

Training Carbon Management Engineers: Removing a Major Hurdle for Geologic CO₂ Storage by Increasing Educational Capacity

Steven Bryant and Jon Olson

**Dept. of Petroleum and
Geosystems Engineering**

The University of Texas at Austin

Key Points

- **Scarcity of skilled subsurface engineers likely for large-scale carbon storage**
- **Substantial new educational infrastructure needed to address scarcity**
- **Proposed solution: “carbon management engineering” program**
 - Existing multidisciplinary program at The University of Texas at Austin could provide model
 - Lead time is long
- **Interim: training for professionals**
 - **STORE project**



Alliance

for **s**equestration **t**training,
outreach, **r**esearch & **e**ducation



Goal: Help create a skilled workforce for CCS industry and foster public understanding with regard to climate change mitigation technology

Region of Focus: Texas, Louisiana and Florida, all top 10 US CO₂ emitters

Project Approach

- Sequestration Workforce Training
- Research and Technology Dissemination
- Workforce Pipeline Education
- Public Outreach





Gulf
Coast
Carbon
Center



sequestration training, outreach, research & education

www.gulfcoastcarbon.org

www.storeco2now.com

The University of Texas at Austin

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Sue Hovorka

Tip Meckel

J.P. Nicot

Katherine Romanak

Becky Smyth

Ramón Treviño

Cockrell School of Engineering

***Department of Petroleum and
Geosystems Engineering***

Steve Bryant

Paul Bommer

Larry Lake

Jon Olson

Sanjay Srinivasan

Carlos Torres-Verdín

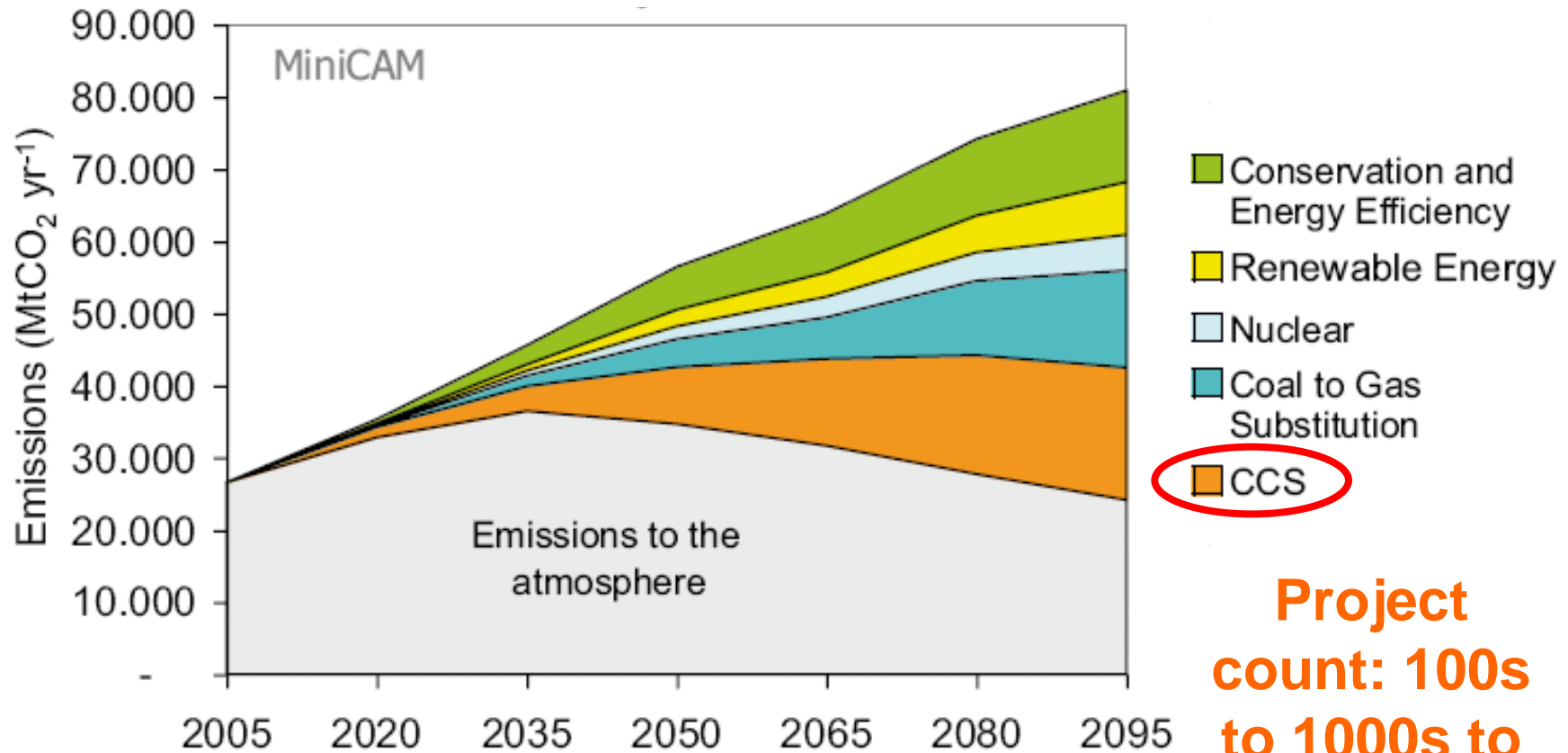
Striker Communications

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Dan Collins

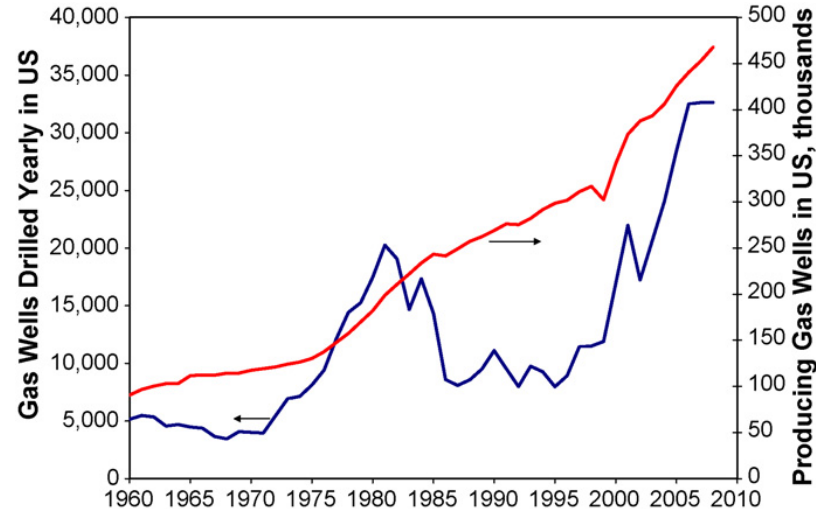
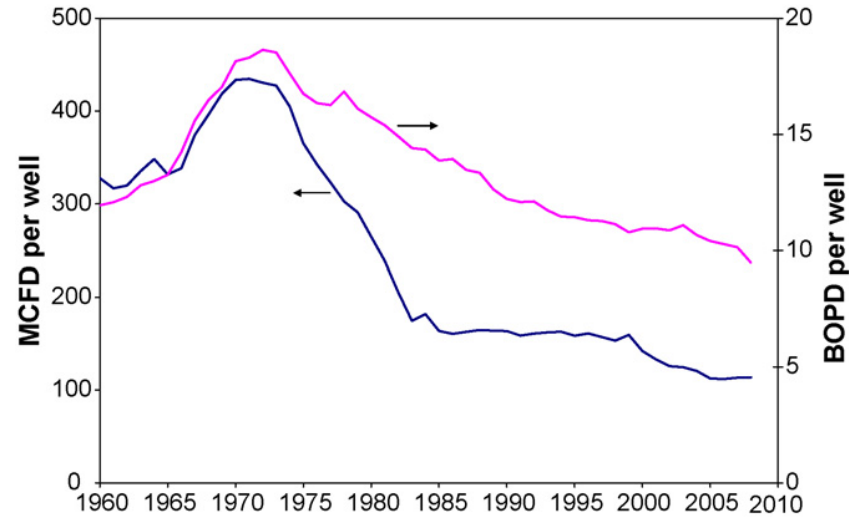
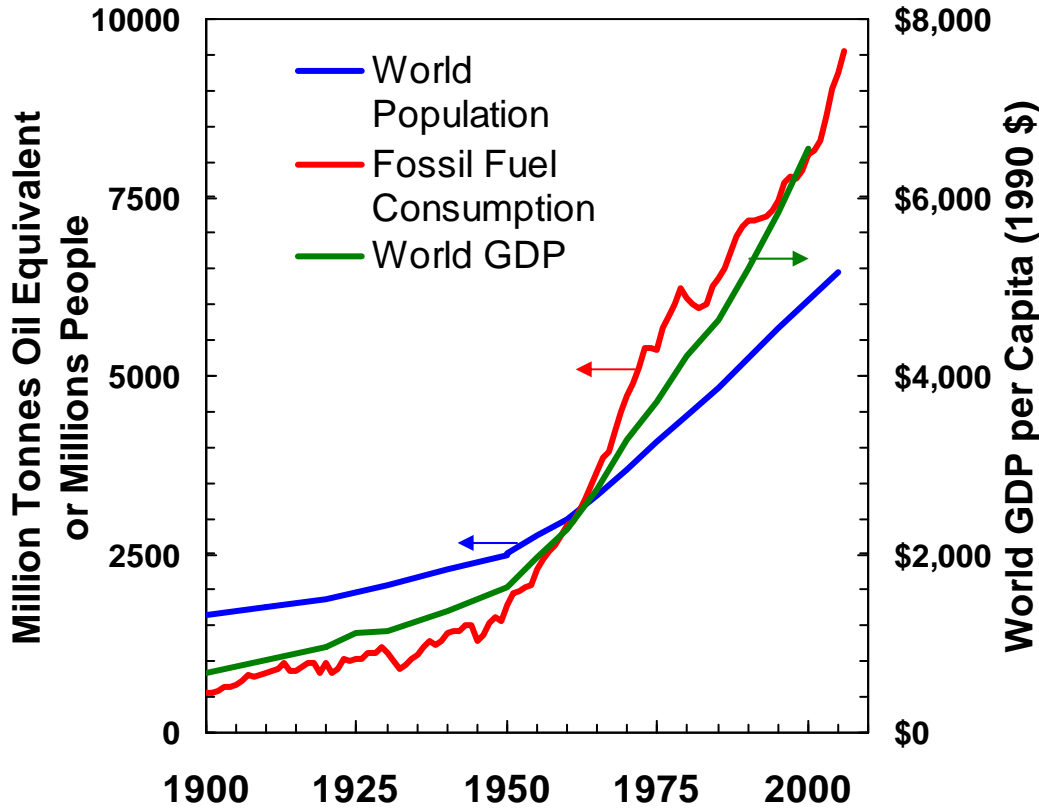
Motivation: Large-Scale Implementation of Geologic CO₂ Storage Needed for GHG Mitigation



IPCC SRCSS Technical Summary

**Project
count: 100s
to 1000s to
achieve 1 to
10 GT CO₂/y**

Remark (1): Demand for Hydrocarbons Will Remain Large, Producing Them Will Be More Difficult

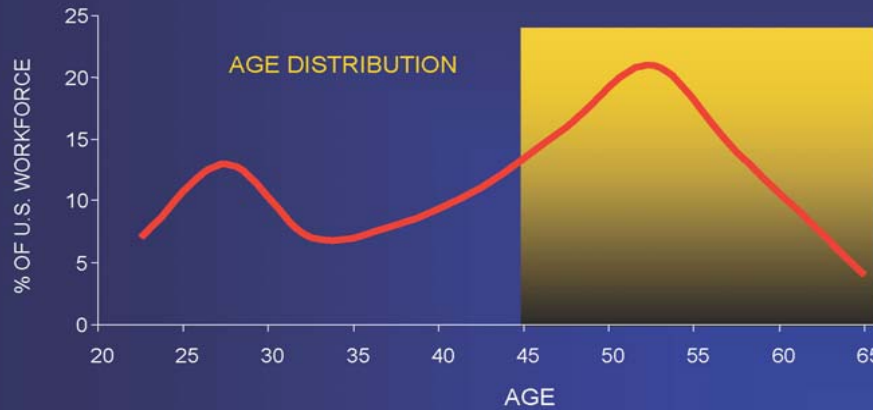


Remark (2):

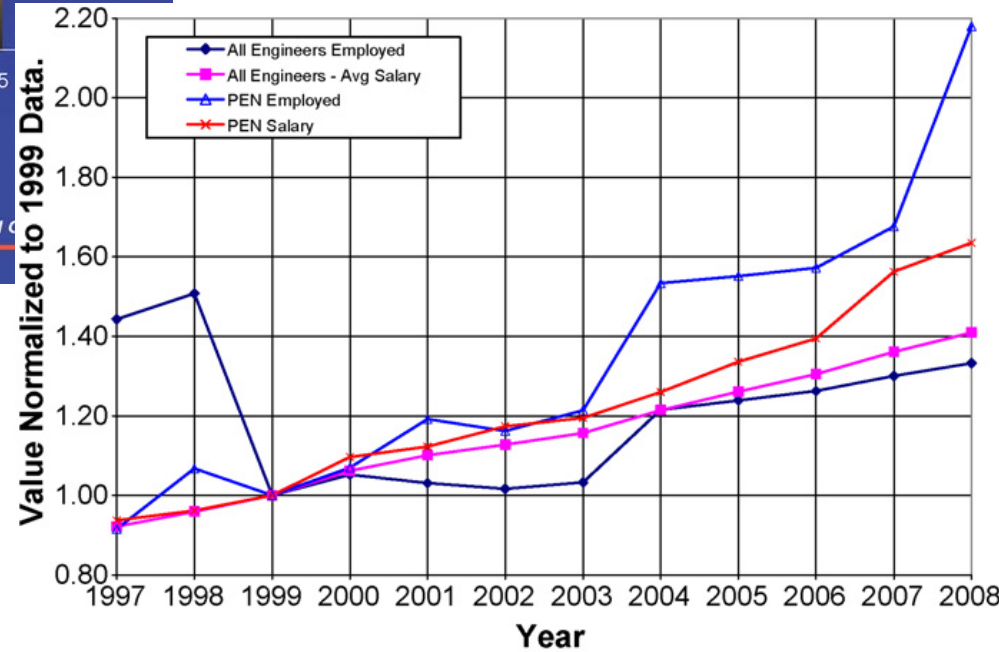
Demand for Subsurface Engineers by Oil & Gas (US) will Strain Education Capacity for Next 20 Years

Demographics of US oil & gas industry

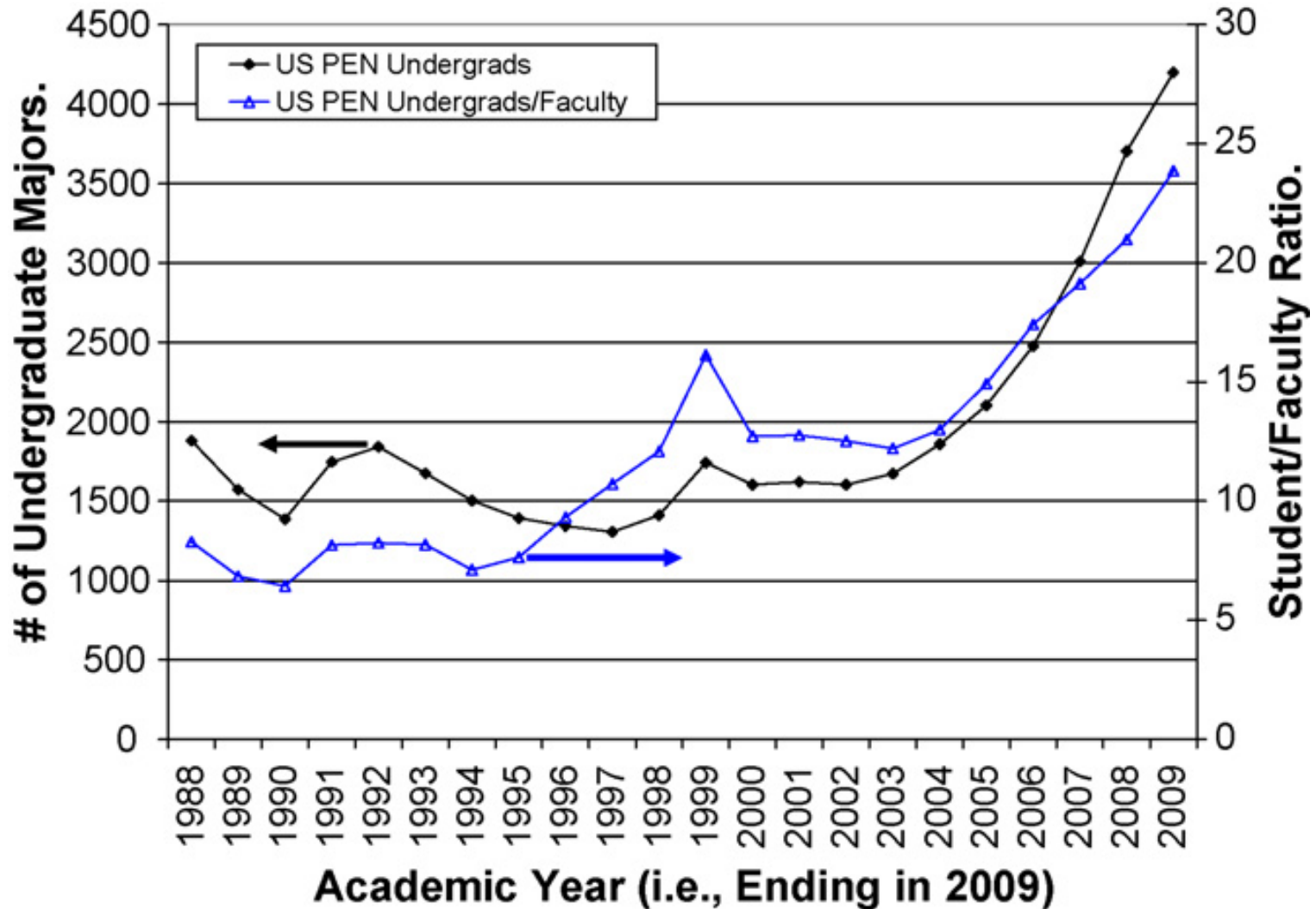
OVER HALF OF THE WORKFORCE ELIGIBLE TO RETIRE IN NEXT 10 YEARS



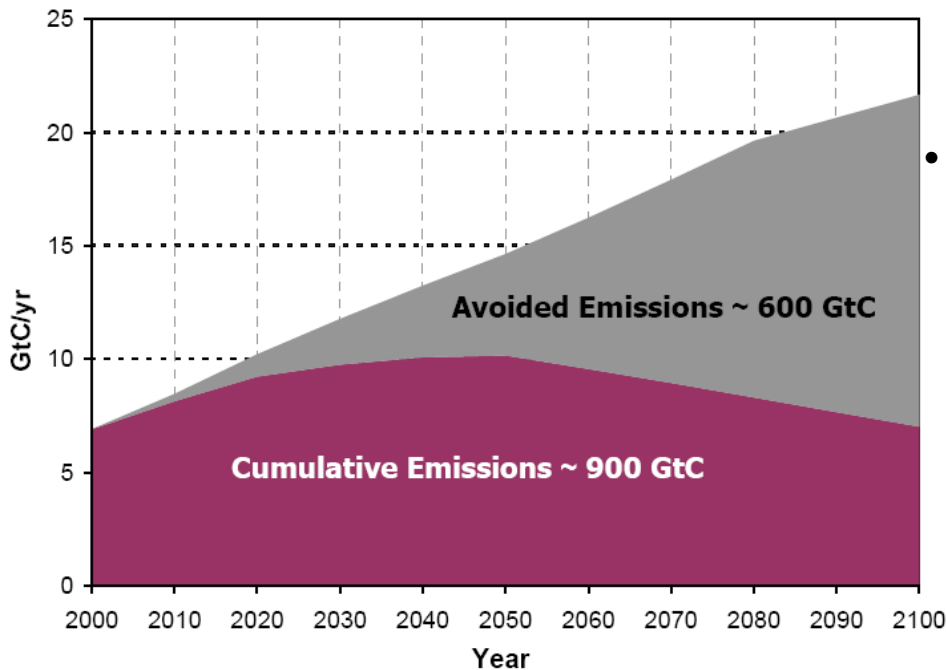
Source: U.S. Dept of Labor.



Remark (3): Subsurface Engineering Educational Capacity in the US is Already Overtaxed



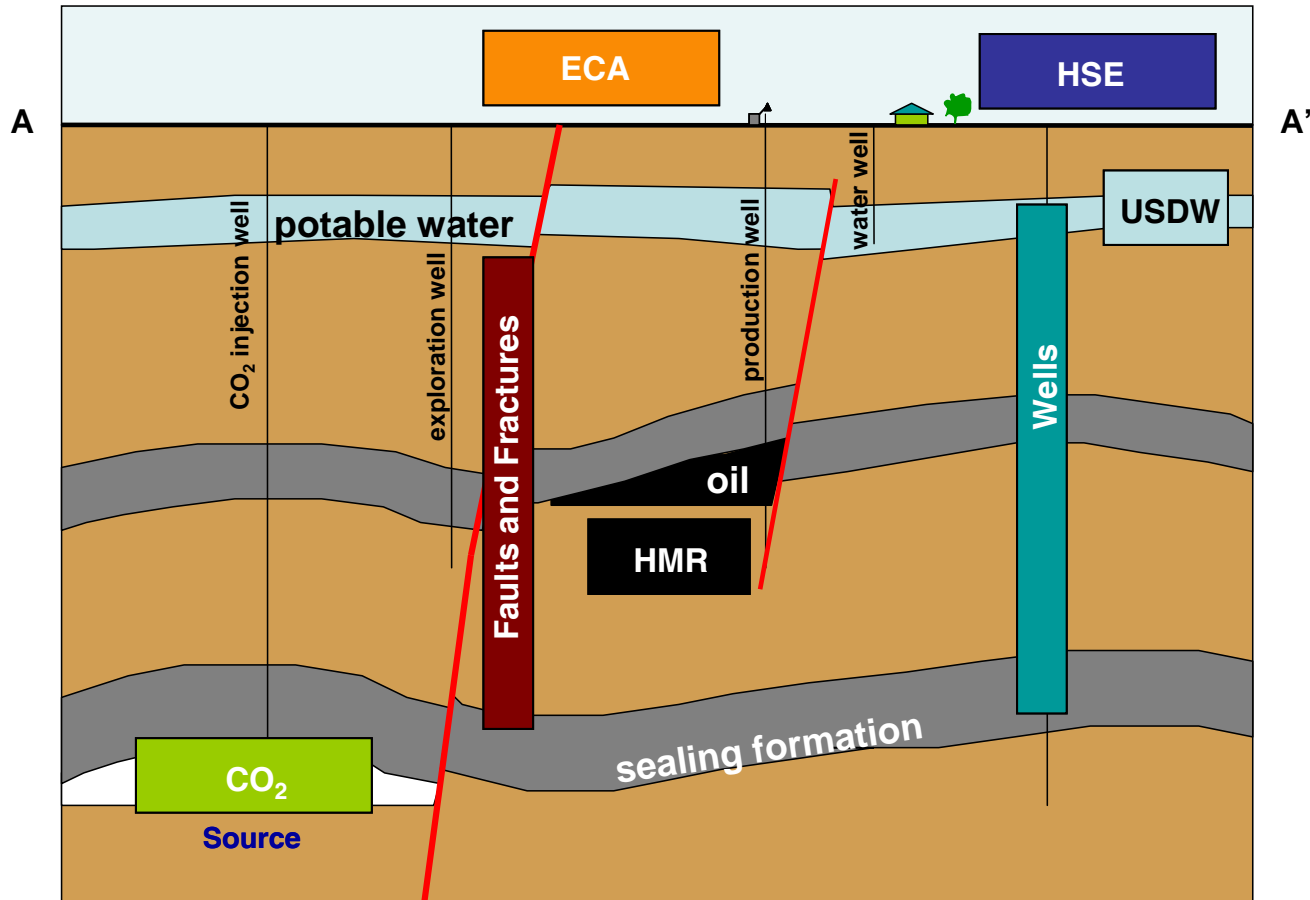
Observation (1): Substantive Carbon Storage will Require Industry Comparable to Oil & Gas



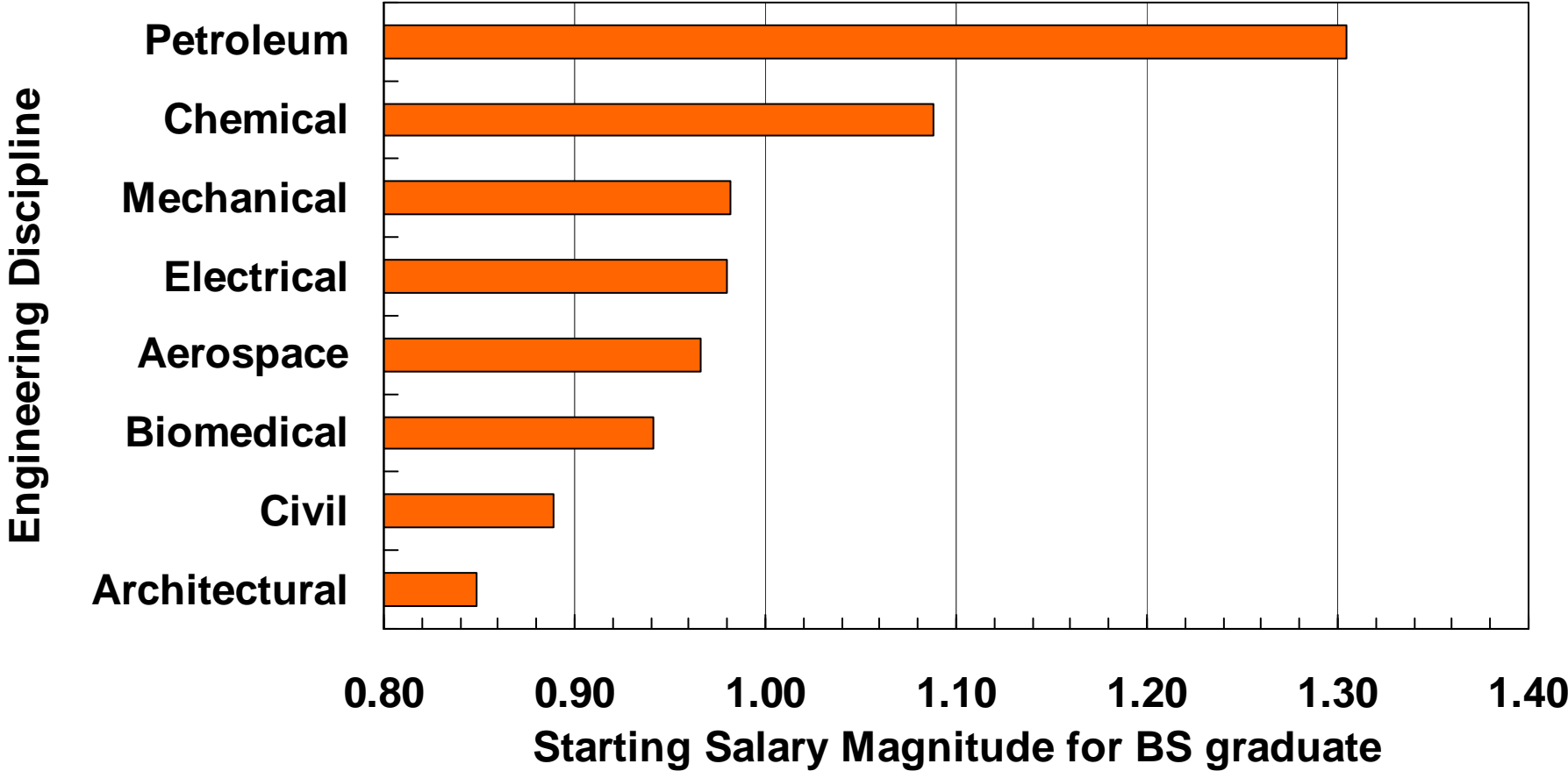
Storing 1 Gt/y carbon is same magnitude as current global oil and gas business

- CO₂ sequestration
 - Injection rate at deep aquifer conditions
 - 17×10^6 m³/d
 - Transportation from sources to sinks
 - 190 BCFD
- Global hydrocarbon
 - Global oil production (2006)
 - 13×10^6 m³/d
 - Global gas production (2006)
 - 270 BCFD

Observation (2): Large-scale Carbon Storage Requires Skill Set Comparable to Oil & Gas E&P



Observation (3): Training Additional Petroleum Engineers Unlikely to Fill Need in Carbon Storage (Even if Training Capacity Existed)



Proposed Solution: Educate “Carbon Management Engineers” (1)

- Requires **new** educational infrastructure
 - Classrooms
 - Faculty
 - Laboratories
- Combine fundamentals of
 - Subsurface engineering
 - Geology
 - Hydrogeology

Proposed Solution: Educate “Carbon Management Engineers” (2)

- **Advantages**
 - New brand attracts non-traditional students to become subsurface engineers
 - Prototype **accredited** program exists
 - **Geosystems Engineering and Hydrogeology (GEH)**
 - **Joint between Petroleum Engineering and Geological Sciences at UT-Austin**
 - **Minor redesign for GEH to become CME**

Model Program: Geosystems Engineering and Hydrogeology (GEH) at UT-Austin

- **Interdisciplinary degree program**
 - **Dept. Petroleum and Geosystems Engineering**
 - **Cockrell School of Engineering**
 - **Dept. Geological Sciences**
 - **Jackson School of Geosciences**
- **Accredited in geological engineering category**
- **Program philosophy: combine fundamentals of**
 - **Petroleum engineering (transport phenomena, petrophysics, multi-phase flow, petroleum chemistry / thermodynamics)**
 - **Paleohistory (geologic time & stratigraphy)**
 - **Earth structure**
 - **Environmental perspective of hydrogeology**

Desired Outcomes for Carbon Management Engineering Graduates

- Solid understanding of **geologic principles**
 - Heterogeneity, data-poor analysis endemic to subsurface projects
 - Perspective of natural fluid movements, effectiveness of seals over geologic timespans
- Chemistry, **thermodynamics** of brine-CO₂-hydrocarbon-rock
- Reservoir engineering principles
 - **Multiphase flow** in porous media
 - Design injection programs
 - Test long term phase stability and movement
- Production engineering, drilling expertise
 - Implement reservoir models
 - **Well construction** and optimization
- Well-logging, tracers and remote **geophysical** methods
 - Monitoring of long-term storage
- Supplementary skills
 - CO₂ capture, compression and transportation
 - Public policy (**elective in core**)
 - Climate change science and politics
 - Economics

Key Findings

- **Scarcity of skilled subsurface engineers is largest hurdle for large-scale carbon storage**
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- **Geologic CO₂ Storage Joint Industry Project**
 - BP
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 - ExxonMobil
 - Halliburton/Landmark Graphics
 - Luminant
 - Shell

