

Symposium Papers  
**SYNTHETIC FUELS  
FROM OIL SHALE  
AND TAR SANDS**

**Louisville, Kentucky**

**May 17-19, 1983**

**Institute of Gas Technology**



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SYMPOSIUM PAPERS

# SYNTHETIC FUELS FROM OIL SHALE AND TAR SANDS

**Presented**  
**May 17-19, 1983**  
**Louisville, Kentucky**



**Symposium Director**  
**Howard H. Elliott**

**Symposium Chairmen**  
**Paul B. Tarman**  
**R. David Matthews**

**Sponsored by**  
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## INTRODUCTION

"Synthetic Fuels From Oil Shale and Tar Sands," May 17-19, 1983, was the third symposium on synthetic fuels from oil shale organized by the Institute of Gas Technology and the first to consider tar sands. The primary purpose of the first symposium, "Synthetic Fuels From Oil Shale," December 1979, was to bring together experts from fields of the developing shale industry both east and west of the Mississippi. The second, "Synthetic Fuels From Oil Shale II," October 1981, presented the different technologies and strategies of Western and Eastern oil shale developers. The emphasis in this third symposium remained on process development and on work with the fundamental properties. In addition to oil shales, this symposium presented achievements in a quite different resource: tar sands. We at IGT believe that this apparent mixing of "apples and oranges" in one program resulted in a valuable interchange of technology between the various developers of these two natural, raw hydrocarbon fuel sources.

The symposium program included a keynote address, 30 formal papers, an informal commentary, and closing remarks.\* Geology, resource appraisal, mining, processing technology, and refining, as well as reviews of late developments in government involvement, received attention in papers divided between the two resources. The first paper sets the stage by pointing out the differences between oil shale and tar sands. In all, ten papers deal with research and development of tar sands; the remaining papers address various new developments in our understanding and processing of oil shale.

A one-day geologically-oriented field trip designed to show non-geologists examples of Eastern shale and tar sands in outcrop was optional. It was the third field trip organized by IGT to emphasize that some form of geological sampling is a necessary first step when using natural materials as feedstocks. The extrapolation of laboratory data can be only as good as the samples are representative. We believe that seeing these natural materials in place points out the importance of proper sampling. Our Field Trip Guidebook, prepared for this trip, has been incorporated in the symposium proceedings.

The various processing technologies using oil shale or tar sands as feedstocks are still competing in a socio-economic and political climate less than favorable, yet oil shale and tar sands are being processed, synthetic fuels are being refined, and products made from shale oil and tar sands are being marketed.



R. David Matthews  
Symposium Co-Chairman

\*IGT has assembled and reprinted each presentation of the symposium without technical alteration. The views expressed in the papers herein are solely those of the authors.

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**FIELD TRIP GUIDEBOOK 625**



## INTRODUCTION OF THE KEYNOTE SPEAKER

Paul B. Tarman  
Vice President  
Process Research  
Institute of Gas Technology

I'd like to welcome all of you to our third symposium on oil shale and tar sands. The success of any symposium depends almost entirely on the quality of its speakers, the content of their presentations, and how they get their message across.

Today we are very fortunate to have as our leadoff and Keynote speaker, Mr. Jimmie K. Bowden, Executive Vice President of the United States Synthetic Fuels Corporation — the action spot of today's Synthetic Fuels Industry and the key, I believe, to whether or not we will have such an industry. Mr. Bowden is with us today to bring us up-to-date on the corporation's latest viewpoints on its programmatic and financial commitments to this industry and the technical and financial criteria used by the SFC in its solicitations and selection process. Most important to all of us, Mr. Bowden will give us an update on the status of the several oil shale and tar sands projects now seeking the assistance of the SFC."

Jim Bowden is no stranger to the energy business. By education, he is a chemical engineer, having received a B.S. from the University of Kansas and an M.S. from Cal Tech. By training, he has been a reservoir engineer at Mene Grande Oil Company in Venezuela, a process design engineer at Phillips Petroleum Company, and a research group leader at Conoco Oil Company. And he learns fast! Five years after he received a Masters in Industrial Management from M.I.T., he became President of the Plastics Division of Conoco; six years later, he was President of Conoco Oil Development Company. We are very honored today to have Jim Bowden speak to us, and we thank him for taking time out of his busy schedule to address us at this symposium.



## KEYNOTE ADDRESS

### SYNTHETIC FUELS CORPORATION'S APPROACH TO OIL SHALE AND TAR SANDS PROJECTS

Jimmie R. Bowden, M.S.  
Executive Vice President  
U.S. Synthetic Fuels Corporation  
2121 K Street, N.W.  
Washington, D.C. 20586

#### ABSTRACT

This paper provides perspective on the present state of synthetic fuel project development and on prospects for industry growth over the next several years. The presentation begins with a brief history of the Energy Security Act and the Synthetic Fuels Corporation, including discussion of the programmatic and financial commitment decisions of the Board of Directors. It then details the Corporation's solicitation process and criteria requirements and examines the status of oil shale and tar sands projects currently seeking assistance from the Corporation. The paper concludes with a few general thoughts on the possible future development of a commercial synthetic fuels industry.

Note: Information in this paper is current as of May 1, 1983.

## SYNTHETIC FUELS CORPORATION'S APPROACH TO OIL SHALE AND TAR SANDS PROJECTS

It is a pleasure to be here this morning. I understand that as "Keynote" speaker my job is to "fire up the faithful," but I'm not sure I'm the right man for that. Many of you have certainly paid higher dues than I in this synfuels development effort.

What I would like to do in this opening session is provide some perspective on the present state of project development and on prospects for the industry over the next several years. And in this connection, I can't help but note that this conference is taking place precisely one year after Exxon closed its Colony project, amid widespread prophesies of imminent "death" for the entire oil shale industry. So much for the seers! The size and interest of this group today is the real commentary on the future of synthetic fuels.

A few weeks ago Fred Hartley brought Union's shale oil car to Washington to Capitol Hill for a demonstration. Some of us noticed something different about that car: it had only one gear -- forward -- which is definitely what you need in this business today.

Admittedly, current economic and energy conditions are not as conducive to synfuel investment as those of a few years ago. Yet we are finding some positive aspects. For example, the overall number of potential sponsors may be fewer today, but the quality of those still involved in synfuels development is much improved. A good many interesting projects, in coal as well as in shale and tar sands, are now in various stages of design development, and some of these will surely come into operation during the eighties. I might add parenthetically that it is also increasingly evident that shale and tar sands projects will be coming into commercial production considerably before coal-based projects for a number of reasons.

\* \* \* \*

The subject I've been asked to address this morning is "The Synthetic Fuels Corporation's Approach to Oil Shale and Tar Sands Projects," and I'd like to begin with a brief history of the Energy Security Act and the Corporation, and then discuss in some detail our efforts and requirements with respect to oil shale and tar sands\* projects.

The Energy Security Act was passed by Congress in June 1980 after about 18 months of intense and frequently

---

\*In the context of this paper the term "tar sands" includes heavy oil, as defined in the Energy Security Act.

acrimonious debate in both Houses. It was a period of energy "crisis," with rising prices and limited supplies. The Energy Security Act set national synthetic fuels production goals, and further stipulated that the Corporation meet these goals in a manner that fostered "diverse types" of production facilities, with maximum "replication" and cost efficiency for each project ("lowest unit cost"/"minimum assistance" necessary) and that the Corporation do all of this in a manner that would be "environmentally acceptable" and "encourag[e] private capital investment and activities" in synthetic fuels.

This was quite an assignment, even under ideal circumstances, which of course never materialized. Instead, there were political disputes over appointment of the Corporation's initial Board of Directors, a presidential election and subsequent change in Administration, and finally the appointment and Senate confirmation of the Corporation's first formally constituted Board of Directors. This took well over a year, and it was not until September, 1981 that the Corporation had a fully functional Board and could proceed.

Immediately, the new Board began to address the various issues and apparent conflicts inherent in the many competing requirements of the Energy Security Act. By February 1982 the Board began defining a program that would emphasize diversity in its initial project selections, as the best means for achieving maximum long-term production. The Board further determined that coal, oil shale, and tar sands were the major resources for development, and in June 1982, made a preliminary determination to spend up to \$6 billion, \$3 billion and \$1 billion, respectively, to achieve a diversity of technologies for coal, oil shale, and tar sands.

In doing this, the Board made clear that these numbers were only preliminary estimates, and it reserved the right to adjust the specific dollar amounts according to future experience and programmatic decisions. The purpose of this early designation was to establish the Board's preference for coal, oil shale, and tar sands and to give an indication of its thinking as to the relative costs of developing a diversity of technologies for each resource. The given dollar figures were never considered binding.

Throughout 1982 the Board continued to refine its programmatic objectives, and by the end of the year it was in a position to specify and budget a comprehensive program through fiscal year 1984. As I run through this program, you will see that the early dollar figures have, in fact, been adjusted upwards somewhat by the Board as it estimated the amounts required to meet both the diversity and production objectives of the Act.

Through fiscal year 1984 (September 30, 1984) the Board plans to authorize up to \$7.0 billion in assistance for coal projects, including 3 major projects; up to \$4.8

billion for shale projects, including 3 major projects; and up to \$1.4 billion for six or seven tar sands projects of various sizes. The remaining funds (up to \$2.0 billion-plus) may be authorized at the discretion of the Board.

\* \* \* \*

The Corporation has used a competitive solicitation process for proposals. Three general solicitations were issued -- in November 1980, December 1981, and August 1982 -- and two targeted solicitations have been issued: for western oil shale projects and for Gulf Province lignite gasification projects. Additional solicitations for coal projects are expected this year.

The general solicitations allowed the Corporation to take the broadest measure of available projects and sponsors, but they had the disadvantage of attracting many clearly immature projects. In addition, the limited definition of these solicitations discouraged some serious sponsors from participating. To answer these problems, as well as to meet the Board's programmatic goals, the staff began developing targeted solicitations.

A review of projects in-house or anticipated under the general solicitations indicated the availability of an ample number and diversity of tar sands projects, but the Board felt it desirable to seek additional shale and coal-based projects. Western shale was chosen for the initial targeted solicitation because, as a homogeneous resource, it posed fewer problems in designing solicitation parameters. The shale solicitation was issued January 20, 1983, for 10,000 barrels per day of shale oil from the Green River Formation. Six projects\* responded by the March 15, 1983, deadline.

The first targeted coal solicitation, for 10,000 barrels per day of oil equivalent from Gulf Province lignite, was issued on April 25, 1983. Under terms of the solicitation, initial bids are due by July 25, 1983, and qualified bidders will be selected by August 25. Other coal areas under consideration for possible targeted solicitations include: eastern region bituminous coal; midwestern bituminous coal; and western subbituminous coal.

\* \* \* \*

Before going on to greater specifics about shale and tar sands projects, let me quickly discuss the Corporation's criteria for project selection. I'd also like to point out that, while emphasis may have shifted somewhat as we moved from the general to the targeted solicitations, the basic criteria of technical competence,

\*The six were: Cathedral Bluffs; Union Oil, Phase II; Syntana; White River; Edwards Engineering; and Montex.



management capability, and equity commitment have not in any way altered or lessened.

Under the general solicitations, emphasis was heavy on project engineering and design development, and projects were evaluated in distinct phases: for maturity and for strength. Initially, a project had to complete this lengthy review process before it could begin even preliminary negotiation discussions. Realizing this was a slow and cumbersome process, with little advantage for either project sponsors or the Corporation, the Board decided to speed up the review/negotiation process. Adjustments were made in the second solicitation, and in the third solicitation sponsors were permitted to begin the negotiating process as soon as the project was judged mature (a matter of only a few weeks for projects with good design development) and had substantial equity in place.

The targeted solicitations are drawn solely as competitive low-bid solicitations. Once a sponsor is designated as a "qualified bidder" he submits a Technical Proposal and a Competitive Bid. All sponsors with acceptable technical proposals then compete under standard terms and conditions for most non-project specific parameters on a "low-bid" basis for an assistance award. The lowest bidder, and perhaps other low bidders, will be selected for negotiations leading to awards in the form and amount of assistance bid. Emphasis in these targeted solicitations is on equity commitment, with increasing amounts of equity required at each bid stage. For example, at the time the Technical Proposal is submitted, the greater of 60 percent of the maximum equity required or \$300 million must be committed to the project. At the same time sponsors are given greater latitude in their development schedules.

This shift in criteria emphasis reflects both the needs of project sponsors for flexibility and a recognition by the Corporation that equity formation and management capability generally are the major obstacles to project progress. Targeted solicitations have much greater specificity in terms of project resource, scale, output, and production schedule. In addition, sponsors have assurance that at least one financial award will be made according to the amounts and forms of assistance outlined and bid in the solicitation. We believe all of this should substantially aid sponsors in lining up their equity and should allow projects to develop in a timely manner.

Now, to spend a few minutes on the current status of oil shale and tar sands projects. By way of introduction, I should probably again draw the distinction between coal and oil shale projects on the one hand, and tar sands/heavy oil projects on the other. Coal and oil shale

are the principal resources for extensive, long-term production of synthetic fuels. Developing these resources will require large amounts of capital, invested in technically complex projects, with long lead times to design, construct and bring into full operation. But ultimately, coal and shale will provide the basis for improved national energy security.

In contrast, the Board is supporting tar sands/heavy oil projects as a means of attaining substantial short term production at fairly modest cost. These projects can be brought on line with relative ease and speed, and could provide the nation with fairly rapid surge capacity in an emergency. At such a time, tar sands/heavy oil projects could be brought into production rapidly to dovetail with the Strategic Petroleum Reserve. Together, these would go far toward meeting immediate national needs in any near-term crisis or supply shortfall situation.

In discussing shale, one must naturally begin with the Union Oil Shale Project, the first commercial shale project in the United States. Construction of the first module, to produce 10,000 barrels per day of oil from shale, is now about 90 percent complete, with project start-up scheduled for this summer. Total cost for the Phase I module is estimated at \$630 million, and Union has started planning for Phase II, which can ultimately reach a production level of up to 90,000 barrels per day, in 20,000 barrel increments.

The Union project, Phase I, has a price guarantee from the Department of Energy, with a maximum federal liability of \$400 million. Union is seeking price guarantees from the Corporation for its Phase II development.

Eight shale projects are undergoing strength reviews in our third solicitation; and most of these have also begun the preliminary fact-finding discussions that precede actual financial negotiations. These projects are: Cathedral Bluffs and Union Oil, Phase II, in Colorado; Cottonwood Wash, Paraho, Seep Ridge, and White River, in Utah; and American Syn-Crude and Means Oil Shale, in Kentucky. The two eastern projects have been placed in a special, delayed evaluation schedule in recognition of their state of maturity. This does not guarantee either project an award; it merely acknowledges eastern shale as a distinct resource base and the fact that it is not likely that the Corporation will issue a targeted solicitation for this resource.

Three projects in the third solicitation, Cathedral Bluffs, Union Oil, Phase II, and White River, have also qualified as bidders in the targeted shale solicitation. One additional project, Syntana, has also been designated as a qualified bidder. Technical Proposals and Competitive Bids are due on June 1, 1983, with awards expected by the end of the year.

Several tar sands/heavy oil projects are in advanced negotiations under the second solicitation. The Santa Rosa tar sands project, in New Mexico, has received a Letter of Intent from Chairman Noble, setting a maximum Corporation obligation of \$41 million to the project. This obligation is about equally divided between loan and price guarantees, and would terminate at the earlier of eight years or six million barrels of aggregate production.

The Chairman has also announced his intention to sign letters of intent with the Calsyn and Hop Kern heavy oil projects, both in California. Calsyn is seeking a loan guarantee of up to \$50.5 million, while Hop Kern is asking for both loan and price guarantees, to a total maximum obligation of \$76.7 million.

Six additional tar sands/heavy oil projects are also before the Corporation. Kensyntar, here in Kentucky, is continuing negotiations in the second solicitation, and five projects are undergoing strength review in the third solicitation. These are: Kentucky Tar Sands; Sunnyside, in Utah; and Chaparrosa, Enpex Syntaro, and Forest Hill, in Texas.

The Corporation hopes to fund a majority of shale and tar sands projects in 1983, and then concentrate on coal projects in 1984. Whether we meet these goals depends largely on the commitment and sense of urgency toward synfuels evidenced by the business community.

\* \* \* \*

The state of the art of synthetic fuels projects is "developing" and the industry's prospects are reasonable. With any new industry, technology, economics and environmental considerations all pose large uncertainties. We are sure that eventually synthetic liquids and gas will make a significant contribution to the country's energy mix. But we do not know precisely when, or at what price. And this appears to be the key.

The Corporation exists to provide limited financial assistance for an initial group of synthetic fuels plants -- financial assistance that would not be forthcoming from private investors. Once these first plants are built, they will provide a forum for problem solving and design improvements. Uncertainties should be resolved and costs should drop. Commercial synthetic fuels will begin to acquire a track record. And at this point, the real benefits of synthetic fuels begin, because they will establish a ceiling for energy prices. Either suppliers of conventional oil and gas will produce below that ceiling or the synfuels industry will expand. I believe it is very possible that both of these things could happen.