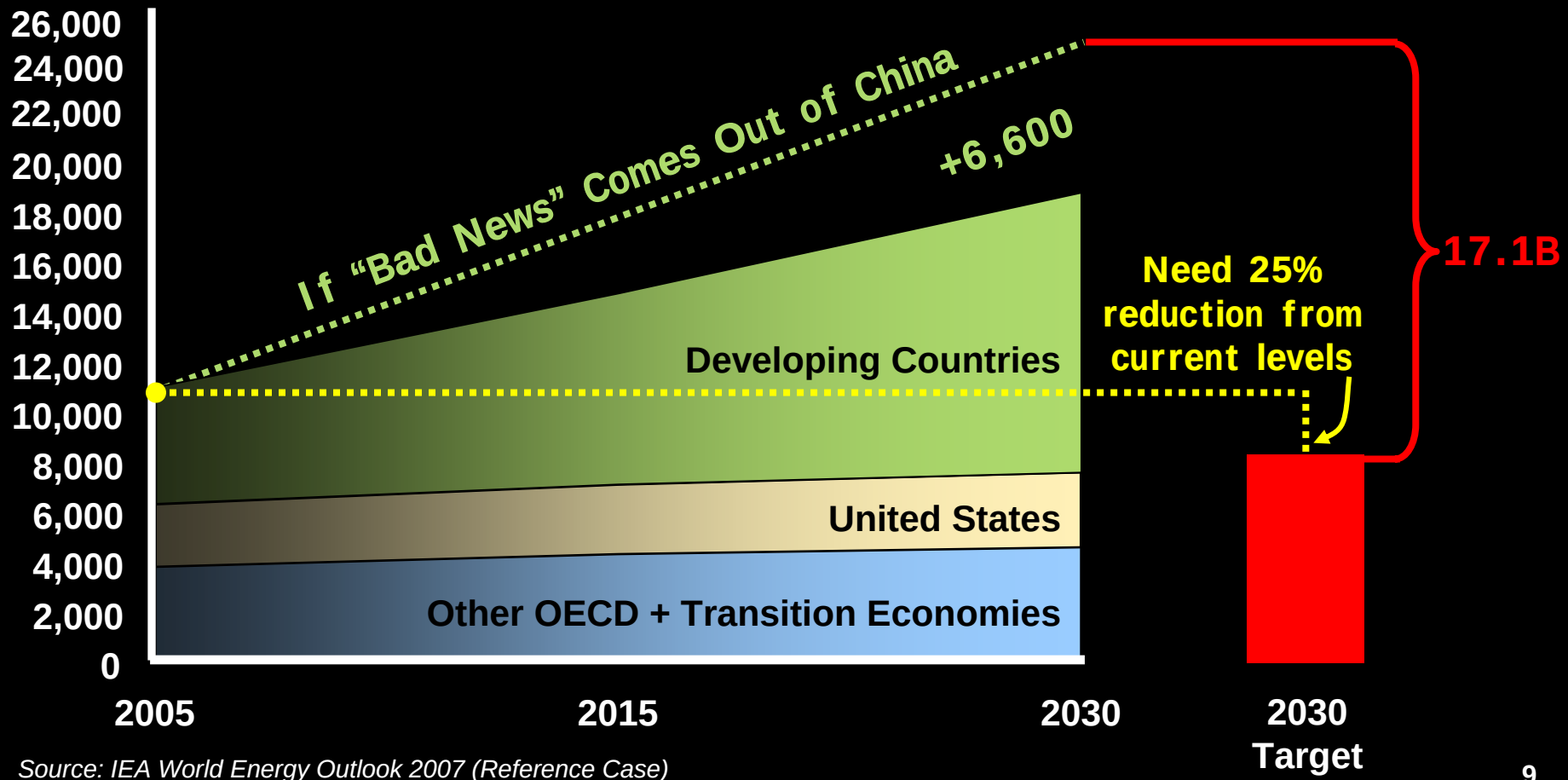

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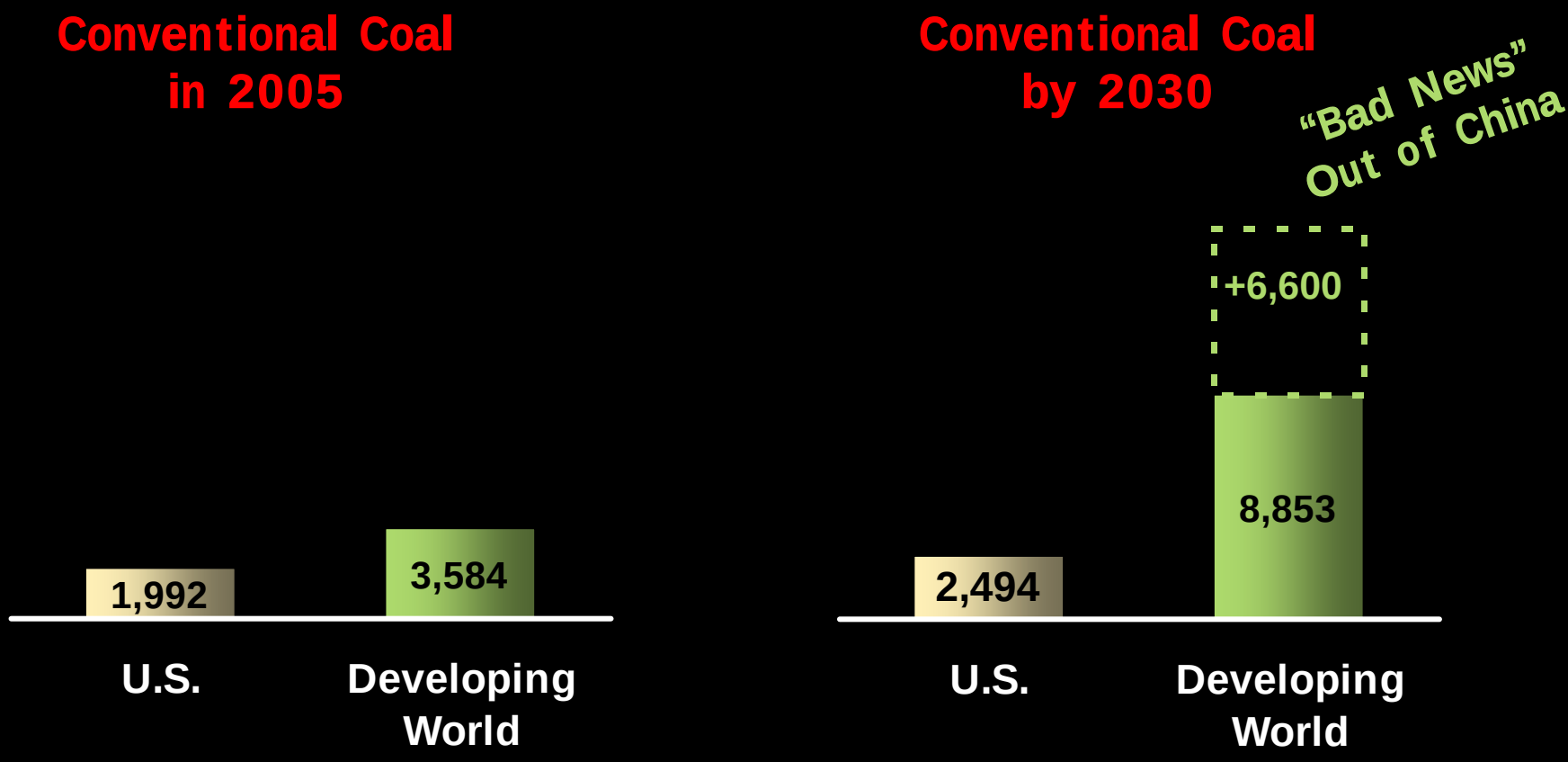
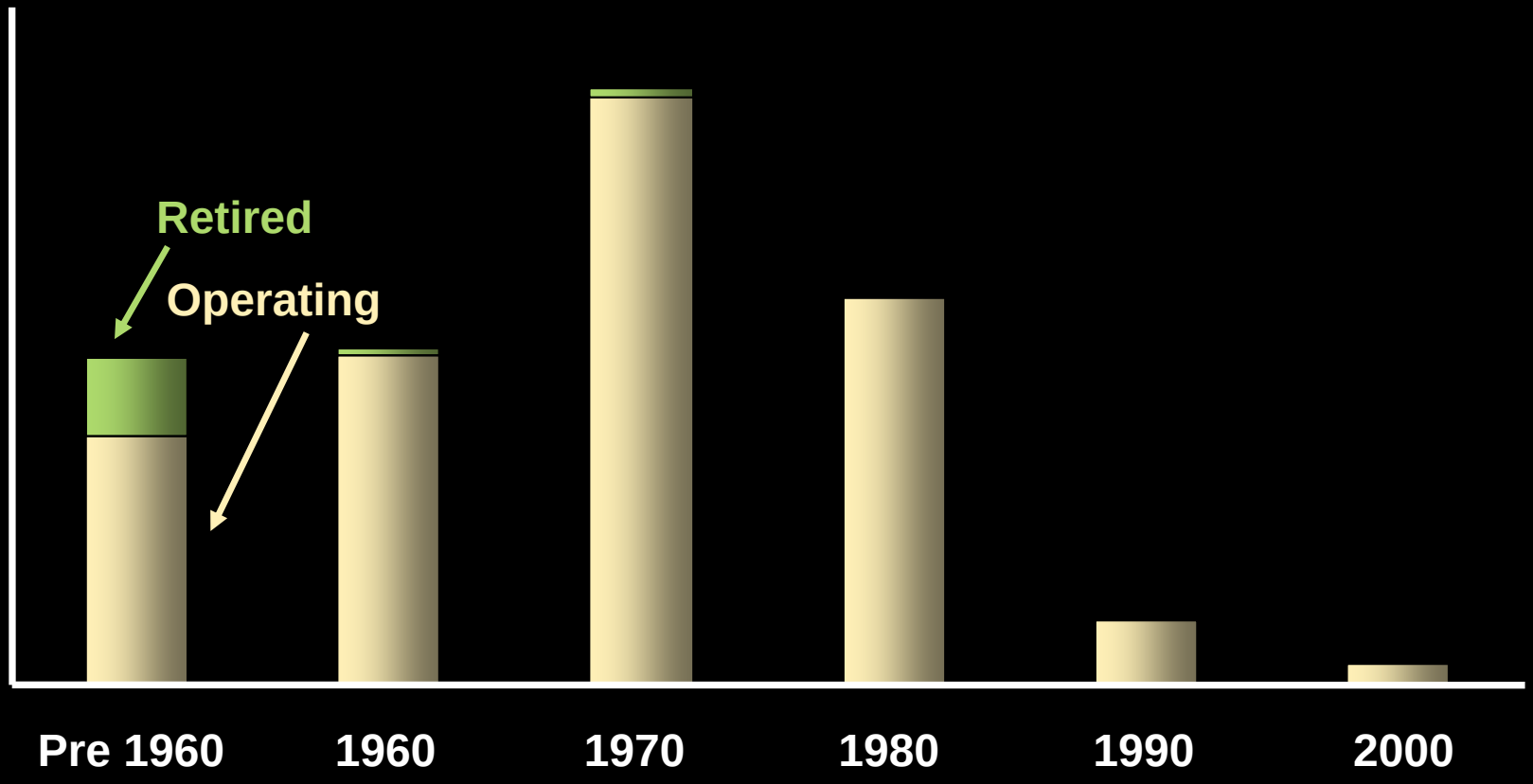


Source: IEA World Energy Outlook 2007 (Reference Case); NorthBridge Analysis

The Problem: Coal Plants Don't Retire

Climate models that assume they retire after 40 years are wrong.

Current U.S. Coal Capacity by Installation Decade
MW Nameplate Capacity



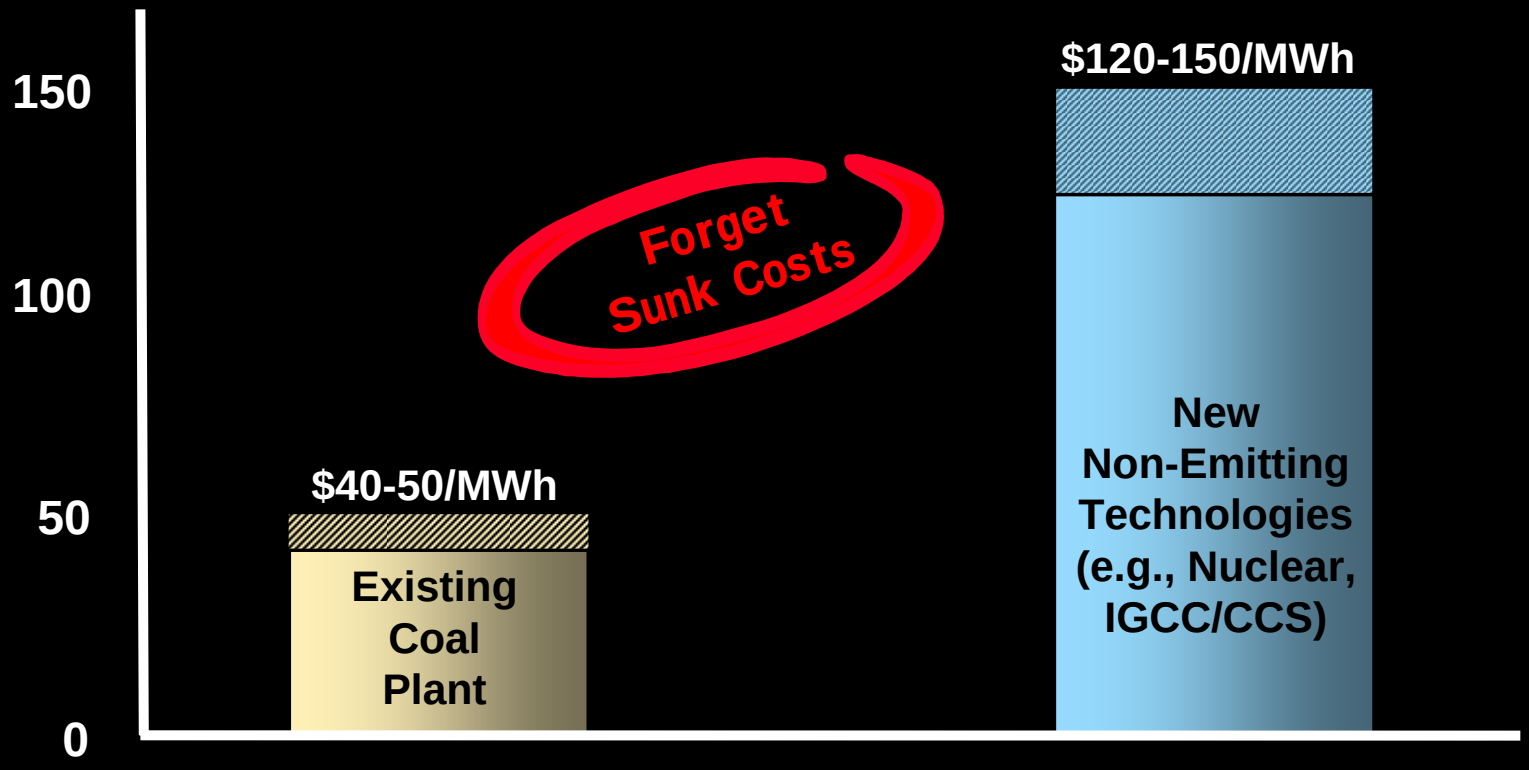
Source: Energy Velocity database

Why Don't They Retire?

It's much cheaper to keep them running than replace them.

Comparison of "To Go" Investment to Keep a Coal Plant Operating vs. All-In Cost to Replace It with New Capacity

Lifetime Real Levelized Costs in 2020 $



Source: NorthBridge Analysis

Why It Matters

Comparison of "To Go" Investment to Keep a Coal Plant Operating vs. All-In Cost to Replace It with New Capacity

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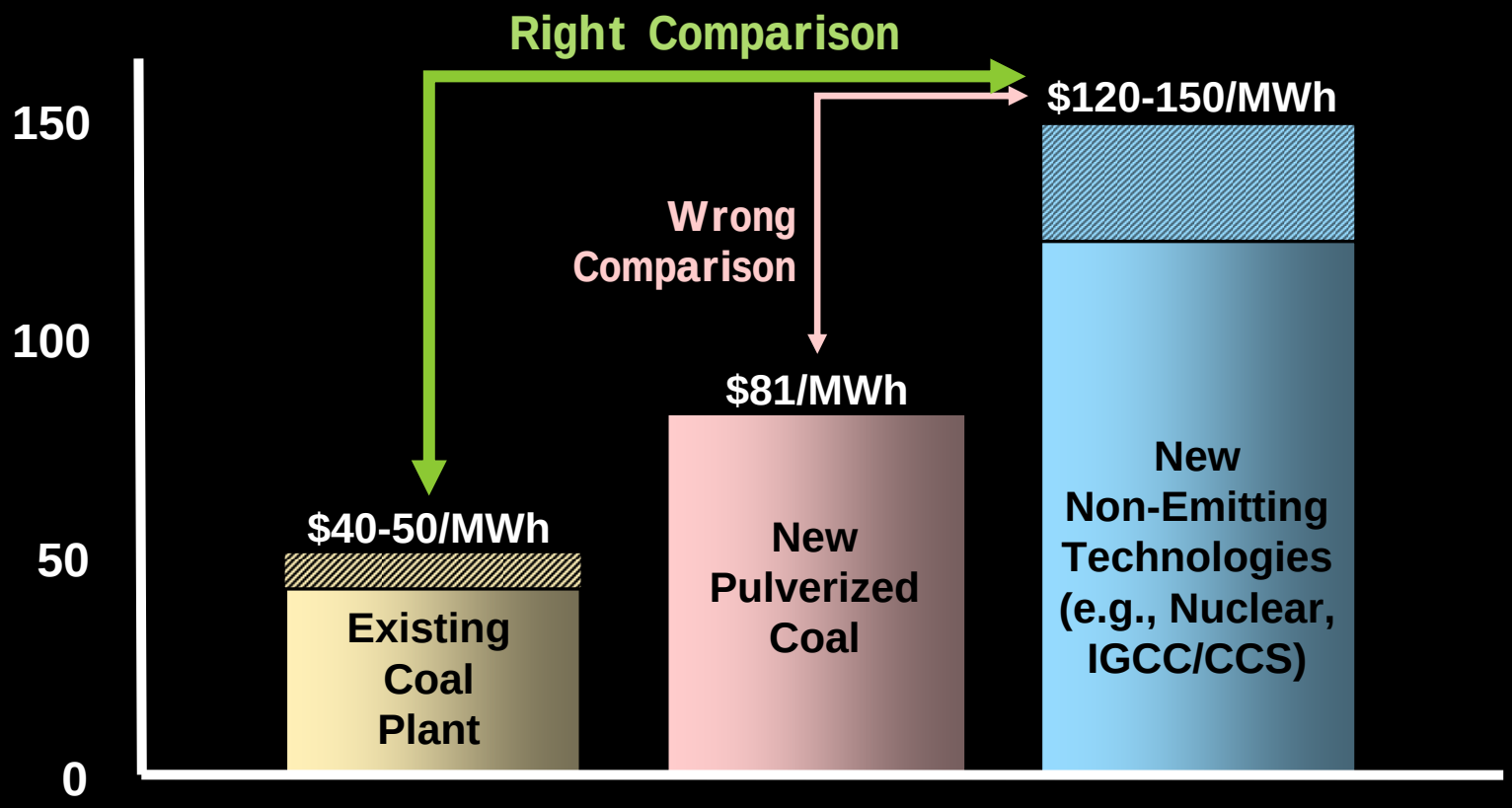


If we don't understand coal economics, we are unlikely to get the policies right.

Source: NorthBridge Analysis

Three Concerns in the Electric Sector

Understanding the Economics of Coal

Getting the Price Signal Right

Mitigating the Effects on Families

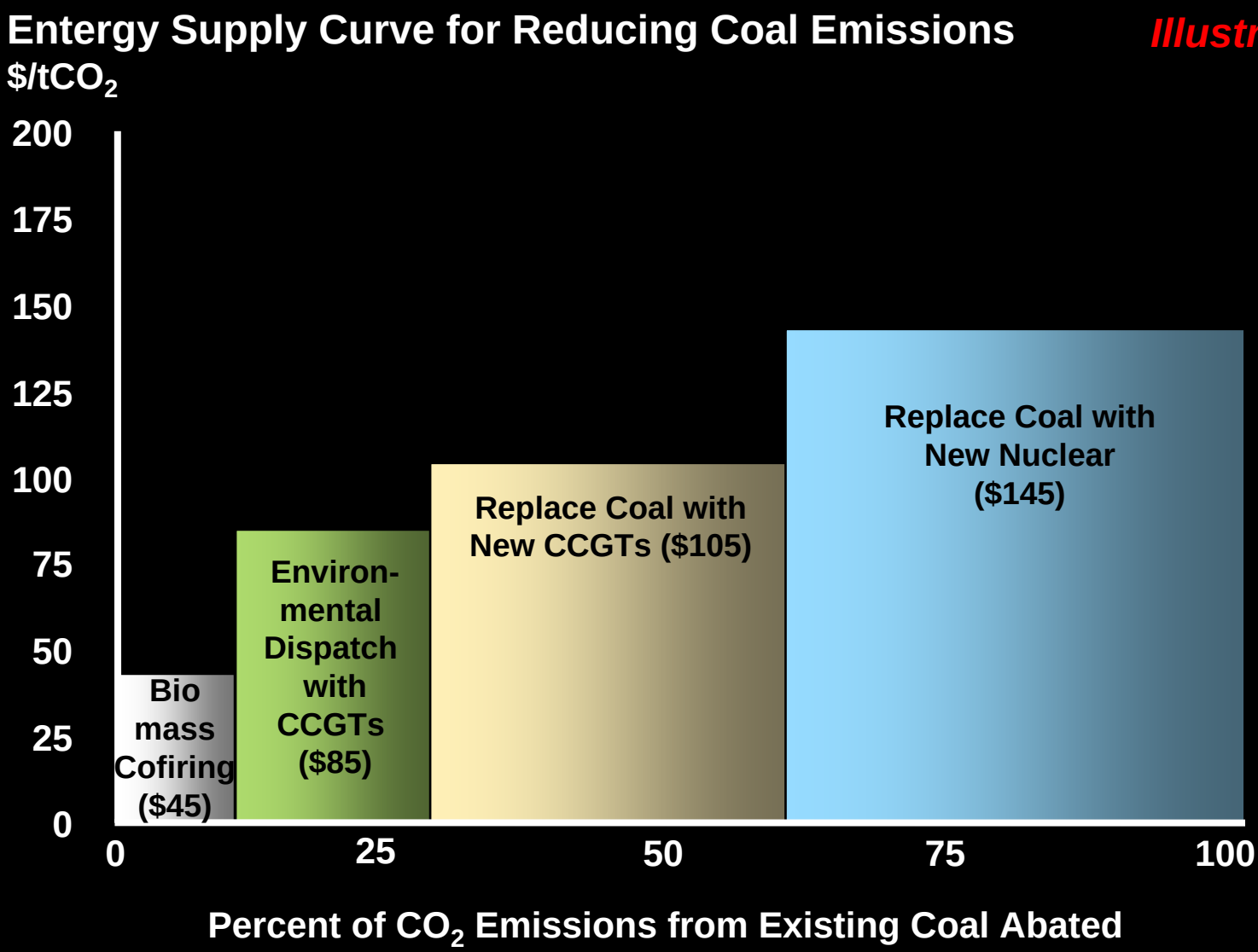
Get the Price Right

Carbon Pricing Principles

1. **Be realistic about coal plant economics**
2. **Set a price high enough to stimulate investment**
3. **Set a price that is also durable**

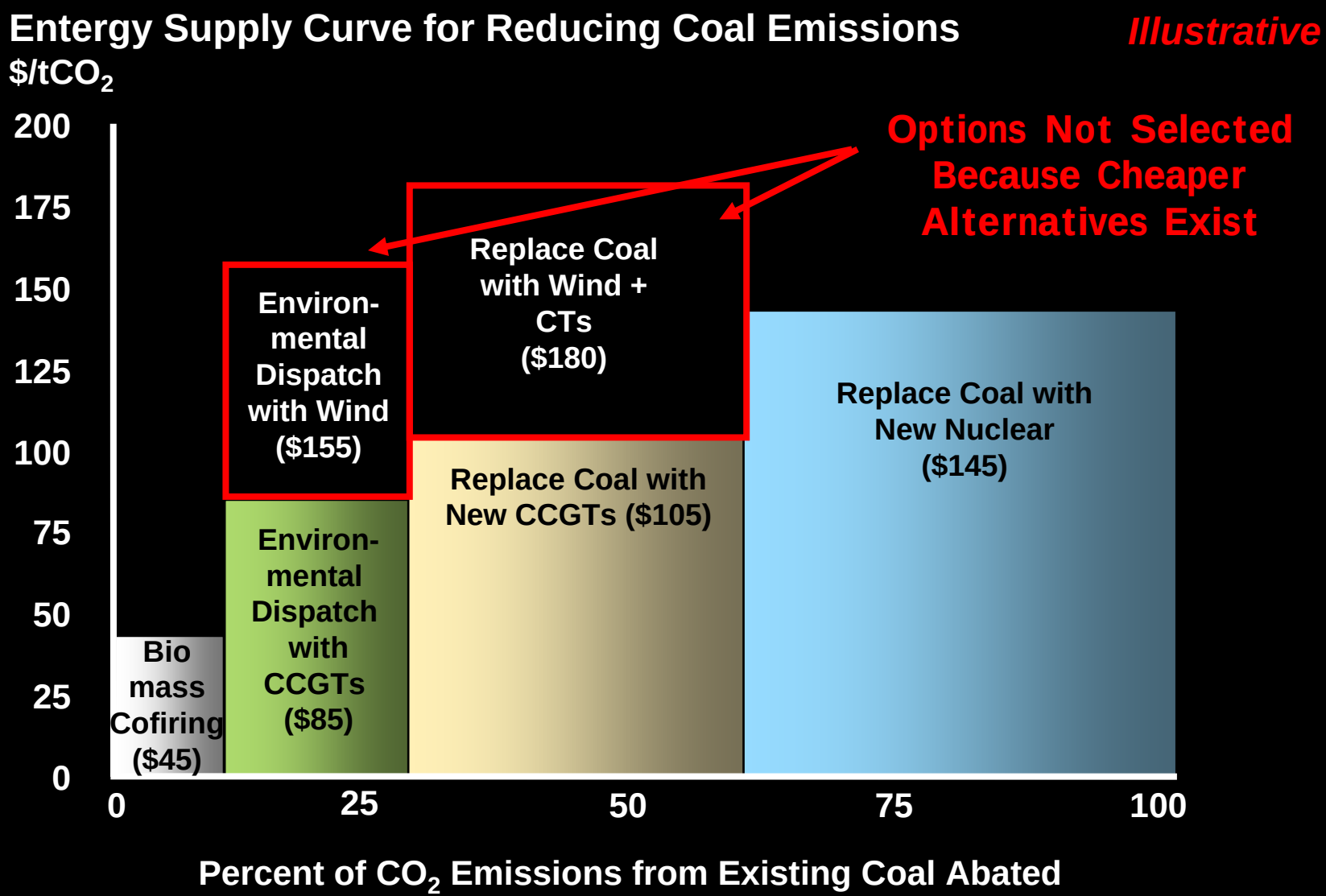
Based upon the economics of our own plants...

Need $150 Price To Replace Existing Coal with Unsubsidized New "Clean" Baseload Plants



Source: NorthBridge Analysis

What About Wind?



Source: NorthBridge Analysis

Price Signals Work

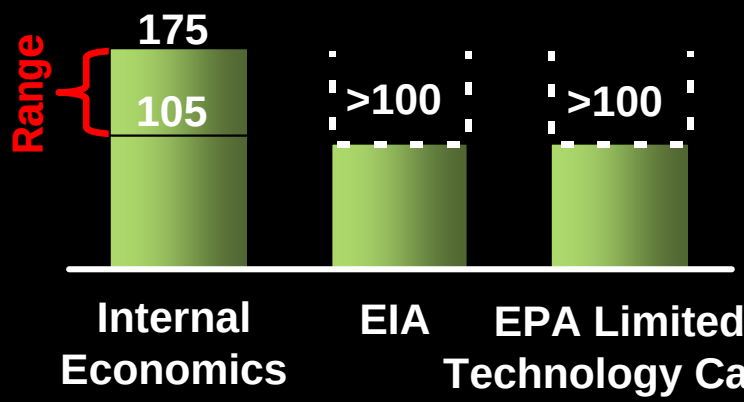
What's the Right Price Signal?

The numbers suggest there is a price at which we can solve this problem with current technology

BUT

That price may be very high

Price Signal
2020; Nominal $

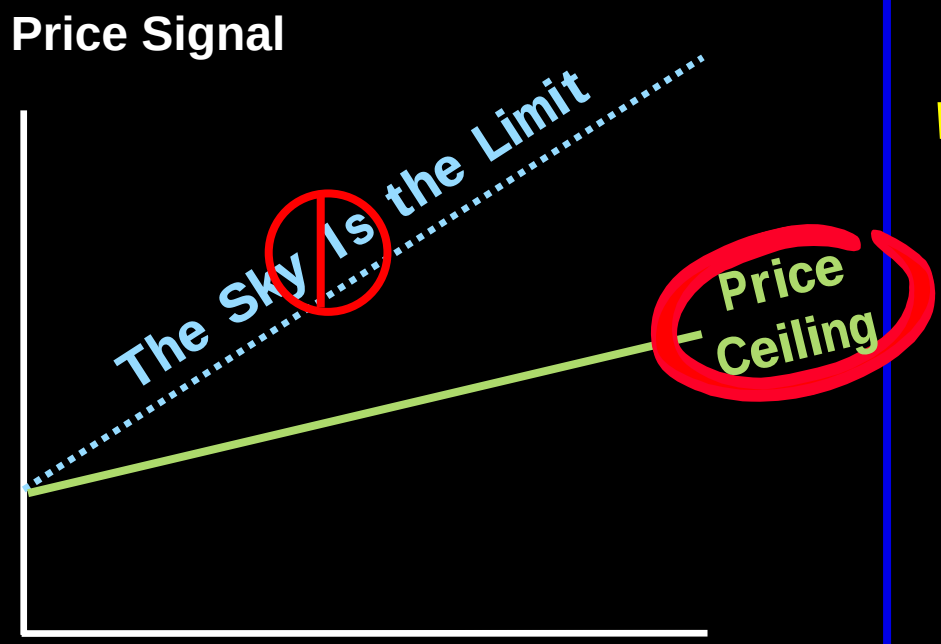


Why Not Let the Market Work?

A price too high may yield a hollow victory

- ✓ Price may be too high to be politically acceptable, i.e., GDP, employment impacts
- ✓ Even if the price is affordable, technology will be too expensive for the developing world
- ✓ If the developing world doesn't reduce its emissions, domestic support will dry up

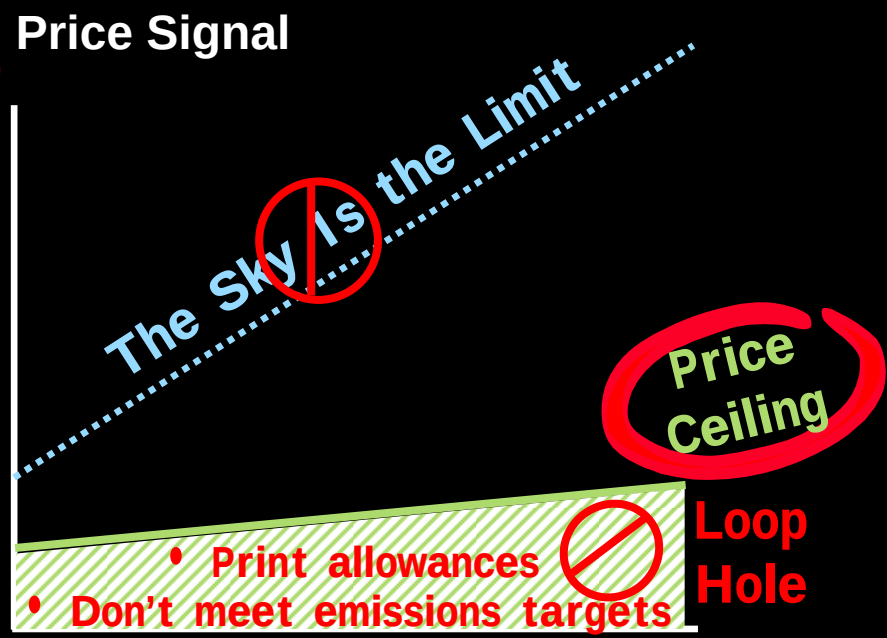
If the Price Is "Too High," How About a Price Ceiling?



- ✓ Provides more political viability
  - Avoids backlash over "No bottom line"
- ✓ Provides investor certainty
  - More certain price trajectory versus "sky is the limit"

BUT

We can't set ceiling price too low

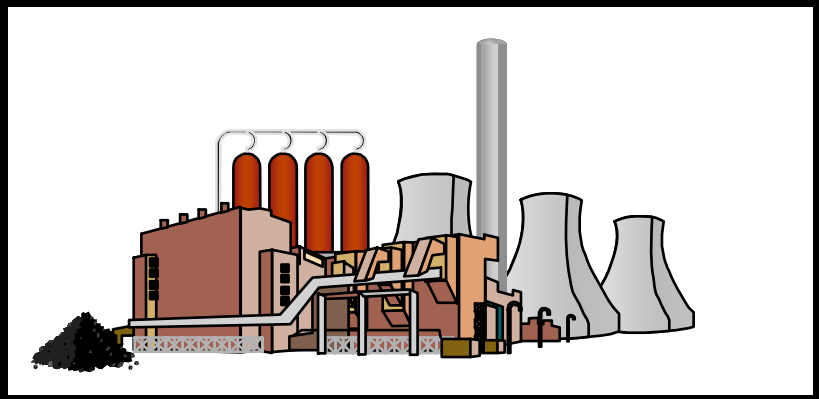


AND

It's Worth a Legitimate Effort

BECAUSE

There is a missing link



Commercially viable post-combustion capture and sequestration technology, something that can be retrofitted on existing plants

Not Available Today

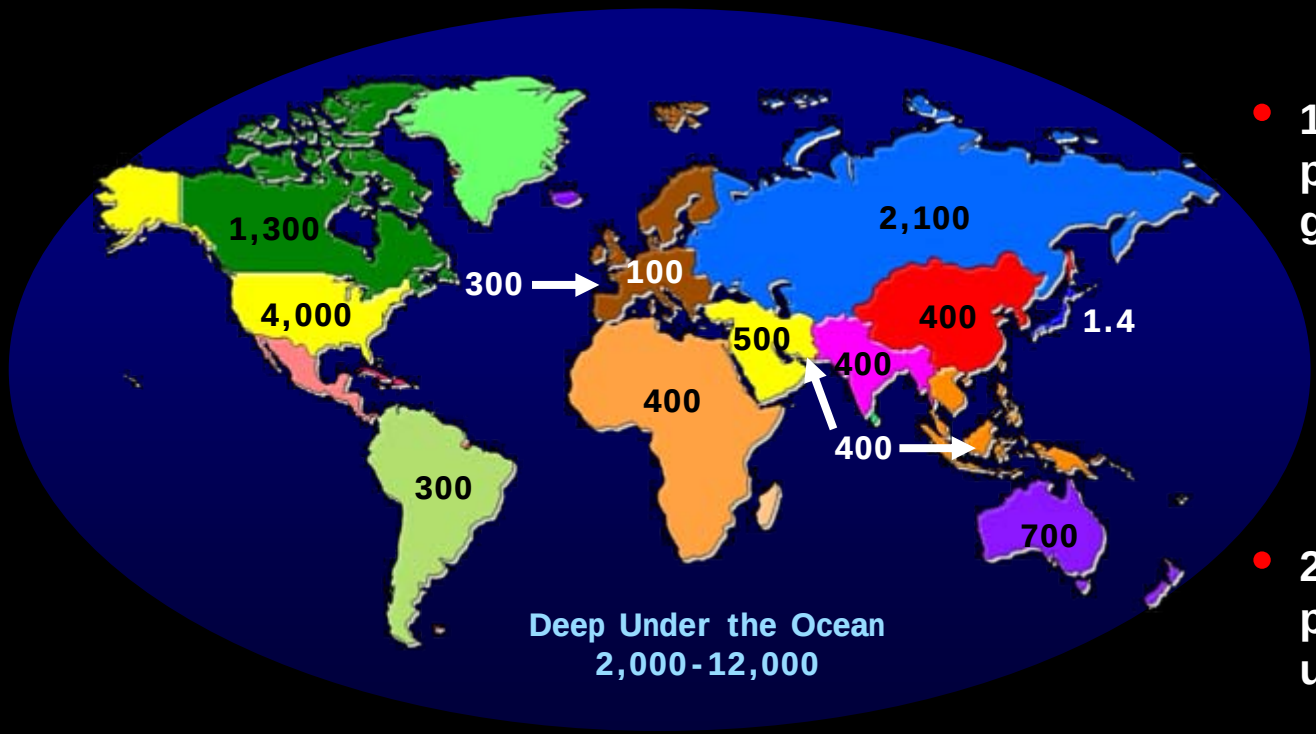
AND

- ✓ **Huge market potential – enough to attract R&D**
  - **1,300+ GW conventional coal capacity world-wide (growing to 1,900 GW)**
  - **Credible estimates, i.e., could be commercially available for $50-75/ton**
- ✓ **Government / industry currently underinvested in R&D**
  - **$25M DOE spending on post-combustion capture**

That's How, But Where Do You Put It?

Global CO_2 Storage Capacity (in Gt): Abundant

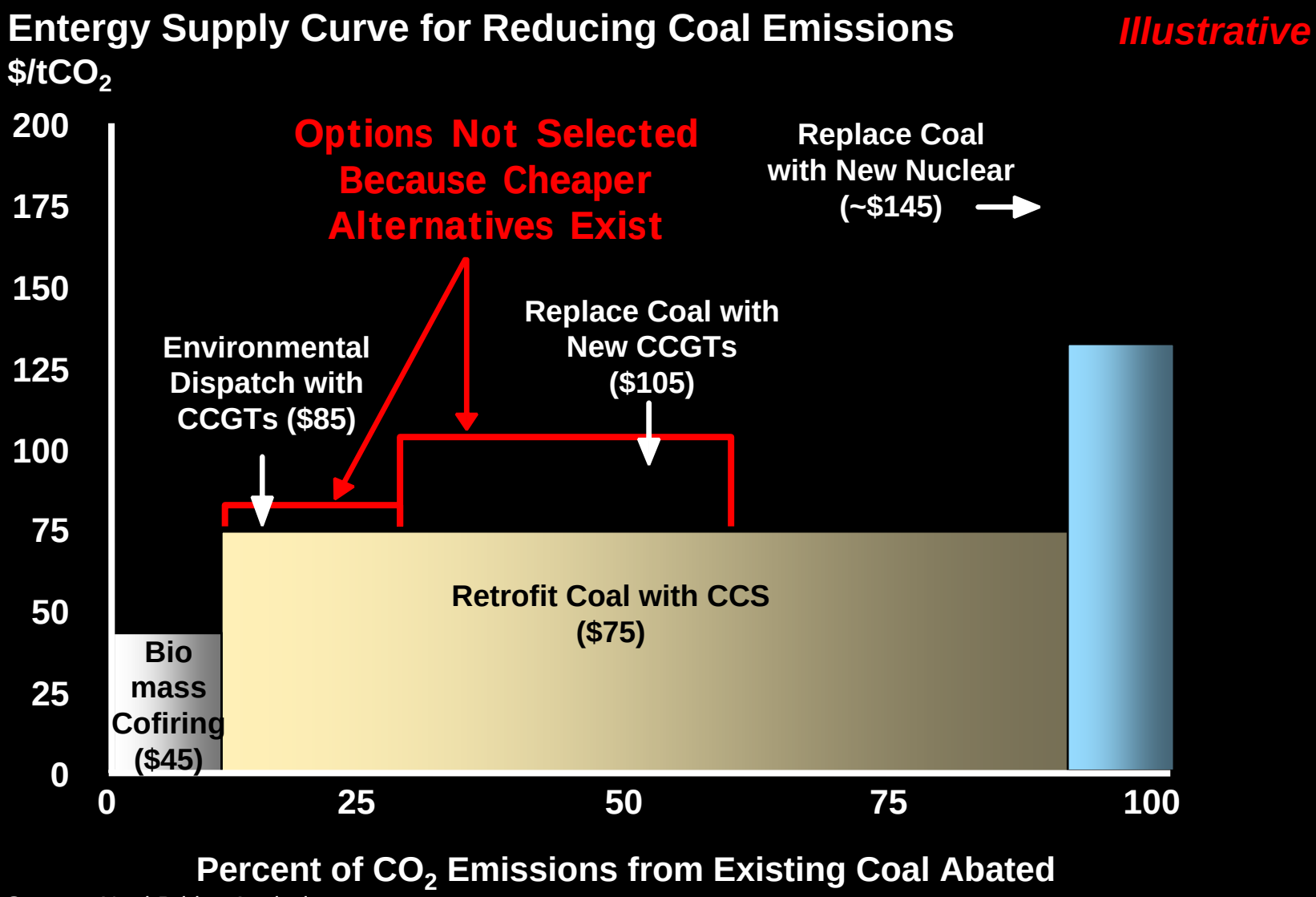
- ✓ U.S., Canada and Australia likely have sufficient CO_2 storage capacity for this century
- ✓ Japan and Korea's ability to continue using fossil fuels likely constrained by relatively small domestic storage reservoir capacity



- 11,000 $GtCO_2$ of potentially available geologic storage capacity
  - Unmineable coal seams
  - Depleted oil basins
  - Depleted gas basins
  - Deep saline formations
- 2,000 – 12,000 $GtCO_2$ potentially available deep under the ocean

Source: Batelle, Pacific Northwest National Laboratory, U.S. Department of Energy

CCS Retrofit Technology at $75/ton Provides More CO_2 Reduction at Lower Cost



Source: NorthBridge Analysis

Carbon Capture Retrofit on Existing Coal

What's It Worth?

Substantial Value

- U.S. compliance cost savings could be as high as $50-100B/year
- More affordable solution for the rest of the world; savings could be as high as $400-600B/year
- Increased U.S. energy independence
- Frees up spending for other purposes

Option Value Is?

Why It Matters

BIG Numbers Matter

1. NO Bottom Line? → Poison Pill
2. NO Legislation? → Poison Pill
3. Price Too Low? → Loop Hole
   - ✓ Print Allowances
   - ✓ No Compliance

Three Concerns in the Electric Sector

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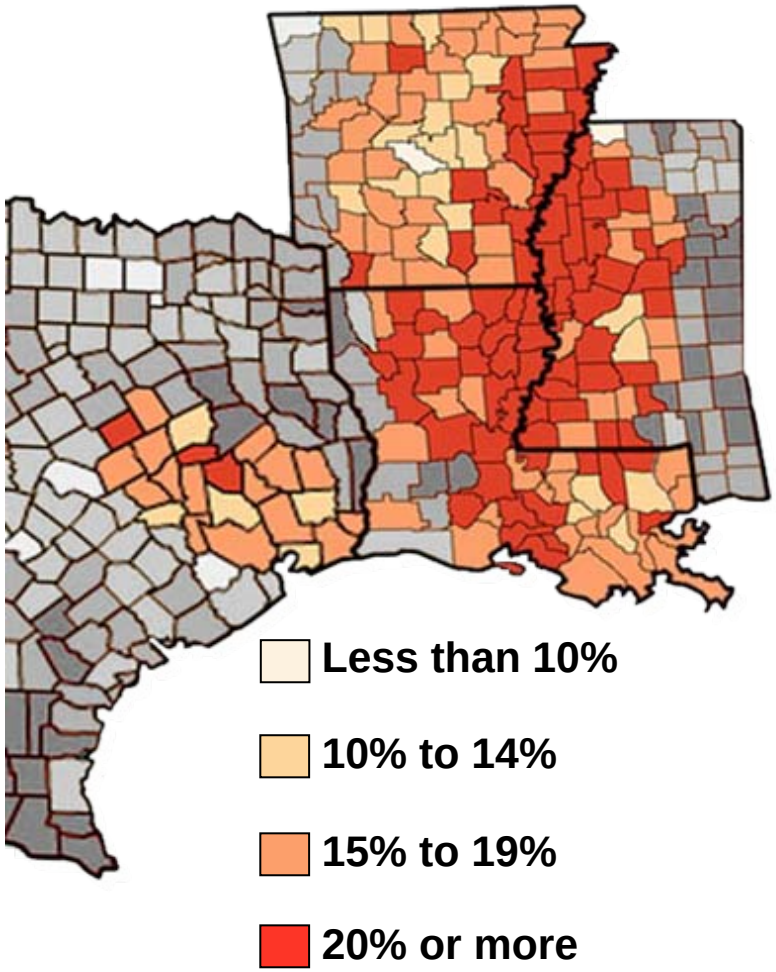
Poverty in Entergy's Region

It's a real issue.

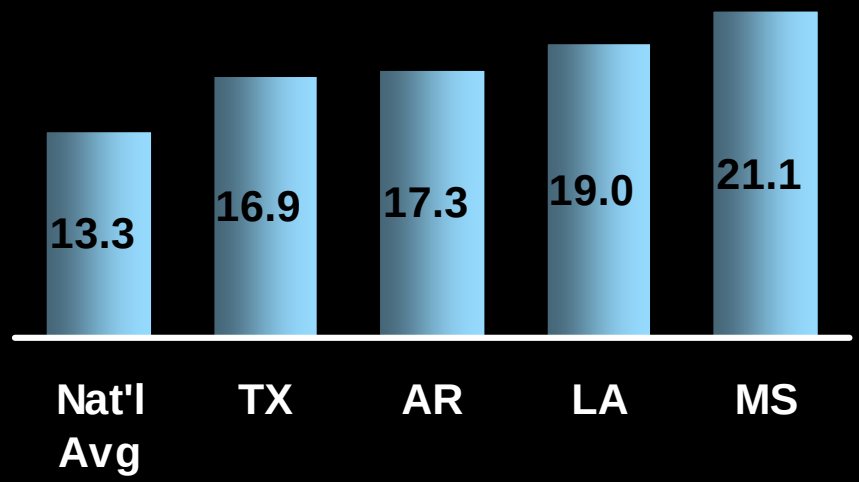
Service Territory Poverty Map



Source: U.S. Census Bureau

Is This the Best We Can Do?

Residents Living in Poverty[1]
2006; %

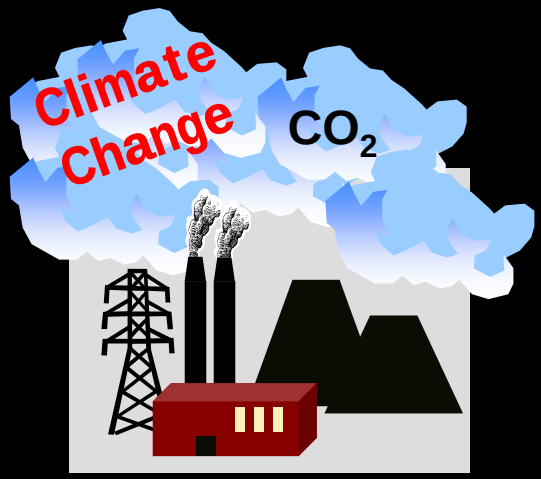


- ✓ **Climate change regulation will make a bad situation worse**
  - **Regressive effect**
  - **Families and children**

[1] If you believe 1960's data Too Low

We Have a Stark Choice

Give Free Allowances to Generators?



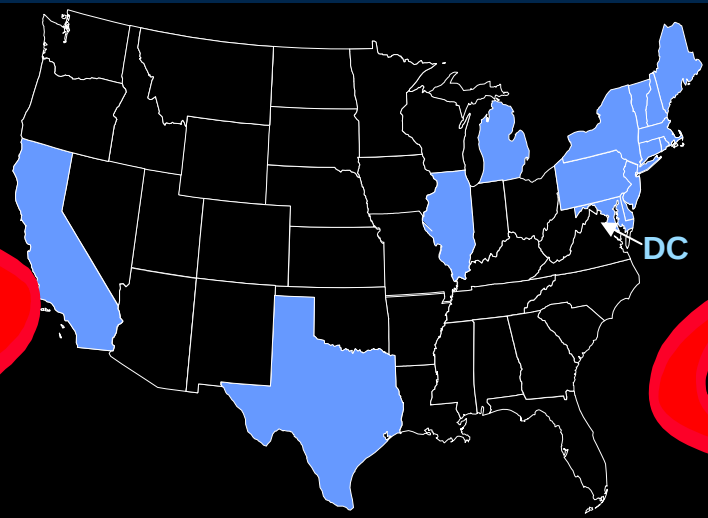
Windfall for Unregulated Generators; "Clean Customers" Pay Twice

2-4X more expensive for customers

Source: Congressional Budget Office

The Problem With Giving Free Allowances To Generators

Regulated States (~50% of population)



Deregulated States (~50% of population)

That's Us Entergy

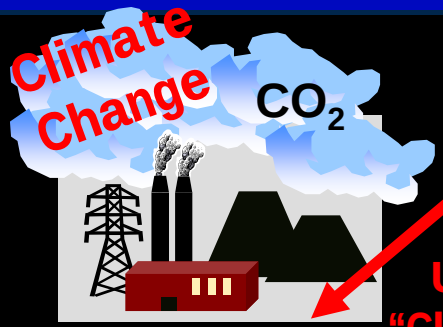
That's Us enexus

Spin-Off

1. The value of allowances given to regulated generators assumed to ultimately go to customers
2. Utilities with more emissions from their generators get more allowances; Utilities with cleaner generation get less
3. Customers of utilities with cleaner generation end up subsidizing customers of utilities with more emissions

1. The value of allowances given to unregulated generators stays with generators, does not go to customers
2. At the same time, wholesale market prices go up, to cover the increased marginal cost of generators – by the amount of allowances needed by the marginal generator
3. Customers in deregulated states get no protection from price increases

We Have a Stark Choice



Give Free Allowances to Generators?

Windfall for Unregulated Generators; "Clean Customers" Pay Twice

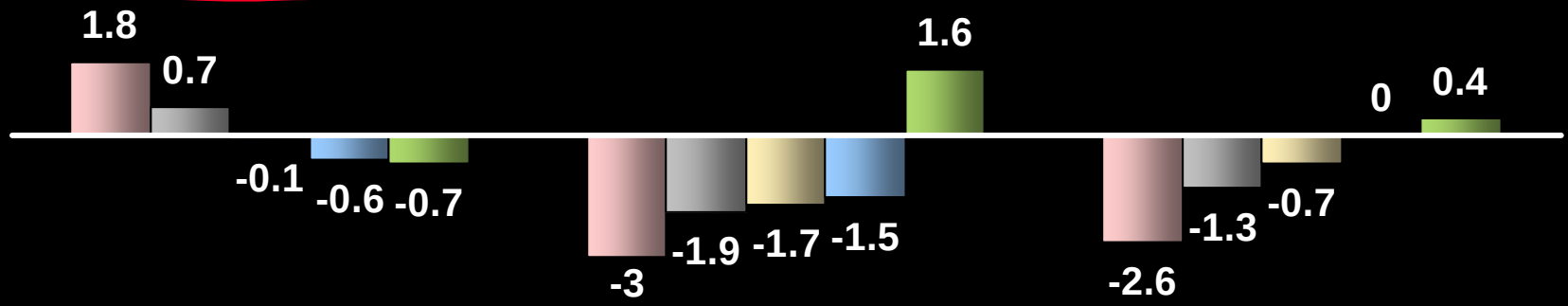
Or Use for Benefit of Customers?

2-4X more expensive for customers

Provide Equal Lump-Sum Household Rebates

Cut Corporate Taxes

Cut Payroll Taxes

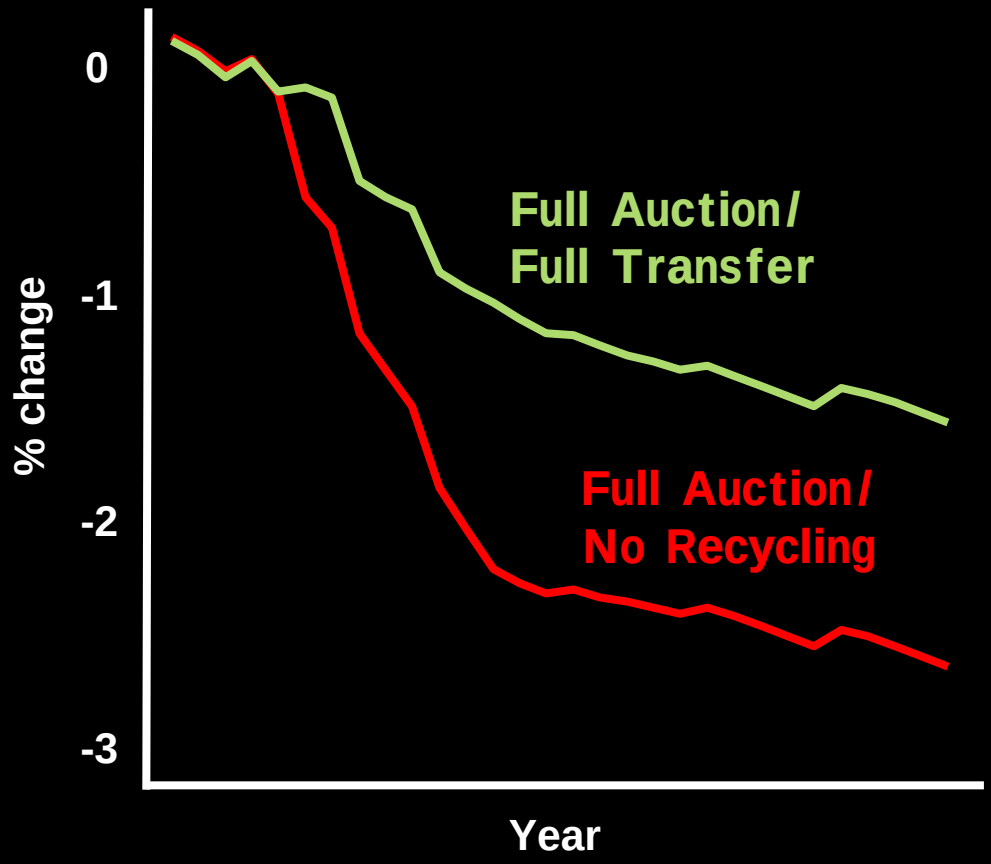


Effect on Average After-Tax Household Income, by Income Quintile
Revenue from Allowance Sales for a 15% Cut in CO_2 in 2010

Source: Congressional Budget Office

Why Does It Matter?

Gross Domestic Product, National Impacts
% Change over Baseline



- Failing to deal with regressive effects is a lost opportunity
- Recycling the revenue back to households is the best way to protect the economy
- Not building in mitigation for families will undermine the ultimate viability of the effort

Summary – The Reality

Understanding the Economics of Coal

-- Solution for coal is mandatory

Getting the Price Signal Right

-- Price signal must be right

Mitigating the Effects on Families

-- Regressive effects must be addressed

Entergy's Vested Interest in Climate Change

- **As a company serving the Gulf Coast, Global Climate Change effects put at risk:**
  - **Billions of dollars of investment**
  - **Our customer base**
  - **Welfare of our employees, their families and our communities**

Hurricane Katrina

Hurricane Katrina
Landfall August 29, 2005

- Landfall Information
  - Buras-Triumph, Louisiana
  - **Monday, August 29 @ 6:10 AM**
  - **Category 3 hurricane**
    - **125 mph**
  - **Storm Surge**
    - **(25 ft) around St. Louis Bay, Mississippi**

Michoud Plant
Hurricane Katrina

Michoud Plant
Hurricane Katrina

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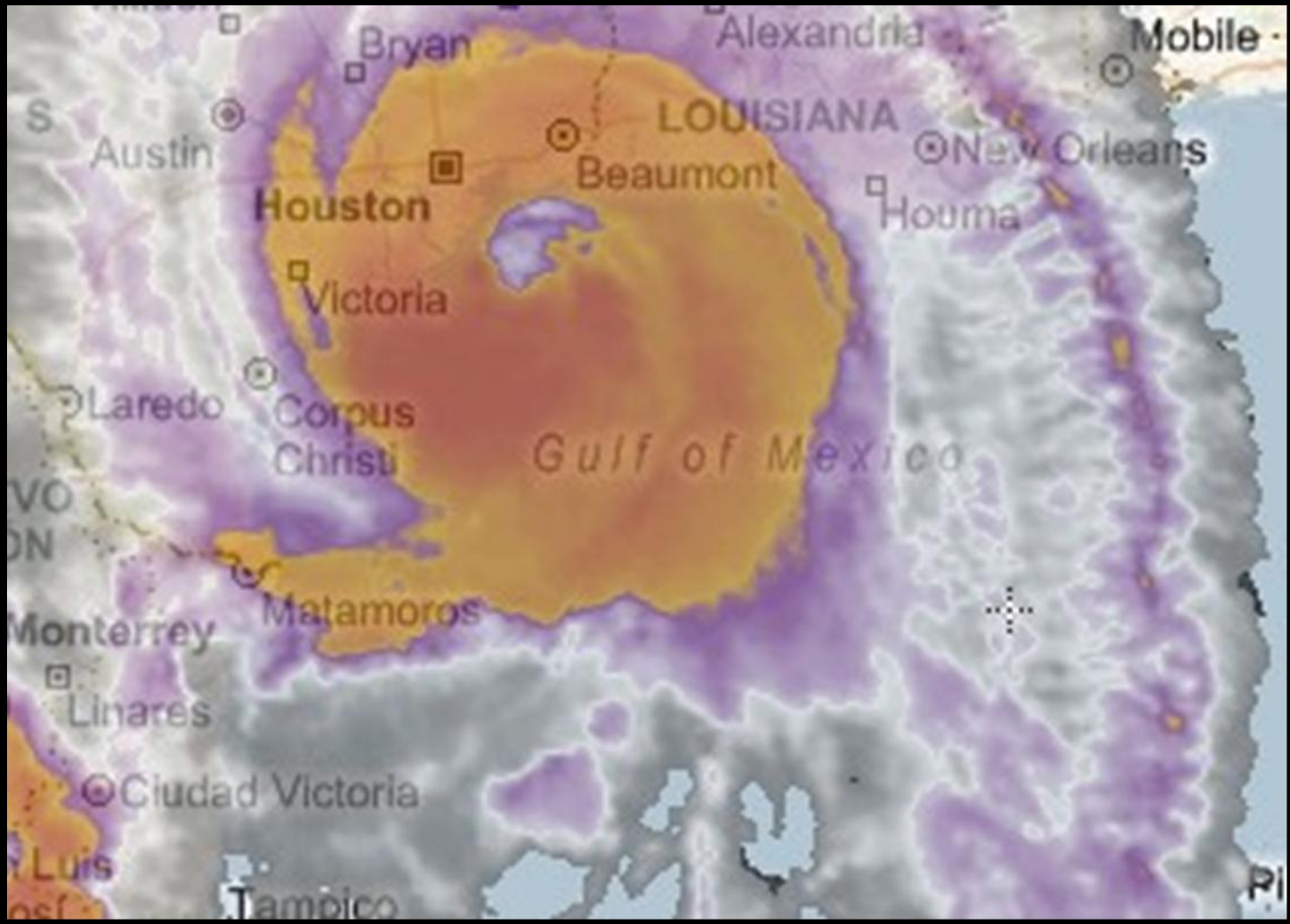
Listed in Order of Spend	Budget
Michoud 2	**$1,149,931**
Michoud 3	**$4,880,084**
Common Equipment and Site Infrastructure	**$4,838,626**
Restoration Total =	**$10,868,641**

Sabine Ike Storm Recovery



Sabine Ike Storm Recovery

- Landfall Information
  - **Galveston**
  - **Saturday, Sept 13 @ 2:10 AM**
  - **Category 2 hurricane**
    - **83 mph at 2:15 AM at Hobby Airport**
    - **102 mph at 2:45 AM in Anahuac**
  - **Storm Surge**
    - **14.24' at Sabine Pass near the Louisiana Border**

Plant Entrance

Sabine 5 Cooling Towers

Sabine Intake Canal & U4/5 Gas Lines

Sabine Water Plant

Switchyard

Intake & Discharge Canal

Transformers

U5 Transformer

203 Tank New Location

201 Tank New Location

Sabine 5 Circ Pump/Motor

Generator Protection Relays

Library


Sabine
Unit
#2
Outage
Planning
SABINE POWER STATION
Sabine Unit #2
Outage Report
Spring 1999
SABINE UNIT #3
FALL 2002 OUTAGE

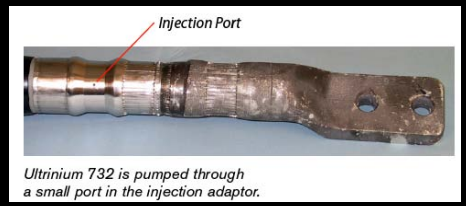
Flood Residue

Vendor Stocking

Ike Survivor

- 5 Units
  - ~ $60-80 mm loss
  - 3-5 ft of water throughout most of plant
  - 43 Days to get U5 back on line
- Over 300 motors assessed
  - Most 100 HP and below were replaced
  - Motors larger than 100 HP were desalinated, dried, dipped and tested
- Cables Assessment
  - 21 cables on unit 5 were pumped with Novinium fluid to drive out water and recondition cables
  - $11/ft as compared to ~$34/ft new cable (material and labor)
  - Over 24,000 ft of cable conditioned
  - Reconditioned cable meggered to 10,000V DC - zero(0) failures

Novinium brand Ultrinium™ 732 is a mix of fluids, which extends cable life 40 years



Ultrinium 732 is pumped through a small port in the injection adaptor.

Views on Climate Change

Entergy Guiding Principles

The risk is real; we need to act now to stabilize at 450 ppm: 60-80% reductions by 2050

Use an economy-wide, market based approach (preferably cap and trade or tax) to find most efficient solutions

We need to build in permanent low-income protection from the start, funded by CO_2 allowance sales or CO_2 tax revenues

- EITC or other rebates

Other Views

The science is too uncertain to justify the cost to the economy

We shouldn't act until the developing world agrees to limits

Income inequality should be dealt with separately, not through environmental legislation

Views on Climate Change

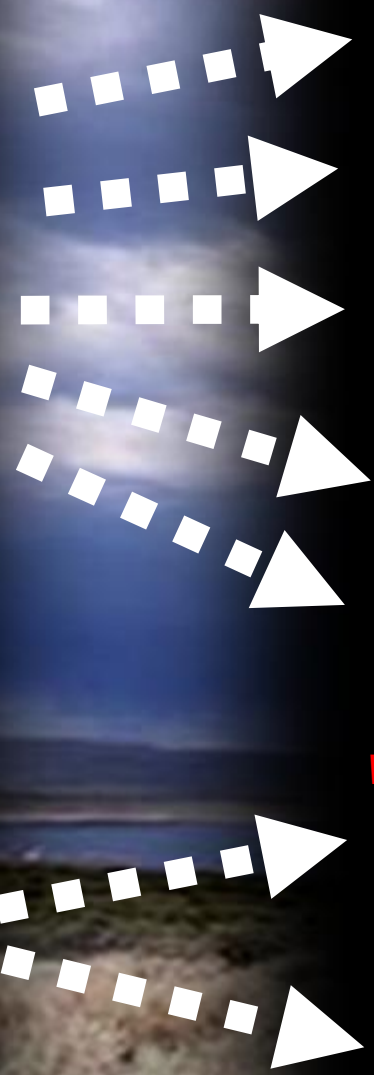
Entergy Guiding Principles

We need a strong but sustainable price signal to stimulate investment in efficiency and new technology

- Preferably cap and trade, with a high "price ceiling," or a CO_2 tax
- Either way, $50/ton by 2020

U.S. policy must be informed by global reality

- Part of the solution will need to be a technology fix for existing coal plants
- Can't meet the goal through efficiency and/or renewables alone – or through new nuclear alone



Other Views

Don't set a price signal until we have the control technology

$50 price is too high – it will kill the economy

$50 may be too low – don't set a "price ceiling" at all

"Climate Fed" to set the price

This is a plan for Entergy to get rich with its non-utility nuclear plants

We can solve the problem relatively cheaply by building clean coal (IGCC) and renewables to replace existing coal

We should invest in efficiency and nuclear