

T O R I S

TOTAL OIL RECOVERY INFORMATION SYSTEM

*An Integrated
Decision
Support
System for
Petroleum
E&P
Policy
Evaluation*



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System Overview

TORIS IS AN INTEGRATED SUITE of databases and analytical computer models focused on the U.S. oil resource. It is designed to facilitate the decision-making process integral to the formulation of governmental policy affecting the upstream petroleum sector. The benefits TORIS brings to this process stem from the ability of the system to provide metrics for a wide range of policy scenarios. Specific applications of the system include:

- Evaluation of alternative tax structures at state and federal levels
- Formulation of optimum royalty structures and related transfer payments
- Evaluation of financial concession terms
- Guidance and prioritization of R&D programs
- Evaluation of technology feasibility
- Cost and benefit analysis of environmental and other regulatory legislation

The system was originally developed by the National Petroleum Council (NPC) in 1984. Experts from industry (majors, independents, service, and consulting firms), universities, government, and private nonprofit organizations participated in the development of TORIS. Since 1984, the

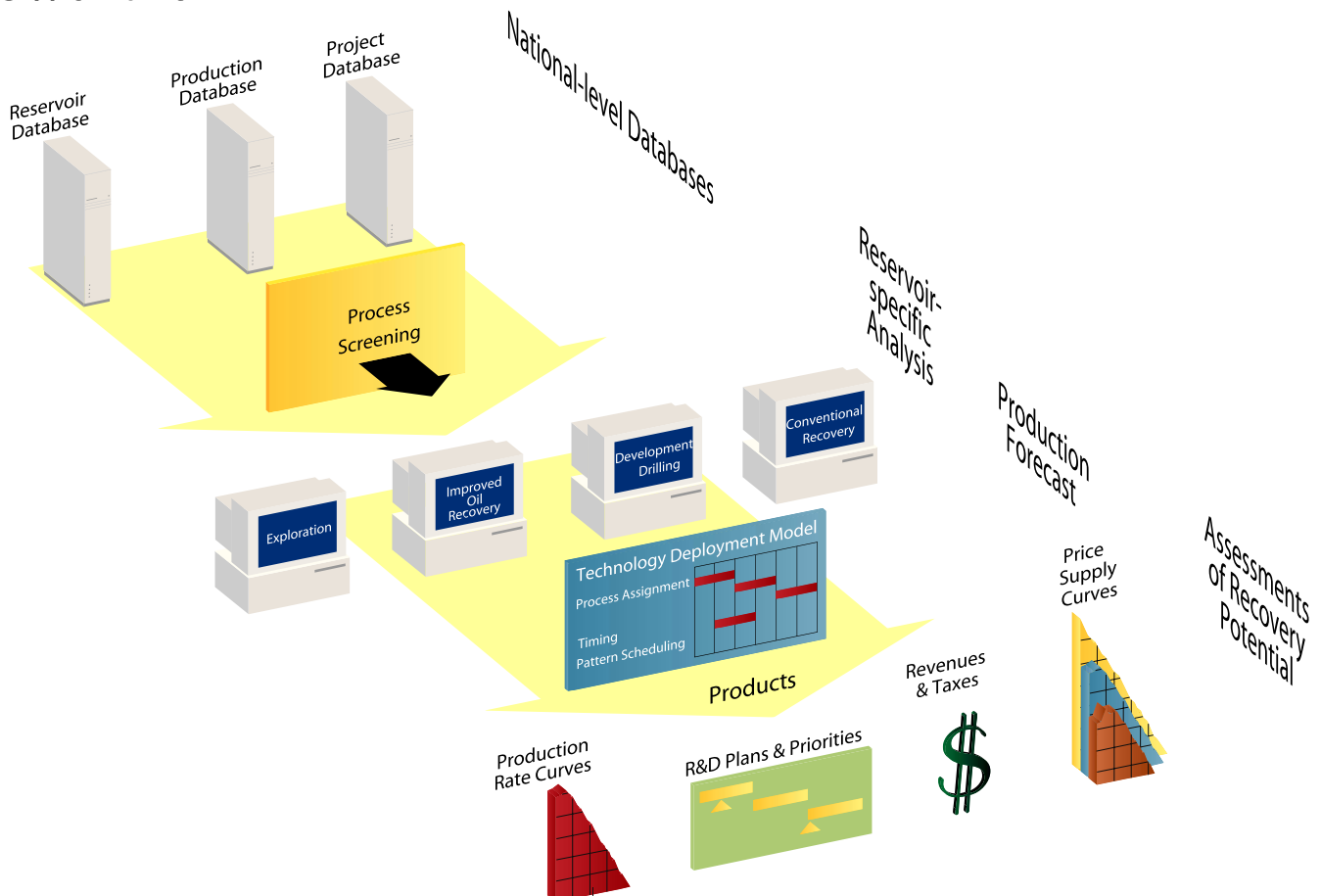
U.S. Department of Energy (DOE), National Petroleum Technology Office (formerly the Bartlesville Project Office) has maintained, updated, and enhanced the capabilities of the system. The system is routinely used to evaluate important policy issues for the DOE and other stakeholders.

TORIS IS CAPABLE OF EVALUATING THE ENTIRE DOMESTIC OIL RESOURCE (conventional, immobile, unrecovered mobile, and undiscovered) by modeling state-of-the-art recovery processes:

- Primary Recovery
- Infill Drilling
- Water Flooding
- Horizontal Drilling
- CO₂-Miscible Flooding
- Polymer Flooding
- Micellar Polymer Flooding
- Injection Profile Modification
- Alkaline Flooding
- Updip Gas Injection
- Steam Flooding
- Insitu Combustion

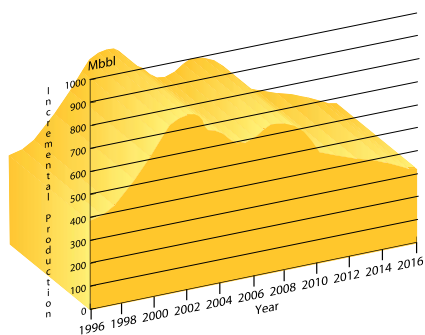
The system evaluates the technical and economic viability of these processes on individual fields and reservoirs and selects the most desirable recovery technology. The results for individual fields/reservoirs are aggregated to state, regional, or national levels as desired and consist primarily of production, injection, revenue, and tax streams.

Flowchart

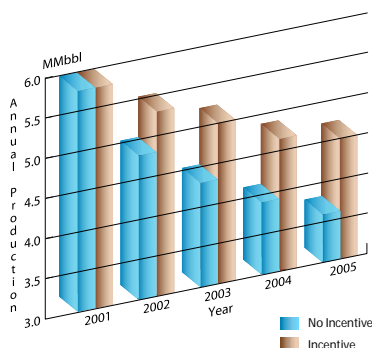


Output

State, Regional, and National Forecasts



Project Forecasts



Example CO2 Flood Project Report				
Year	Oil (MB)	Gas (MMCF)	Water (MB)	CO2 (MMCF)
1	13.1	9.8	122.4	202.3
2	13.1	9.8	122.4	202.3
3	16.2	12.1	115.9	202.3
4	26.6	19.9	93.9	202.3
5	28.3	21.2	87.7	202.3
6	27.2	20.8	83.2	202.3
7	26.9	20.2	79.7	202.3
8	25.3	19.0	78.9	202.3
9	22.1	16.6	78.2	202.3
10	7.9	11.8	72.5	160.3

Measures include employment, contribution to GDP, public sector revenues, state, and federal revenues, investments, O&M costs, transfer payments, reserves and production.

Primary Components

Reservoir Database. THE RESERVOIR DATABASE CONTAINS ROCK AND FLUID PROPERTIES FOR MORE THAN 2,500 CRUDE OIL RESERVOIRS IN THE U.S. It also carries volumetric information, development and performance data, as well as geologic classification data.

Production Database. THE PRODUCTION DATABASE CONTAINS ANNUAL PRODUCTION AND WELL COUNTS FOR ABOUT 1,800 TORIS RESERVOIRS. Information found in this database includes annual oil production beginning in 1970, annual gas and water production beginning in 1980, and annual well count information beginning in 1980. This data is primarily used in conventional decline analysis of ongoing production.

Process Screening Models. THE PROCESS SCREENING MODELS CONSIDER TECHNICAL RESTRICTIONS to the application of various recovery processes prior to analysis of recovery potential. The models use certain elements of the database to determine which recovery processes can reasonably be applied to a specific reservoir.

Predictive Models. EACH RECOVERY PROCESS IS MODELED BY A DETAILED, ENGINEERING-BASED PREDICTIVE MODEL. The models use key elements of the reservoir database to estimate production rates for oil, gas, and water based on fractional-flow theory assuming a five-spot injection pattern geometry. Oil recovery is predicted for a single pattern and then scaled up to the entire field based on the pattern initiation schedules typically used by operators in developing each process in actual reservoirs. This procedure makes TORIS models uniquely capable of evaluating a large number of reservoirs in a very timely and cost-effective manner.

The models have been calibrated against actual field results and simulators. They have been deemed highly credible by the oil industry.

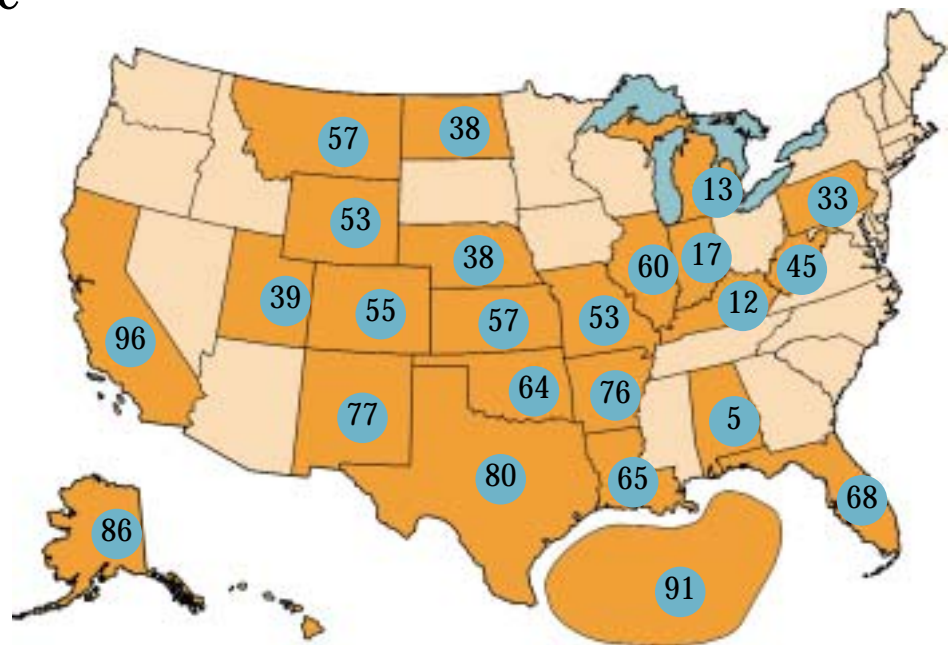
Economic Analysis Models. THE ECONOMIC MODELS CONDUCT DETAILED CASH FLOW EVALUATION for each reservoir based on the output of the predictive models and the cost and investment requirements associated with each process. The parameters estimated by the economic models provide direct measures of the benefits and trade-offs of alternative policy issues.

Technology Deployment Models. THESE MODELS ASSIGN A RECOVERY PROCESS TO EACH RESERVOIR and schedule the expected future production resulting from the application of the process in the reservoir. First the process most likely to be applied in the reservoir is selected from a set of processes judged to be technically and economically feasible at the oil price and conditions being modeled. Next an iterative scheduling algorithm to determine the probable start date of the reservoir. Capital and resource constraints are then used to phase development over time.

Offshore Gulf of Mexico Models. A COMPREHENSIVE SYSTEM FOR MODELING THE OFFSHORE GULF OF MEXICO RESOURCE IS CURRENTLY UNDER DEVELOPMENT. This system will contain data at the well/completion level, lease/platform level, and the sand level. Production history will date from 1947 and will be maintained on a well completion basis. A hyperbolic decline model will be used to predict future technically recoverable oil. Economic and timing routines will be available to evaluate the resource at a well, lease, platform, or field level.

Resource Coverage

● Percent of original oil-in-place



System Applications

FOR OVER A DECADE, TORIS HAS BEEN UTILIZED TO ADDRESS IMPORTANT POLICY ISSUES IN THE AREAS OF R&D, economic incentives, and environment regulations. The following is a list of some of the studies and evaluations conducted by the National Petroleum Technology Office using TORIS:

- Federal royalty relief for offshore Gulf of Mexico marginal properties located in waters depths of 200 meters or less (ongoing study)
- Federal royalty relief for oil recovery from stripper well properties in the state of New Mexico (1998)
- Federal tax credit for horizontal well applications (1996)
- Federal royalty relief for oil production from Federal lands in the states of California and Wyoming (1995)
- Remaining oil resources in 23 states under a project known as the "Advanced Oil Recovery and the States," (1994)
- The FY91 Federal EOR tax credit (1990)
- The impact of Federal royalty relief on oil production by CO₂-miscible flooding in the state of New Mexico (1992)
- Federal policy incentives to increase oil recovery from domestic reserves (1990)
- Potential economically recoverable reserves in Texas, Oklahoma, and New Mexico (1989)
- President Bush's tax incentive proposal for enhanced oil recovery (1988)
- The Federal investment tax credit for EOR in the United States (1988)
- The known remaining oil resource in the states of Texas, Oklahoma, and New Mexico (1986-88)
- The increased depletion allowance on oil production in the United States (1987)

The reports of these evaluations are available from the U.S. Department of Energy, National Petroleum Technology Office.

Recent Users

THE DEPARTMENT OF ENERGY, OFFICE OF FOSSIL ENERGY (DOE/FE), has utilized the TORIS system to address policy issues at the request of various Federal government agencies, local/state agencies, as well as industry associations. A selective list of users includes the following:

- The White House
- U.S. Congress
- U.S. Department of Interior (DOI/BLM)
- Office of Management of Budget (OMB)
- U.S. Department of Treasury
- Interstate Oil and Gas Compact Commission (IOGCC)
- Petroleum Technology Transfer Council (PTTC)
- National Petroleum Council (NPC)
- Energy Information Administration (EIA)
- Environmental Protection Agency (EPA)
- Independent Petroleum Association of America (IPAA)

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