AN INTEGRATED IGCC-CSS DESIGN COURSE FOR GRADUATE STUDENTS IN PETROLEUM ENGINEERING

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TEXAS A&M
THE HAROLD VANCE DEPARTMENT OF
PETROLEUM ENGINEERING

Virtual Conference on Climate Change and CO2 Storage, 3rd December 2008

Summary

- Introduction to the course
- The design project
  - FutureGen field case
  - Workflow
- Lessons learnt & conclusions

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Introduction to the course

- A new graduate course on CO_2 Capture and Uses was offered for the first time at Texas A&M, Pet. Eng., in Fall 2008.
- A multidisciplinary team of instructors from the Pet. Eng. & Chem. Eng. departments was assembled to ensure the appropriate expertise.
- The objective of the course is to let the students understand the need for / potential of Carbon Capture and Storage (CCS) & Enhanced Oil Recovery (EOR).

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Course contents & multidisciplinary team

Topic	Instructor (Prof.)
Course Overview and Purpose	Robert Lane, Maria Barrufet
Geological Screening and Site Characterization	Walter Ayers
Separation Aspect and Cost-Efficiency Analysis	Carl Laird
Boosting, Transportation, and Injection	Gioia Falcone
Injectivity and Well Design	Hisham Nasr-El-Din
Use of CO2 for EOR	David Schechter
Modeling Tools and Techniques, Leakage Pathways	Behnam Jafarpour
Economic and Regulatory Aspects	Christine Economides

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The design project

The course includes a term project - the students design a CCS system based on data available from the FutureGen project (www.futuregenalliance.org/).

The following steps are included in the design project:

1. Site characterisation
2. CO_2 capture & separation
3. CO_2 boosting, transport and injection
4. Mass balance & numerical flow simulation
5. Risk, monitoring, regulations & economic evaluation

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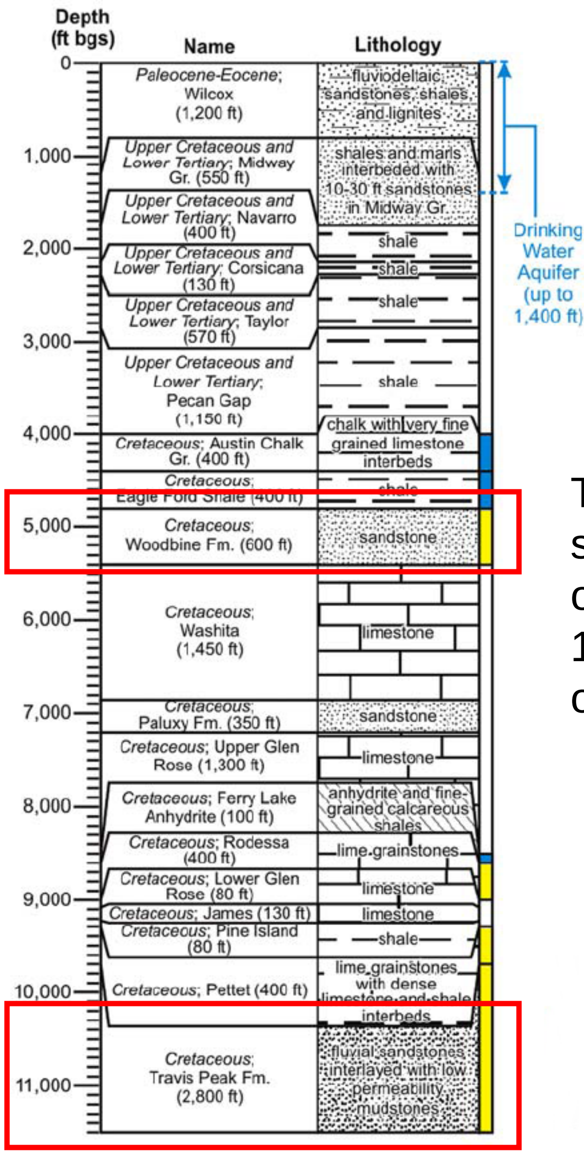
Site characterisation - Brazos, Texas



Parameter	Brazos Woodbine	Brazos Travis Peak
Depth to top of injection horizon (ft)	4800	9200
No. of wells	2	1
Flow split/well	45%	10%
Flow rate/well (lb/hr)	283,130	62,917
Max. injection pressure (psi)	3197	6114
Required injection pressure (psi)	2496	6114

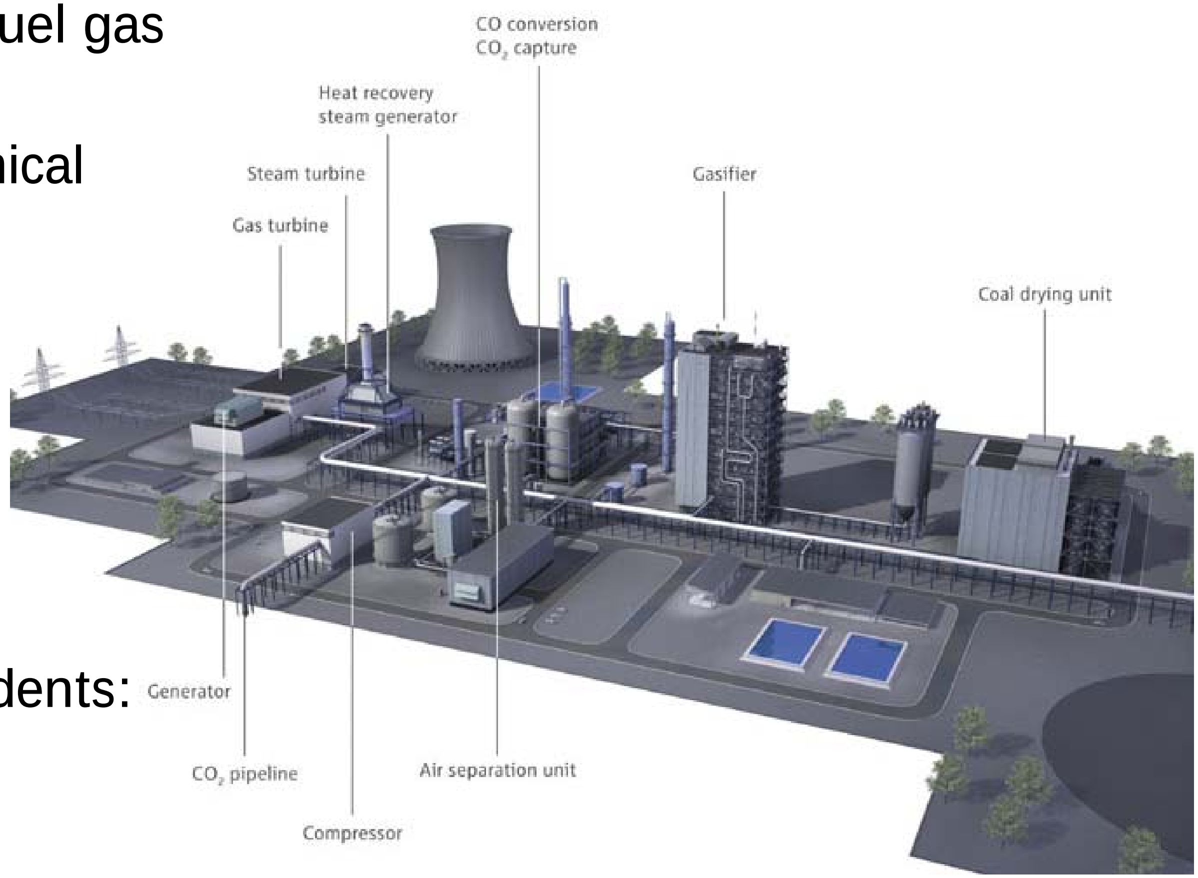
The Woodbine formation is a 500-foot thick clean sandstone. For Lower Woodbine sandstones, porosity of 25%, with permeability of several hundreds md to 1,200 md. For Upper Woodbine sandstones, porosity of 25-30%, with permeability > 3,000 md.

The Travis Peak formation, the optional secondary target sequestration formation, consists of 0.5 mile of stacked fluvial sandstones interbedded with low-permeability mudstones, comprising 800 to 900 feet of net sandstone, with porosity of 5-8%.

(FutureGen Project EIS, November 2007)

CO2 capture and separation

- Post-combustion fuel gas separation
- Physical and chemical absorption
- Capture efficiency



- Tools used by students: **ASPEN**, **ProMax**

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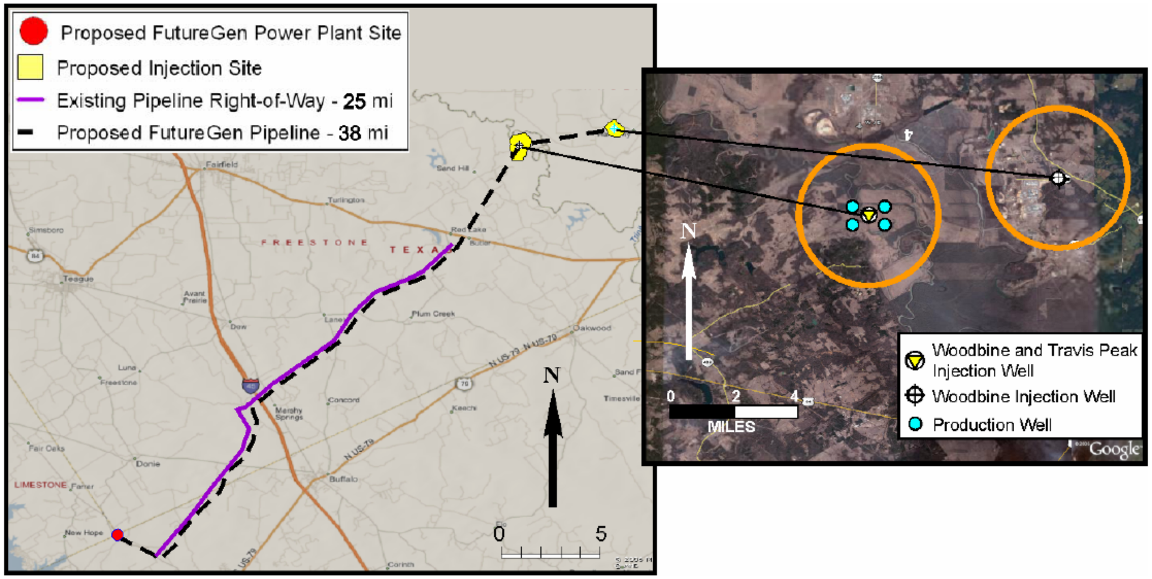
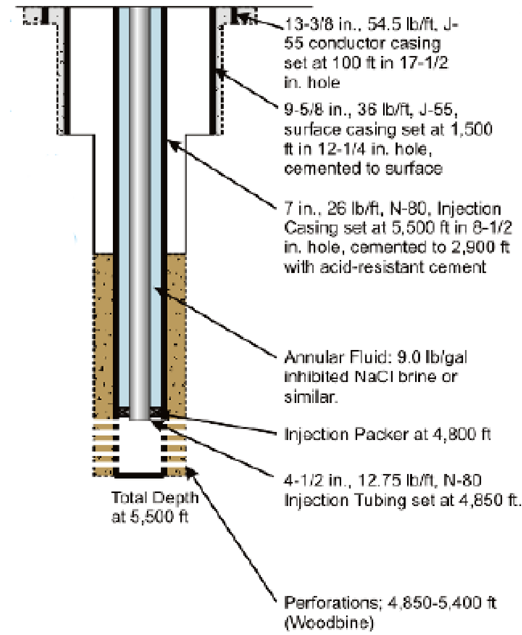
(www.rwe.com 2008)

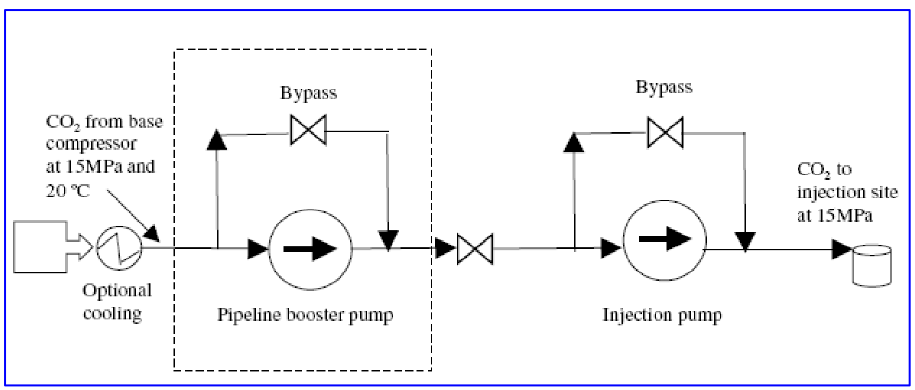
CO_2 boosting, transportation & injection

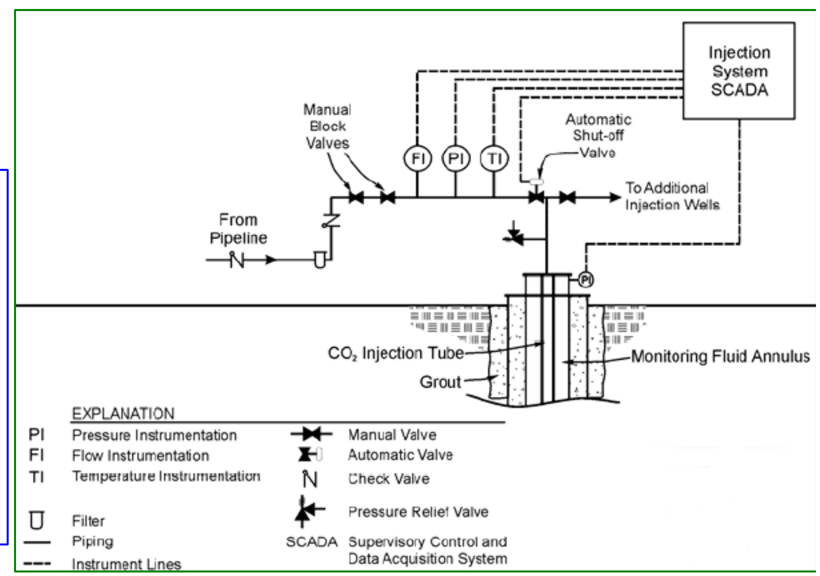




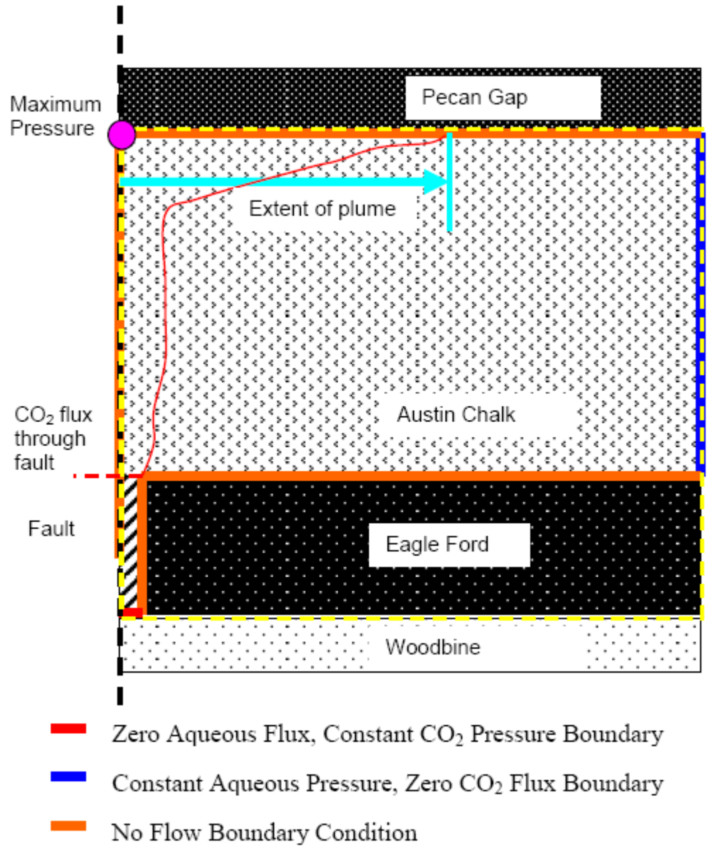
Tools used by students:

Hand calculations, PROSPER / GAP

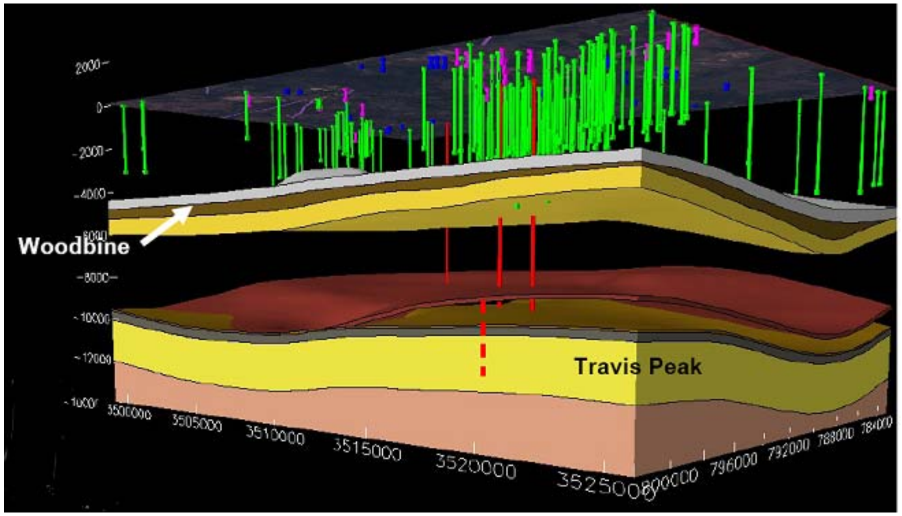


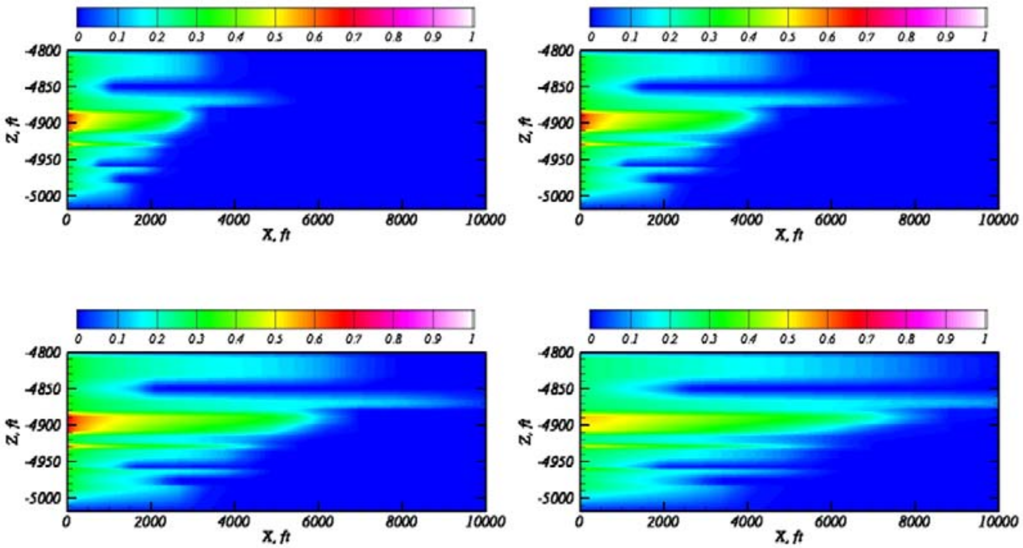


Mass balance & numerical flow simulation



(FutureGen Allience, May 2007)





Gas saturation profiles at 5, 10, 20 and 50 yrs (Woodbine)

Tools used by students:

Eclipse CO2-Store

Conclusions

- With this new course, engineering students are offered a unique opportunity to learn about integrated IGCC-CCS systems.
- Conventional Pet. Eng. & Chem. Eng. skills and techniques fully complement an integrated approach to the contemporary energy scenario.
- A design project based on a real field case is ideal for scholarly purposes – we plan on using more field data as they become available.

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