

CO₂ Enhanced Oil Recovery's Eligibility for CO₂ Sequestration

Plains CO₂ Reduction Partnership Annual Meeting

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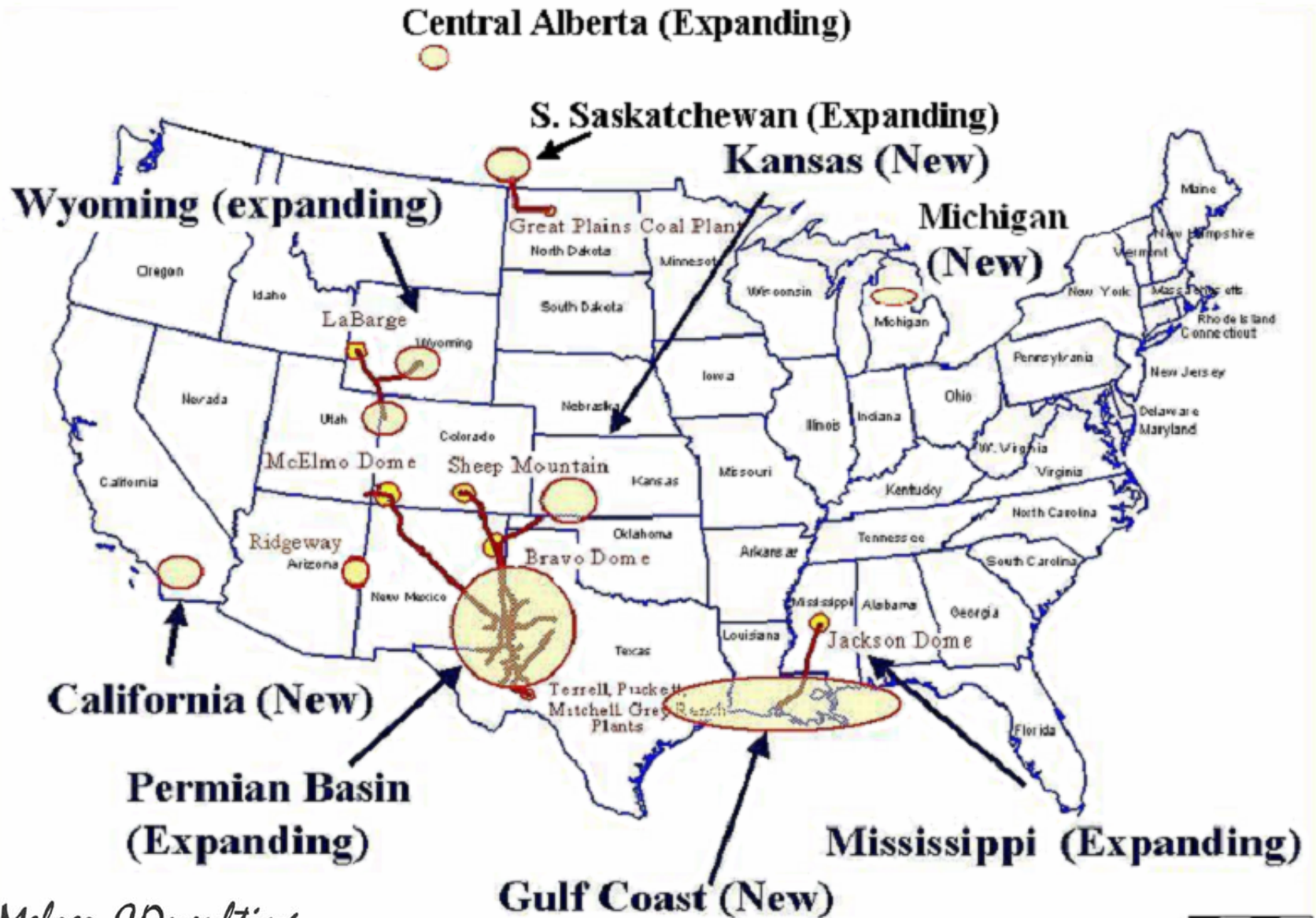
OUTLINE OF TALK

- I. A Quick Update on the Status of CO₂ EOR
- II. Searching for New Energy Answers and The “New Lens”
- III. Strategies Aligned to Meet both Energy and Environmental Needs
- IV. The Evolving Regulatory Frameworks for CO₂ Injection
 - Past Regulatory Approaches for Injection
 - The IOGCC Model
 - **The Draft EPA Model**
 - The World Resources Institute’s Study and Report
- V. The ‘Crossover’ Option for EOR
- VI. Comparisons, Reflections and Recommendations

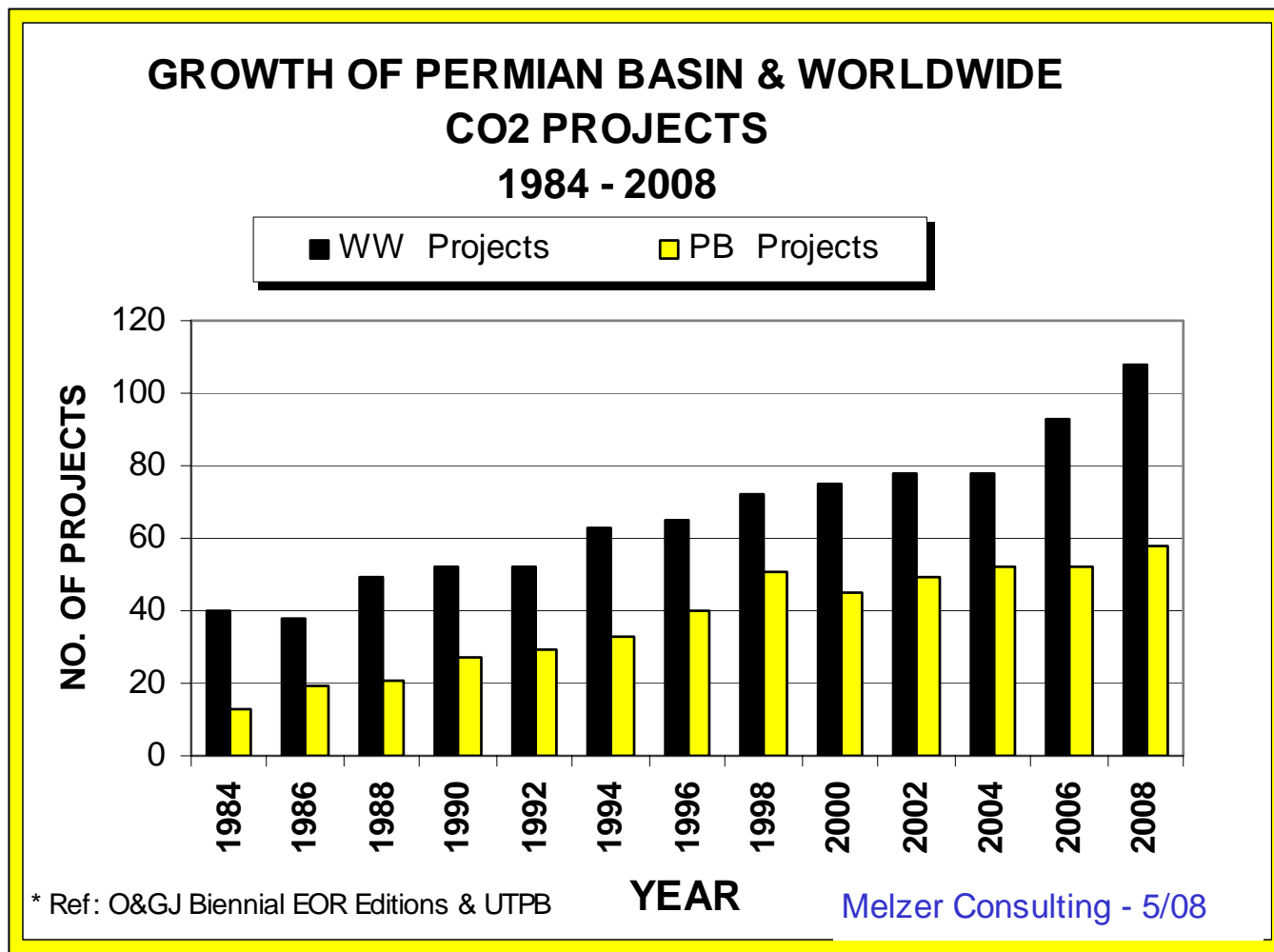
SECTION I

An Quick Look at CO₂ EOR Today

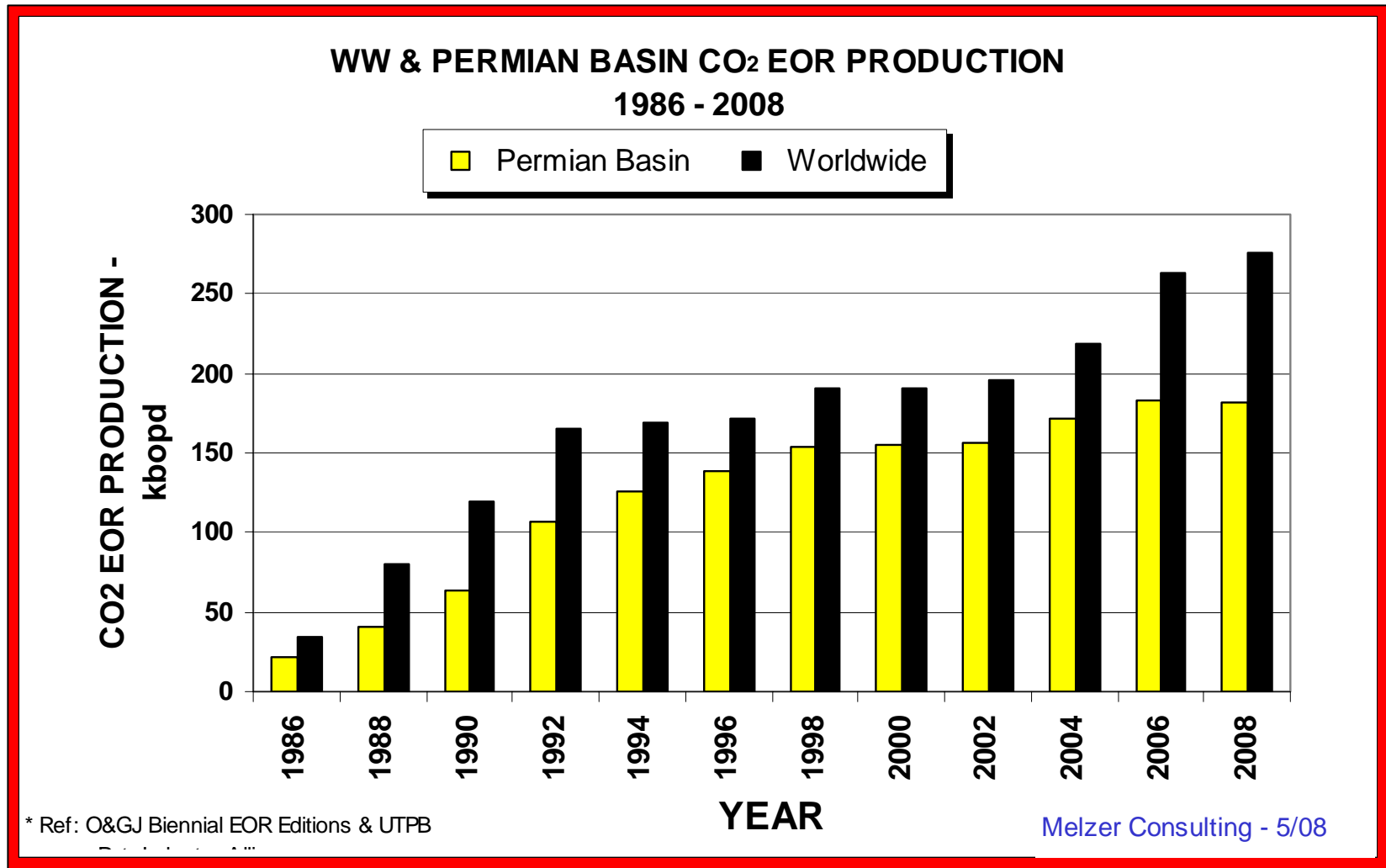
NORTH AMERICAN CO₂ SOURCES AND EOR AREAS EXPANDING and NEW MARKETS



CO₂ EOR PROJECT GROWTH *

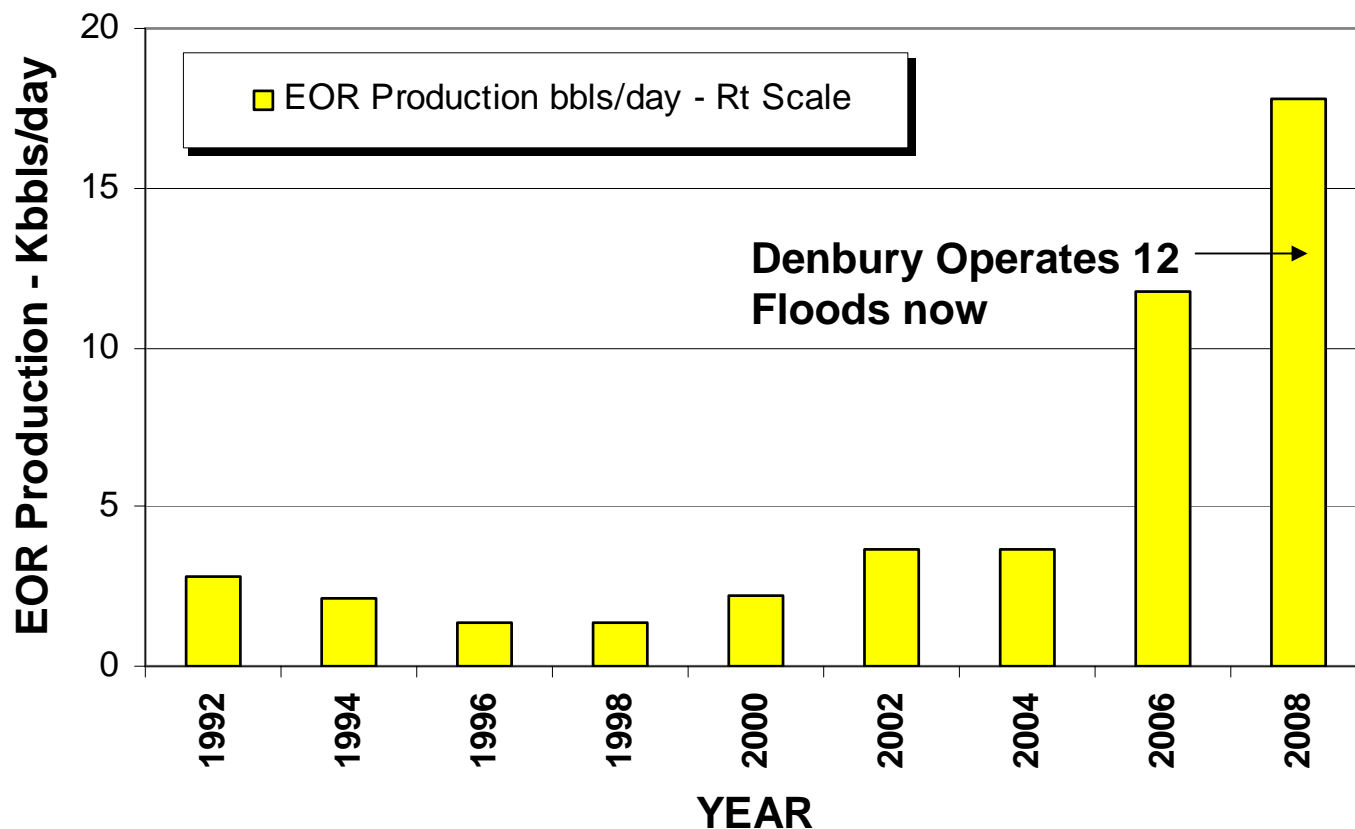


CO₂ EOR PRODUCTION GROWTH *



New Developments in Mississippi

RECENT GROWTH OF MISSISSIPPI
CO₂ PROJECTS & PRODUCTION
1992 - 2008



SECTION II

Searching for New Energy Answers

A THREE-PART ENERGY SQUEEZE

- #1 Natural Gas
- #2 Transportation Fuels
- #3 Electricity

In the U.S., we saw the need for NG supplies and let industry loose to solve #1, we seem reluctant to do the same for #2. Our society has nurtured a love “affair” of renewable energies that is defaulted to a preeminent position for solving #3. It is two grand experiments we are playing out for provision of adequate transportation fuels and electricity – with a lot at stake.

CONCLUSION:

CONTINUING USE OF HYDROCARBONS

- In Spite of Society's 'Affair', There Can be no Quick Divorce from Fossil Fuels; natural gas, oil or coal
- But Business Clearly Now Recognizes the Day of Business as Usual is Gone (Cleaner Energy including Capture of CO₂ Emissions is Here)
- Size of WW CO₂ Capture Challenge is Immense (>10 gt per year {500 bcfpd})

HOW TO AVOID EMISSIONS?

WHAT ARE THE U.S. MARKETS FOR CO₂

- Existing

- CO₂ EOR (2.2 bcfpd)

- Merchant CO₂

- Hydrofracturing services (60 mmcfpd)

- Food Grade (550 mmcfpd)

- Food, beverage, waste water treatment

Shortages of CO₂ Exist Today –
Probably could use 50% more right
away! - & a Bunch More in the Future!

Predominately
Stored

Smaller &
Ultimately
Vented

- Potential

- Enhanced Coal Bed Methane

- Enhanced Gas Recovery

IF: WITH CO₂ CAPTURE

THEN: NEW SOURCES OF CO₂ FOR EOR (1)

EXISTING SOURCES (BUT NOT CAPTURED)

- EXISTING BUT NON-UTILIZED INDUSTRIAL CO₂ SOURCES
 - NATURAL GAS BYPRODUCT CO₂
 - HYDROGEN PLANTS
 - ETHANOL
 - CEMENT
 - EXISTING FOSSIL FUEL POWER PLANTS
 - PETROLEUM COKE GASIFIERS
 - OTHERS

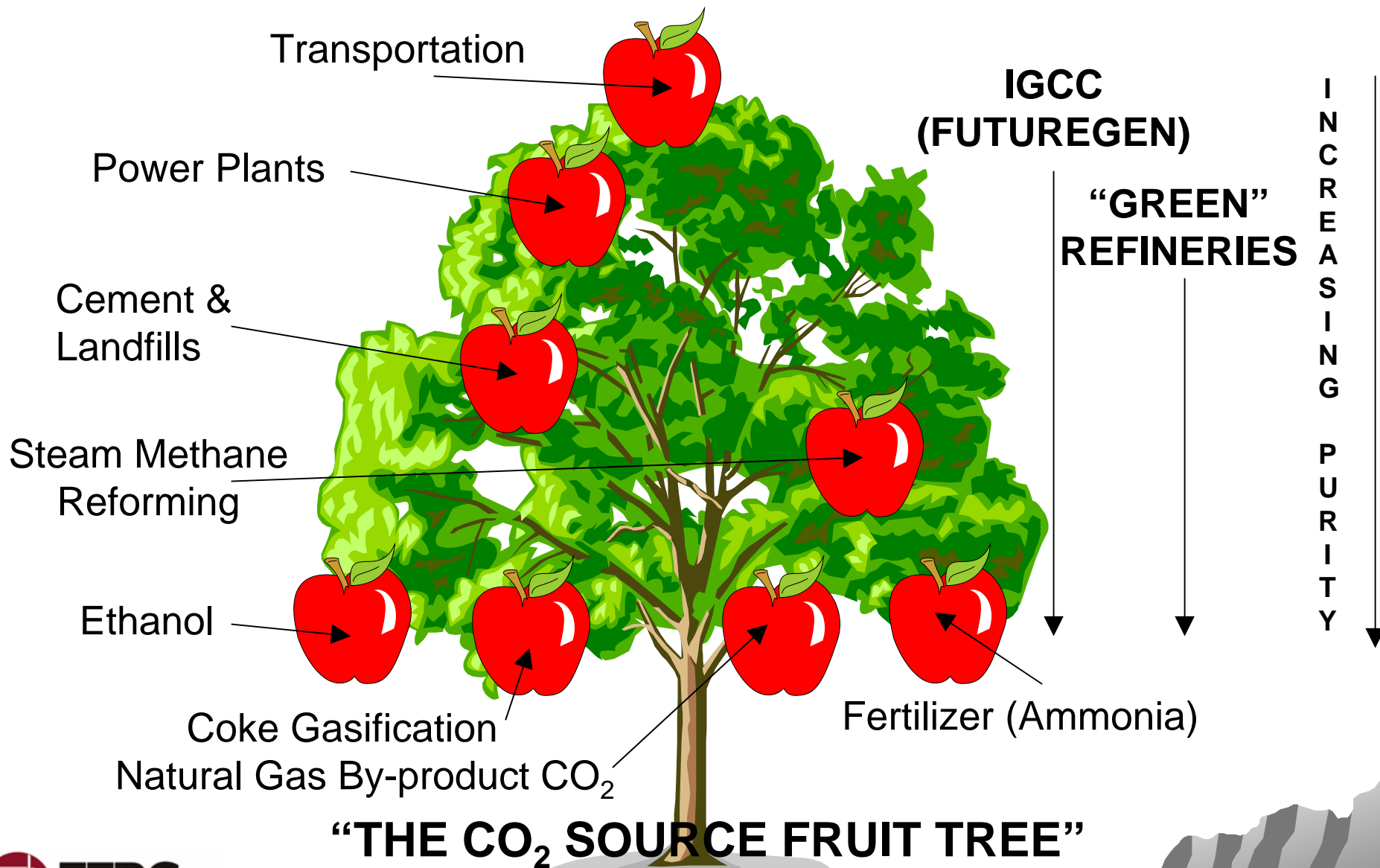
IF: WITH CO₂ CAPTURE

THEN: NEW SOURCES OF CO₂ FOR EOR (2)

COMING SOURCES

- NEWLY DEVELOPING INDUSTRIAL SOURCES
 - ELECTRIC POWER PLANTS
 - RETROFITS FOR CAPTURE
 - NEW POST COMBUSTION CAPTURE (e.g., AEP, Tenaska)
 - COAL GASIFICATION (FUTUREGEN-LIKE (e.g., Duke @ Edwardsport)
 - SYNGAS AND POLYGEN GASIFICATION (e.g., DKRW in Wy, Dow, Eastman in GC)
 - OIL SHALE AND IN-SITU GASIFICATION
 - OTHERS

Industrial CO₂ Sources



"THE CO₂ SOURCE FRUIT TREE"

HOW BIG CAN THE CO₂ BUSINESS BECOME?

- IF WE VIEW THROUGH THE OLD “LENS”
 - OIL PRICES AVERAGING \$12-25/BBL
 - CO₂ SOURCE AND TRANSPORTATION INFRASTRUCTURE EXPENSIVE AND LIMITED
 - NOT MANY MORE RESERVOIRS PASS MUSTER
- THE NEW “LENS”
 - OIL PRICES ABOVE \$80/BBL
 - CO₂ CAPTURE UBIQUITOUS
 - REVENUE STREAMS FOR BOTH OIL PRODUCTION AND STORAGE
 - MANY, MANY MORE RESERVOIRS ARE PROFITABLE
- SO LET’S BEGIN TO LOOK AT CO₂ FLOODING DIFFERENTLY

THIS IS WHERE WE'VE BEEN

SO WHERE MIGHT THINGS BE GOING?

First, We Must Have some Nurturing Policies

Section III

Strategies Aligned to Meet both Energy and Environmental Needs

Can We Do CO₂ Storage (GS) on a Large Scale?

Conceptual Analogues

- CO₂ EOR (124,000 tons/per day of “new” CO₂, = 2.16 bcfpd ~ 1.1 mmbpd)
- Natural Gas Storage (450 State Permitted NG Injection Sites)
- Strategic Petroleum Reserve (700 mmbbl in Storage as of 2008) – Current storage capacity - 727 mmbbl

Conclusion: Industry is Doing This!

* <http://fossil.energy.gov/programs/reserves/spr/spr-facts.html>

THE CASE FOR CO₂ EOR JUMPSTARTING GS

- I. Expansion of the Existing and Experienced Industry
- II. Established Subsurface Conditions: Proven Traps and Seals
- III. Potential for Value-Added Products with Commercial Subsidizing of GS
- IV. Co-Use and Expansion of Existing CO₂ Infrastructure
- V. Well Explored Local and Regional Geologic Settings
- VI. Embedded Compensation to Mineral/Surface Owners
- VII. The Superposition of Oil Production and GS Provides a Solution to the Most Difficult of Propositions: Convincing Site Owners of the Need for Waste Injection on Their Property
- VIII. While other GS options may hold future promise, EOR is clearly the only available option today and one that holds large volume capacity

SECTION IV

The Evolving GS Regulatory Frameworks

THE THREE KEY REGULATORY DOCUMENTS TO DATE

- The Interstate Oil & Gas Regulatory Compact Commission's Documents ^{1), 2)}
- The Environmental Protection Agency's Draft Regulatory Framework Document ³⁾
- The World Resources Institute's Draft Report on Guidelines for Carbon Capture and Sequestration ⁴⁾

- Refs:
- 1) **Carbon Capture and Storage: A Regulatory Framework for States; Interstate Oil & Gas Compact Commission Phase I Study, 2005**
 - 2) **CO₂ Storage: A Legal and Regulatory Guide for States, 2008**
 - 3) **Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO₂) Geologic Sequestration (GS) Wells Proposed Rule**
http://www.epa.gov/safewater/uic/wells_sequestration.html#regdevelopment
 - 4) <http://www.wri.org/project/carbon-capture-sequestration>

IOGCC Treatment

- The Earliest Work
- Assumes State Primacy: Rules are Framed up by State Regulators with Injection Experience
- Wide Scope: Looked at All Aspects of CCGS
- Excludes Capture Piece

EPA GS Regulatory Recommendations

- Authorized Via Safe Drinking Water Act
- Looks at Subsurface Injection
- Scope Limited to GW Protection
- Extends UIC Approach to GW Protection
- Attempts to Avoid Waste Injection Labels
- Mentions, but Does not specifically treat, Commercial CO₂ Injection activities

World Resources Institute's Guidelines for Carbon Capture and Sequestration

- Only Work to Broadly Treat Capture, Transportation, and Sequestration (i.e., Surface and Below Ground)
- Most Thorough Treatment of Subjects
- Actively Recruited Injection Industry's Experience

The Gathering of Interested Parties

ENTITY TYPE

IOGCC

EPA

WRI

- Federal Regulators
- Environmental Parties
- Research Organizations
- Service Companies
- State Regulators
- Commercial Injectors



CO₂ Injection Experience

- Limited to about 20 Companies
- Their Past Participation Hampered by No Clear Vision that the Business of GS would Evolve

As a Result:

- Have Come Late to the GS Arena (and some are still not there)
- Regulatory Work has not yet Vetted through them

Key Requirements of the GS Regulatory Framework (1)

(an Industry Perspective)

- **Set Rules According to Perceived Risks of Subsurface Sites**
- **Not to Preclude Early Commercial Activity**
- **Protect Public's Health and Safety**
- **Protect USDW's**

Key Requirements of the GS Regulatory Framework (2)

(an Industry Perspective)

- **Encourage State Primacy (for Local “Ownership” of Key Enabling Features such as Aggregation of Rights, Resolution of Subsurface Trespass, etc.)**
- **Rank Order Sites for First Permits to Minimize Early Risk and to Reward Early Movers**
- **Capitalize on the Existing Knowledge Base, Infrastructure and Operational Success**
- **Recognize that Technologies and Understanding will Continue to Evolve**

An Examination of the EPA Draft Document

Strengths, Weaknesses and Omissions*

** From a PCOR Analysis in Conjunction with the Texas Carbon Capture and Storage Association*

A Cautionary Word on Past Underground Regulatory Frameworks

Historically, Underground Regulation has been Developed
at the State Level

And, then

Federal Rules have been Promulgated after Examination
and Modeling the Best of the States' Experience

We are attempting to Reverse the Order here !

The Draft EPA Document

- Does not Set Injectate Composition
 - Does not Attempt to Prioritize Lower Risk Sites
 - Is Very Conservative in Approach and, as such, does not Encourage Early Action
-
- But...it is a thorough look at Regulation and is a good start for the Future & Higher Risk GS Sites

How Do the EPA Rules Relate to the Strategy of Enabling GS?

- Recognize that a “Commercial (i.e., oil revenue) Subsidy” Trumps a “Taxpayer Subsidy” – Not addressed since EPA treats EOR only in a passing fashion (not part of their scope)
- Recognize Eligibility of GS for EOR Projects – Same Comment as Above
- Grow a Sequestration Industry from the Experience in Commercial Injection – Not a Consideration in Developing the Rules

SECTION V

The 'Crossover' Option

Two Paths Moving Forward

Pathway 1): Continue to work out details of the EPA Rules and “One-Size-Fits-All” Category of Injection (Deep Saline Formations)

Pathway 2): Develop State Based and Parallel Rules to Certify Storage During CO₂ EOR – “Crossover Eligibility”

Pathway 2: The CO₂ EOR “Overlay” for GS

- Develop “Opt-in” Strategies for Recruitment of Existing Experience in EOR to GS
- Encourage Simultaneous EOR and GS (for emission offset reasons)
- Develop MMV Requirements to Demonstrate Stored Volumes during EOR Projects
- Encourage States to Develop “Green Oil” Incentives
- Qualify Anthropogenic CO₂ EOR Projects for Same Storage Incentives as other Sequestration Projects

SECTION VI

Summary and Recommendations

Conclusions

(one Industry Perspective)

- **EPA has been Extremely Responsive for Development of Some Rules for GS.**
- **However, EPA Draft Rules for GS are “off-center” When Viewed in the Perspective of Enabling GS.**
- **Input and Influence of Research Organizations and Environmental Groups has been Strong.**
- **Commercial (Injection Industry) Influence has been Weak (Fault Lies on Both Sides).**
- **State Input has Been Minimal.**
- **As is, Rules are Likely to Set up Separate Paths for CO₂ Injection (CO₂ EOR distinct from Sequestration) and a Grand Opportunity is Lost Since CO₂ EOR Addresses both Transportation Fuel Supply and Electricity Challenges Ahead**

Recommendations

- Continue Working the “One-Size-Fits-All” EPA Approach
- But...Meanwhile Create an Expedient Pathway Based upon the Success of CO₂ EOR Injection (the ‘Crossover’ Option)
- Assure Capturers that Emission Offsets are Eligible in Pathway 2
- Have the States Regulatory Bodies Specify the Monitoring ‘Overlay’ for Commercial Injection

Why All the Fuss?

or.... why is Simultaneous EOR and GS Important?

- It is Expensive to Design Next Generation (N_xG) Coal Plants that Capture CO_2
- We need to be Implementing N_xG Coal Plants tomorrow to see if there is a future there
- CO_2 captured from those projects, if not storable, will be a liability and funding will not come for N_xG Coal Plants
- CO_2 EOR has proven storage and provides the Proven Jump Start for those Early Mover Projects

Thank you

Questions?