TOPICAL CONSENSUS

The conference had two objectives which were: (1) identifying the AFUP adjustments and (2) identifying associated new areas of synfuels R&D. The material which follows represents a sincere effort to objectively and accurately reflect:

- Consensus opinions, or
- Minority or individual viewpoints which might warrant future discussion.

This section has been organized into what might be called a series of "fact lists," the argumentative nature of many of the so-called "facts" notwithstanding. There is considerable overlap and interaction between these topical groupings and a key point may well be repeated, albeit in slightly altered context or phrasing.

Since there is a close relationship between supply and using technologies, much of the discussion addresses points of interest to, but outside, the responsibilities of the AFUP.

Alternative Fuels Utilization Program

The AFUP is well-defined in terms of objectives and strategies; what must now follow is the identification of specific project work on finished fuels from synthetic crudes described in terms of levels-of-effort, scope, and time frame.

The overall policy of alternative fuels development should be based on a cradle-to-the-grave optimization concept. Indeed, the AFUP plan reflects this philosophy and the DOE is in a unique position at this time to make significant progress by providing incentives for specific cooperative R&D project work aimed at the fuel/engine interface.

Although much has been accomplished, there are any number of specific criticisms of the lack of impetus in alternative fuels program development which can be laid directly at DOE's doorstep. It should be countered that this Department is in its formative years as compared with the more mature Departments of Defense, Transportation, Agriculture, etc., all of which doubtless had similar, perhaps identical, problems and growing pains in their first few years of existence under a new administration.

Nontechnical Factors

The alternate fuels and future powerplant technical community has, for some years, been talking to itself; it is now time to speak openly and with candor to the public and to the Congress. To this end, a viable organization should be created whose mission is to bring the synfuels problem to the attention of the proper congressional authorities and the public in no uncertain terms. The mechanism of creation of such a group and of its constituency remains argumentative. Whether the existing organizational framework of professional societies, nonprofit organizations, or cooperative councils should be utilized and whether the attractive value of columnists, popular writers, and consumer advocate organizations should be included is subject to debate. Existing organizations are not necessarily sufficiently well-balanced to represent the several technical sectors as would be required in the interdisciplinary synthetic fuels program; well-known groups and individuals, for the most part, also have well-established credibility gaps.

Publicity is required—but *proper* publicity. One approach is to hold the next meeting on this subject in the immediate Washington D.C. area when Congress is in session and hopefully at a time during which congressional representatives and their staffs can give synthetic fuels one or two days of their undivided attention. Emphasis at such a meeting should be on what *can* go on, not what *has been* going on; congressional staff are already well-versed on the past history and politics of the energy situation.

As with this present conference, attendance at the next should be carefully selected and limited. Subject matter should include such topics as:

- Additional retail gasoline tax to subsidize alternative fuels R&D.
- Synthetic fuel transition scenarios generated through cooperative DOE/DOD/DOT exercises.

Synthetic fuels and advanced engines technology has reached the point that specific facts can be presented to congressional staff and, some believe that with proper preparation, a well-stated

challenge to the Congress can be made which will, in effect, encourage their participation and support.

Fuel Specifications

Today's fuel specifications are based upon evolutionary development utilizing petroleum resources. These specs should be re-evaluated in terms of anticipated nonpetroleum resources and challenged as to what a finished fuel specification ought to be in order to meet future engine requirements.

If current transportation fuels specs are taken as the requirements for future alternative fuels, there is simply no need for any further R&D in this area. If specs remain the same, refinery operations and engine design criteria will also remain the same. However, this approach may negate opportunities to save energy and costs. If the popularity of a "new fuel" gains momentum because of energy savings at the refinery or some other factor in the logistical train, then refinery operations and engines R&D must necessarily be accelerated.

Transportation synfuels will develop over the next two to three decades; they cannot be considered as near-term concepts. However, activity needs to be started soon to achieve the needed results in an orderly fashion. Consequently, it is time to initiate a properly organized program to investigate the potential for off-spec and variable quality-spec fuels in terms of extending existing engine technology, as opposed to some form of "crash program" approach to interfacing new fuels with old engines.

Utilization

A popular (but not unanimous) attitude in the synthetic fuels technical community is that utilization of shale- and coal-derived materials as fuels should be aimed at stationary powerplants, thus displacing petroleum for application to transportation fuels. Synfuels should not be utilized as transportation fuels simply because this is the only definable DOE end-use program in existence at the present time. This, in fact, is the worst place to start a new fuel; utilize it in stationary powerplants, profit by this experience, and then make the transition to transportation applications.

An equally popular counter-argument to the above is that all of this will take valuable time. Transportation engines have significantly different requirements from fixed-facility powerplants. Domestic petroleum supplies will eventually be exhausted while transportation requirements will increase; interface of synthetic fuels with transportation engines will eventually become mandatory and considerable R&D must precede this.

Powerplant R&D

Conventional diesel and spark ignition automotive engines are likely to continue to dominate the domestic highway vehicle scene for the next two decades. Radically new engine designs will not appear in significant quantities during this time and should not be considered near-term items as regards new fuel interface.

Environmental

Environmental constraints imposed upon automotive propulsion system design will be a major obstacle in future fuel/engine interface activities.

Experimental R&D on synthetic fuels composition should be oriented around environmental considerations to include exhaust emissions, safety in handling, toxicity, etc. A comprehensive and well coordinated fuels evaluation R&D program will include these factors as well as engine performance data.

The need for environmental considerations highlights the necessity for close relationships in the federal government between all concerned, such as DOE, EPA, and DOT.

Environmental policies within the several western states which possess most of our oil shale and a large amount of coal will be the most significant obstacle to construction of shale- and coal-conversion plants in these areas. Pilot-scale facilities concerned solely with R&D will probably be tolerated; commercial scale plants probably will not in the immediate future. Whether this impasse can be resolved by means of federal-to-state financial incentives remains one of the most elusive aspects of the development of domestic resources.

Synthetic Fuels Composition

Projected formulation ranges for future alternative fuels should be defined at the earliest possible time in order that simulated reference fuels can be produced to be used in test programs aimed at early identification of fuel/engine interface problems.

The development of energy-efficient fuels which interface with energy-efficient, fuel-tolerant engines will, without doubt, be an iterative exercise. This further emphasizes the need for increased interindustry coordination and cooperation in R&D projects. Relative fuel tolerances of the several candidate future engine classes (e.g., stratified charge, gas turbine, Stirling, etc.) cannot be objectively assessed until a family of future reference fuels is defined in terms of key compositional characteristics with associated tolerance limits. It is presently technically feasible to theoretically define energy-efficient future alternate fuels in terms of minimized refinery energy loss. Such a criterion is a strong arguing point for the development of the so-called broadcut fuel. There is an immediate need for the definition and formulation of a broadcut reference fuel or family of such fuels. An initial reference broadcut synthetic fuel can be simulated on this basis and test scale batches can be blended utilizing petroleum fractions, organometallic materials, etc. The premise of the widespread existence and utilization of such a fuel will, of course, be based upon the corresponding premise of the widespread existence and popularity of engine classes which can accommodate such a fuel. This will force cooperative R&D aimed at coordinated introduction of fuels and engines on production levels.

Theoretical formulation of future alternative fuels will be critically dependent upon accurate compositional information on synthetic crudes derived from oil shale and coal. Lab and pilot scale batches of some syncrudes are presently available. It is argumentative as to whether the composition of these present-day syncrudes can be extrapolated to future full-scale production plant output, but they must be taken as representative to provide a starting point.

Syncrude Conversion Technology

The prevailing mood of most of the attendees at this conference was one of impatience. Rather than developing new shale- and coal-conversion processes, the United States should capitalize on existing conversion systems which have been used or are currently being used in other parts of the world.

Only by operating full-scale syncrude conversion modules can we begin to make synthetic fuels cost competitive. Sufficient R&D has been completed at laboratory and pilot-scale levels to warrant significant commitment of private and federal funds towards this goal. DOE will no longer underwrite demonstration plant programs, only pilot plant level projects. Consequently, full-scale syncrude conversion plants can only be realized through cooperative financial commitments from the major petroleum companies, the federal government, and possibly the automotive industry. Funding requirements for an accelerated program of this nature are so enormous that significant commitments from each of these sectors is mandatory if anything is to happen.

Powerplant R&D poses no barrier to the accelerated development and operation of syncrude conversion plants, since engine design to accommodate a particular fuel or family of fuels can be initiated in parallel with or even at a slightly later comencement date and still come up with fuel tolerant engines by the time a syncrude plant is in full-scale production.

A counter proposal to the above scheme is that the private sector cannot make financial commitments of such a scale as required by syncrude production facilities construction. Therefore, the federal government should totally subsidize one such plant, of significant size, and legislate mandatory utilization of these syncrudes by the existing domestic refinery industry utilizing the widely accepted concept of blending syncrudes with conventional petroleum crudes and thus minimizing, or possibly eliminating, the requirement for increased sophistication in refining technology. This would, of course, force the question of just how bad a syncrude can be (i.e., what properties such as sulfur, nitrogen, and metals content can be accommodated by blending dilution and what properties must be attenuated).

Such a forced cooperative arrangement is apparently underway in China, Russia, and possibly South Africa because of their particular forms

of government. All fuel industries in these nations are required to take some sampling products for commercial utilization. There would be considerable resistance to such a plan within the United States simply because there are so many domestic oil companies of such a variety of sizes that an equitable syncrude distribution arrangement would be virtually impossible to work out.

Refining Technology

The transition period wherein nonpetroleum liquids are introduced as domestic fuels should utilize existing refineries rather than dedicated synthetic fuel refineries. In this way, refinery technology can evolve in proportion to nonpetroleum crude concentration in the crude slate input. Catalysis technology relevant to the acceptance of syncrudes in existing refineries has progressed to a point which indicates the economic feasibility of acceptable liquid hydrocarbon product slates.

The price of domestic synthetic fuels may never be competitive in the near term on its own with imported oil because suppliers can simply make price adjustments so that there will be significant differential. The main consideration is just what, if any, differential the U.S. can, should, or will permit. We will be purchasing a degree of international economic security with our domestic nonpetroleum reserves, and must some day soon determine the exact amount of subsidy that we are willing to commit for this independence.

The Department of Energy and the Department of Defense have openly expressed a willingness to cooperate in generating political transitional scenarios for synthetic fuels. Economic uncertainties within these scenarios regarding projected costs of pure synfuels may not be as significant a barrier as presently envisioned simply because it may take twenty to forty years before a pure synthetic fuel is utilized in a transportation situation.

Refinery outputs at various world locations indicate wide flexibility in middle distillate yields; increasing demand for middle distillates collides with and penalizes efforts to maintain refinery efficiency and control costs. Refining efficiency appears to be maximized if product slates include a maximum of around 30 percent middle distillates.

Middle boiling distillates from oil shale are, without question, technically feasible as exemplified by the PARAHO program. The point in time at which economic parity of oil shale-derived distillates with petroleum products will be reached was not reported and was inadequately discussed, perhaps because of lack of accurate data.

PARAHO Program

The leadership of the Department of Defense in developing and executing a positive, well-defined sequence of operations through the PARAHO program is exemplary. Because high-performance military tactical and combat equipment requires MIL-spec fuels, this program's ultimate objective has been to produce a spectrum of such fuels from oil shale for evaluation by the military and by the civilian synthetic fuels R&D community. At this time, some 100,000 barrels of syncrude have been delivered from the PARAHO conversion plant in Colorado to SOHIO's Toledo refinery. As announced by DOD at this conference, small quantities of these synfuels will be provided to legitimate R&D organizations for analysis and testing subject to the following requirements:

- The fuel cannot be sold.
- Intended use of the fuel must be well-defined.
- The fuel must be used for research and development.
- DOD must receive reports on the utilization of these test materials.

There will be no charge for small samples but some charge for larger quantities.

This program is the front runner in the entire domestic alternative fuels R&D program. It was not designed to establish the basis for commercial synthetic fuels refineries, but rather to demonstrate the feasibility of producing MIL-spec quality fuels from oil shale. One criticism of this program seems to be that testing large volumes of finished products from oil shale is pointless since the products themselves do not represent finished quality from large-scale commercial processes. Implicitly, level of testing will exceed level of process development.

The fact remains, however, that very shortly these fuels *will exist* and will be utilized in a fairly widescale R&D evaluation program. Data will exist where no data existed before; *something* will have been done where *nothing* had been done before.

Key General Points

If future alternative fuels are going to be more expensive, then they should be of as high a quality as is practical. This should be a guiding principle in the development of alternative fuels and should extend to performance, economy, emissions, and safety.

There is an indication of a very promising alternative to the expensive hydrotreating of shale oil and coal syncrudes. This entails taking the lighter materials from pyrolyzed coal and from oil shale syncrude, combining these lighter materials, and refining them into a broadcut fuel compatible with future advanced engines. The heavier materials from both shale and coal syncrudes would be combined into coal-oil mixtures applicable to nontransportation powerplant utilization.

Petroleum feedstocks are becoming more sour, dirtier, and heavier; they are consequently imposing refining penalties in terms of increased cost and reduced yields. Nevertheless, refiners are likely, at the outset, to resist initiation of syncrude refining or blending in the crude slate to the point of using petroleum crudes inferior to synthetic crudes.

The ultimate compromise for the *next fifty years* will involve working out a balance between disruption of our environment and disruption of our socioeconomic stability and quality of life. An efficient and equitable approach to this balance can only come through accelerated and objective research and development. The only dramatic change in this scheme can come through major technological breakthroughs in the utilization of other energy forms for transportation (e.g., solar, electric, etc.) R&D in these areas is, at the present time, in its infancy.

The ultimate mission of that segment of the technical community represented at this conference is to *buy that fifty years* by developing realistic schemes for the efficient utilization of our remaining fossil energy reserves.