

Enhanced Oil Recovery Commission

Plan Period: FY2008 (July 1, 2007 through June 30, 2008)

Quality of Life Results:

- Wyoming has a diverse economy that provides a livable income and ensures wage equality (Result #1 Strong Economy).
- Wyoming state government is a responsible steward of State assets and effectively responds to the needs of residents and guests (Result #6 State Government).
- Wyoming natural resources are managed to maximize the economic, environmental and social prosperity of current and future generations (Result #8 Natural Resources).
- Advanced technologies and workforce allow Wyoming business and communities to adapt and thrive (Result #10 Technology and Workforce).

Contribution to Wyoming Quality of Life:

Wyoming's oil fields are, in most cases, declining in production, yet most of the oil in these fields remains underground. While unrecoverable by traditional production methods, significant amounts of oil in these fields can be recovered through enhanced oil recovery (EOR) techniques. According to conservative estimates by the Wyoming Geological Survey, approximately 8 billion barrels of oil remain in Wyoming fields and between 5% to 15% of this oil can be recovered with EOR technologies. Therefore, a broad application of EOR could increase the state's ultimate oil production by anywhere from 400 million to 1.2 billion barrels. Given the current high price of each barrel of oil, the revenues from royalties and property and production taxes to Wyoming government, and ultimately the government's ability to support state programs, will be tremendously increased.

Commission Facts:

Directors Name and Official Title:
Peter Wold (Chairman)

Agency Contact Person:
Glen Murrell

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Statutory References:

W.S. 30-8-101

The Enhanced Oil Recovery Commission (EORC) was created in 2004 to provide overall direction and oversight of EOR programs conducted by the Enhanced Oil Recovery Institute (EORI) at the University of Wyoming. The legislature appropriated \$2.4 million to fund programs in two overarching areas: Research and Technology Transfer.

The EOR commission requested \$6,110,825 for FY 2007-08 to continue the efforts and a further \$6,110,825 for the FY2009-2010 Biennium Budget. Moreover, the biennium budget includes three categories of activities:

1. Information Assembly and Acquisition: This category includes gathering and organizing existing information and the creation of new knowledge in the field of EOR.
2. Technical Development: This category includes the development of new or expanded capabilities for EORI scientists, engineers and economists.
3. Corporate Outreach and Strategic Alliances: This category includes all techniques and activities that provide a mechanism to transfer knowledge and capabilities to Wyoming oil producers.

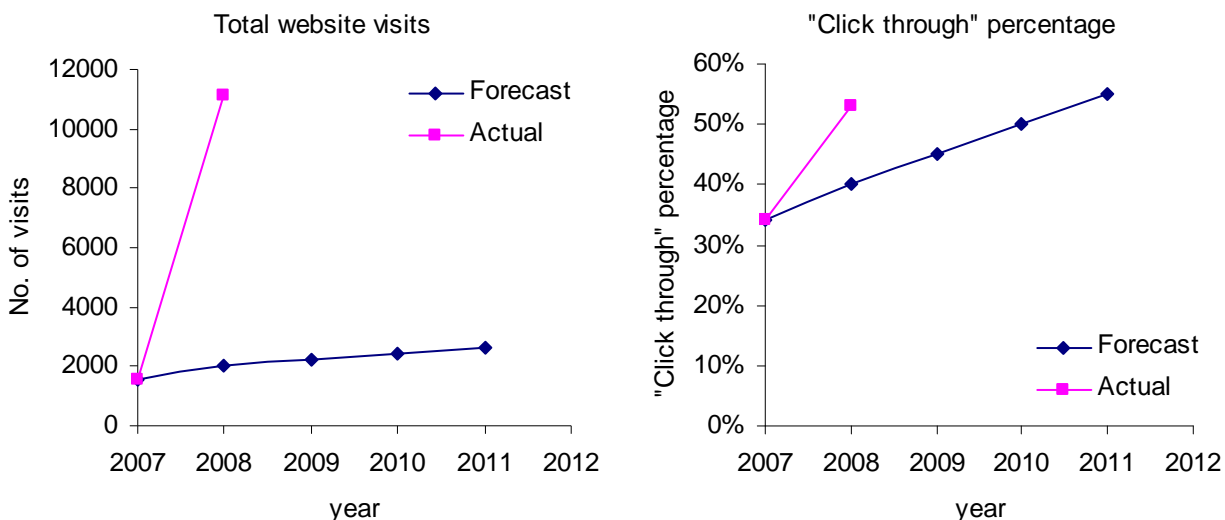
These activities ultimately benefit the entire state population via increased state revenue and the implicit fiscal benefits.

The EOR Commission consists of eight commissioners appointed by the Governor and meet quarterly. The Commission reports to the Office of the Governor and the Joint Minerals, Business and Economic Development Committee. As of June 30, 2008 the Commission included the following members:

Governor Dave Freudenthal, ex-officio
Senator Charles Townsend, ex-officio
Ron Surdam, State geologist, ex-officio
Lynne Boomgaarden, director, Office of State Lands and Investments
Gail Chenoweth, Marathon Oil Company
Bern Hinckley, geologist, Hinckley Consulting
Jim Neiman, UW trustee
Peter Wold, president, Wold Oil Properties (Chairman)

Performance Measure 1: Information Assembly and Acquisition

The acquisition and assembly of information forms an integral component of the Commission's strategy to be a resource of knowledge, information and data regarding Enhanced Oil Recovery techniques in Wyoming.



All data current to 06/30/2008

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Story behind the performance:

Several of the information assembly projects have been completed and the results made public. Oftentimes completion of the project has highlighted further areas for development and investigation in these areas continues. Public notification and dissemination of the results at EORI technical outreach meetings and through the EORI newsletter or external scientific journals has raised awareness of the work of the EORI.

What has been accomplished?

A digital database of Wyoming reservoir characteristics, compiling data from several different sources has been built and validation continues. The database has been used internally for several months and the Institute is able to run queries for companies when requested. Reservoir screening of the database continues, results have been published and development of a GIS is underway to enable spatial analysis of the data. It is foreseen that the database and the GIS will be connected to several of the screening and scoping tools also under development and will be publically accessible via the internet.

A “Wyoming CO₂ Scoping Model” has been completed and the results were presented at our annual CO₂ conference in May. The results have also been made available through our website.

A physical repository of Wyoming reservoir rock and fluid types is being compiled and characterized.

A fracture characterization study has been completed and is available online.

New information assembly initiatives required additional scientific and engineering staff at the Institute. The following professionals have been hired or contracted during the 2007-2008 fiscal year:

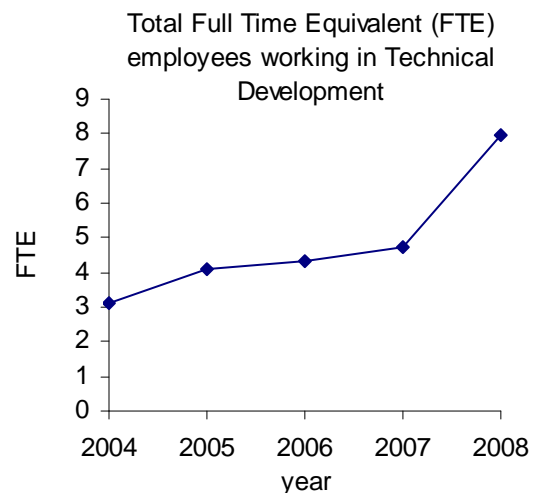
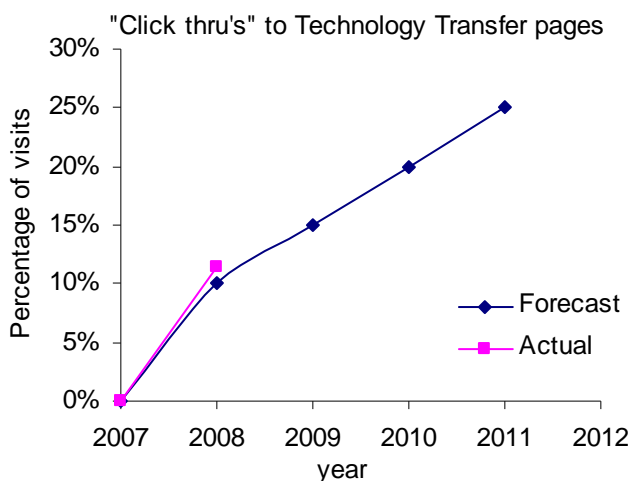
John Lorenz, Ph.D. – Geology

Jill Buckley, Ph.D. - Chemical Engineering

Kyle Murray, Ph.D. - GIS

Performance Measure 2: Technical Development

In order to increase the application of enhanced oil recovery in Wyoming, the Commission supports researchers’ efforts to contribute to the state of the art of EOR techniques in the state of Wyoming.



Story behind the performance:

Progress continues with all of the technical development projects. Examples include the Institute's CO₂ separation studies. This work is ongoing and has reached the 'pilot-study' stage of development.

Work continues in developing theoretical approaches for predicting the thermodynamic properties of reservoir fluids and a model for predicting Minimum Miscibility Pressure (MMP).

Work continues on the characterization of Wyoming reservoirs to assist with the identification of statistical 'performance groups'.

A study has been initiated to determine the mechanism responsible for low-salinity water flooding incremental recovery. This project is in the calibration phase.

Additional laboratory scale investigations have been completed, are currently underway, or are proposed in the areas of chemical flooding, and reservoir stimulation.

What has been accomplished?

Up to this point a considerable amount of technical development has occurred at the laboratory scale. Moving forward, more effort will be spent in implementing small scale pilot studies assessing the real world operational capabilities of the techniques under investigation.

Included below is a selection of key presentations and publications by EORI researchers in FY 2008:

- S. Wo, P. Yin, B. Blakeney-DeJarnett and C. Mullen: "Simulation Evaluation of Gravity Stable CO₂ Flooding in the Muddy Reservoir at Grieve Field, Wyoming", SPE 113482, presented at the 2008 SPE Improved Oil Recovery Symposium held in Tulsa, Oklahoma, April 19-23, 2008.
- Peigui Yin and Shaochang Wo: "Fracture Cementation and Its Effects on Permeability Directionality in Tensleep Sandstones, Wyoming", presented at the 2008 AAPG annual meeting held in San Antonio, Texas, April 20-23, 2008
- Yang, F.; Zhao, G-B.; Adidharma, H.; Towler, B.F. and Radosz, M. "Effect of Oxygen on Minimum Miscibility Pressure in Carbon Dioxide Flooding". *Ind. Eng. Chem. Res.*, 2007, 46, 1396-1401
- Phillips, Owen R. and van 't Veld, Klaas, T., "CO₂ Sales in the Wind River and Big Horn Basins: A Demand Study for CO₂ Production near Shute Creek, Wyoming," draft August 10, 2008
- Phillips, Owen R. 2008, March 26, "The Law and Economics of CO₂ as a Pollutant and Commodity," invited presentation at Vanderbilt University Law School, Nashville, TN.

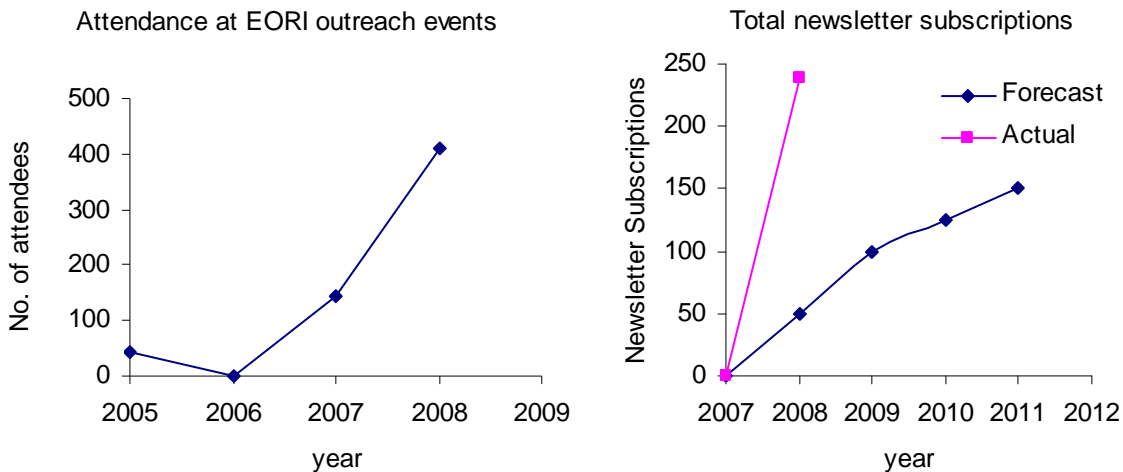
- Zhang, Y.S., Xie, X. and Morrow, N.R., “Waterflood performance by injection of brine with different salinity on reservoir cores,” paper SPE 109849 presented at the SPE Annual Technical Conference and Exhibition, Nov. 11-14, 2007, Anaheim, California, USA.
- Loahardjo, N., Xie, X. and Morrow, N.R., “Low salinity waterflooding for a reservoir core,” Paper SCA82 presented at the 2007 International Symposium of the Society of Core Analysts, Calgary, Alberta, Canada, September 2007.
- Pu, H., Xie, X. and Morrow, N.R., “Application of coalbed methane water to oil recovery from Tensleep sandstone by low-salinity waterflooding,” paper SPE 113410 presented at the 2008 SPE Improved Oil Recovery Symposium, April 21 – 23, 2008, Tulsa, Oklahoma.
- Tomasso, M., 2008, “A Collaborative Study of CO2 EOR Potential in the Fiddler Creek Field, Muddy (“Newcastle Sand”) Reservoir, Wyoming. Part 1: Geological Characterization and Assessment”. Technical report prepared for Carl D. Underwood Oil and Gas Co. Enhanced Oil Recovery Institute, The University of Wyoming, 80 pp.
- Wo, S. & Tomasso, M., 2008, “A Collaborative Study of CO2 EOR Potential in the Fiddler Creek Field, Muddy (“Newcastle Sand”) Reservoir, Wyoming. Part 3: Evaluation of CO2 Flooding in the Newcastle/Muddy Reservoir, Fiddler Creek Field, Weston County, Wyoming”. Technical report prepared for Carl D. Underwood Oil and Gas Co. Enhanced Oil Recovery Institute, The University of Wyoming, 23 pp.
- V. Alvarado, G. Thyne, G.R. Murrell. “Screening Strategy for Chemical Enhanced Oil Recovery in Wyoming Basins”. SPE 115940 (submitted)
- Maciej Radosz, Xudong Hu, Kaspars Krutkramelis, and Youqing Shen. “Flue-Gas Carbon Capture on Carbonaceous Sorbents: Toward a Low-Cost Multifunctional Carbon Filter for “Green” Energy Producers”. Ind. Eng. Chem. Res. 2008, 47 (10), 3783-3794.
- Fulin Yang, Gui-Bing Zhao, Hertanto Adidharma, Brian Towler, and Maciej Radosz, “The Effect of Oxygen on Minimum Miscibility Pressure in Carbon Dioxide Flooding”, IEC Research 2007, 46 1396-1401

New technical development initiatives required additional scientific and engineering staff at the Institute. The following professionals have been hired and have commenced work during the 2007-2008 fiscal year:

Mark Tomasso, Ph.D. - Stratigraphy and reservoir characterization
 Mark Leslie, M.S. - Geochemistry
 Brian Reyes, B.Sc. - Geology and GIS

Performance Measure 3: Corporate Outreach and Strategic Alliances

The EOR Commission promotes and facilitates the transfer of new technologies developed at the Institute throughout the oil and gas industry in this state. Furthermore, the EOR Commission facilitates the development of formal agreements between the Institute and the oil and gas industry through which the industry is provided access to the Institute’s geologic and engineering reservoir modeling and reservoir characterization expertise in exchange for providing data access and testing facilities.



Story behind the performance:

Corporate outreach continues in two forms. Several contractual projects and cooperative associations (project work agreements) have been completed and several have been initiated and are planned (see examples below). Technology transfer continues in the form of EORI organized meetings and conferences and the EORI newsletter. These meetings have been very successful and their recognition in the industry has grown as evidenced by the increasing numbers of attendees. Furthermore, website traffic, bounce rate and time on site values continue to improve. Further recognition has come in the form of invitations to be media and/or organizational partners at complementary conferences and meetings elsewhere. The increased website traffic is starting to generate cold calls from operators and other industry professionals.

Current contractual projects include:

Underwood Oil and Gas: Fiddler Creek Field Study

Nadel & Gussman: Hatfield Dome Field Study

St Mary Land and Exploration Company: Mahoney Dome Field Study

El Paso Western Pipelines and a confidential utility company: Economics of CO2 EOR and sequestration, School Creek.

What has been accomplished?

Some key conferences and projects include:

- Fiddler Creek field study with Underwood Oil and Gas
- "Finding the Balance: Energy and Climate" summit, October 8 - 10, 2007
- 1-day EOR workshops, October 25 and 26, 2007: Nuts and Bolts of CO2 Enhanced Oil Recovery - Steve Melzer, Chemical Flooding Enhanced Oil Recovery - Dr. Gary Pope, Single Well Chemical Tracer Testing - Charlie Carlisle
- 2nd Annual Wyoming CO2 Conference" May 29th & 30th, 2008

EORC
(Enhanced Oil Recovery Commission)



EORI
(Enhanced Oil Recovery Institute)