ALTERNATIVE FUELS PROGRAM PLAN

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ALTERNATIVE FUELS UTILIZATION PROGRAM

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The transportation energy problem is serious and urgent because transportation is almost totally dependent on petroleum. Domestic petroleum resources are being depleted, imports continue to increase and world production is projected to peak near the end of this century. Failure to implement solutions in a timely way may lead to serious economic, social and political disruption.

One way to prevent such a disruption is to develop synthetic fuels from oil shale and coal to extend and eventually replace petroleum as the fuel for highway vehicles.

The subject of my presentation today is the Department of Energy's Alternative Fuels Utilization Program (slide 1). The overall objective of the program (slide 2) is to extend and eventually replace petroleum as a source of fuels for highway vehicles. The primary goal of the program is to foster the use of alternative fuels by lowering the uncertainty costs associated with their use. Uncertainty costs include direct dollar costs, social costs, costs of information, etc.

In our alternative fuels utilization program we have five categories of fuels under consideration. The fuel categories are listed in slide 3 and are: new hydrocarbons, alcohols, synfuels, advanced fuels and emergency fuels. The fuel categories are listed in order of descending priority in terms of the need for research and development. Because of the limited time available for this presentation, I will only address the new hydrocarbons and synfuels in detail. However, first I would like to say a few words about the other three categories. The alcohol fuels program includes work with straight methanol, methanol/gasoline blends, and ethanol/gasoline blends. The program on advanced fuels includes both hydrogen and hybrid fuels. The hydrogen program includes work to: (1) obtain data necessary to design a true hydrogen engine; and (2) improve onboard storage capability utilizing metal hydrides. Hybrid fuels are mixtures of petroleum/non-petroleum materials such as slurries (solid-in-liquid), emulsions (liquid-in-liquid), slurried emulsions (liquid-solid-liquid), and solutions (liquid-liquid). The final fuel category is emergency fuels which are defined as those nonstandard fuels that might be used in existing engines in order to maintain reliability of critical fleets such as ambulances, fire trucks, police fleet, etc., during an emergency situation (serious fuel shortage).

Now, I would like to get back to the main topic of my presentation. With regard to finish fuels, the two categories of fuels under consideration are new hydrocarbons and synfuels. A new hydrocarbon is defined as any hydrocarbon mixture which has specifications different than those of conventional automotive fuels. An example would be a broad-boiling-range fuel say with an initial boiling point of 100°F and an end point of about 650 to 700°F. These type fuels are sometimes referred to as broadcut fuels. The primary advantage of a broad-boiling-range fuel is that it can be produced at the refinery at a lower cost and less energy is lost in the processing involved in making the fuel.

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Synfuels are those fuels which are produced from syncrudes which meet the specifications of present-day conventional fuels. Examples are synthetic gasoline and diesel fuels. Please note that even though synfuels meet today's specifications for conventional fuels, chemical characteristics may be quite different and use of such fuels may lead to problems. Therefore further research will be required when these fuels become available. I will have more to say about that later.

Our program objectives for evaluating new hydrocarbons in the near term (slide 4) are, to evaluate the operation of various candidate new hydrocarbons in research engines of the continuous combustion types in order to uncover problems related to the use of such fuels. Also, to evaluate the operation of various candidate new hydrocarbon fuels in present and developmental intermittent internal combustion engines. In the longer term, (slide 5) our objective is to evaluate new systems to optimize the resource/fuel/engine system for efficiency, emissions and performance. When I say optimize the total system for efficiency, the following factors are considered: the energy content of the resource; the energy losses associated with the manufacture of syncrude; the energy losses in refining the syncrude to finished fuel; energy required for fuel distribution; and finally the energy efficiency of the engine/vehicle system. The bottom line then would be to maximize the vehicular distance traveled per unit of resource. For example, maximize miles per ton of coal, or miles per ton of oil shale.

The strategies for attaining the objectives for new hydrocarbons (slide 6) are to: assess the fuel requirements and suitable fuel types for candidate combustors used in continuous combustion engines. Achieve operation with various fuels in the turbine, the Stirling or other suitable engines. Test and evaluate engine performance, emissions and fuel economy (slide 7) of continuous combustion engines and evaluate transition strategies and problems for new fuels in continuous combustion engines.

Regarding the use of new hydrocarbons in intermittent combustion engine (slide 8), our strategies for attaining the objective is to assess the octane and cetane requirements of candidate engines. To achieve operation of candidate engines with various new hydrocarbon fuels. Test and evaluate engine performance, emissions and fuel economy (slide 9) for intermittent combustion engines and finally to evaluate transition strategies and problems for new fuels intermittent combustion engines.

Moving now to our other fuel category called synfuels which as I mentioned before, are synthetic fuels which meet specifications for conventional fuels. In other words synthetic gasoline and diesel fuel for highway vehicles.

The objective for synfuels (slide 10) is to evaluate synthetic gasoline and diesel fuels in current engines and improved versions of current type engines. The strategies for attaining the objective for synfuels (slide 11) are to evaluate engine performance, efficiency and emissions. Evaluate unregulated emissions such as Polynuclear-aromatic hydrocarbons and to evaluate fuel characteristics. Although the synthetic fuels may meet today specification for gasoline and diesel fuels, there may be differences in chemical characteristics and impurities in the fuels that may cause problems in current engines.

I will conclude my presentation today by outlining the project plan work flow for attaining the objectives which I talked about earlier. Slide 12 shows a skeleton of a matrix of items to be addressed in the project plan. There are five columns in the matrix in which the direction of work flow is from left to right. These columns correspond to: problem definition; problem solving; selection and verification; pilot-scale programs; and finally large-scale adaption. There are four rows in the matrix which correspond to the four major factors (slide 13) which are considered. They are: process technology assessment; fuel properties and composition; engine-vehicle characterization; and systems studies. A dashed line is used to separate fuel properties and composition and engine-vehicle characterization because fuel properties and engine characteristics are interactive when optimizing the fuel/engine systems.

The Alternative Fuels Utilization Branch is not directly involved in process technology assessments, but, rather follows the activity of the DOE Energy Technology and industry groups through liaison with those groups (slide 14). Slide 15 is the same as slide 14 except that the rows corresponding to fuel properties and composition and engine-vehicle characterization are added to the matrix.

Resource-through-end use assessments are made throughout the project period as indicated in slide 16 corresponding to systems studies. Finally to complete the matrix of project plan work flow (slide 17), socioeconomic, environment, legal and institutional factors are considered in the system studies.

Please note that the matrix in this slide illustrates the basic elements of the project work plans and is applicable to any of the given fuel categories that were discussed earlier.

Department of Energy

Alternative Fuels Utilization Program

78-11424M/4-23

Alternative Fuels Utilization Program

Objective:

- To Extend and Eventually Replace Petroleum As the Fuel for Highway Vehicles

Goal:

- To Foster the Use of Alternative Fuels by Lowering the Uncertainty Costs Associated with Their Use

78-11424M/3-23

Alternative Fuel Categories

- New Hydrocarbons
- Alcohols
- Synfuels
- Advanced Fuels
  - Hydrogen
  - Hybrids
- Emergency Fuels

78-11424M/2-23

Objectives Related to New Hydrocarbons

Near Term

- To Evaluate Operation of Various Fuels in Research Engines of the Continuous Combustion Types
- To Evaluate Operation of Various Fuels in Present and Developmental Intermittent Internal Combustion Engines

78-11424M/5-23

Objectives Related to New Hydrocarbon

Long Term

- To Evaluate New Systems to Optimize the Resource/Fuel/Engine System for Efficiency, Emission and Performance

78-11424M/6-23

Strategies for Attaining Objective

Continuous Combustion Engines

- Assess the Fuel Requirements and Suitable Fuel Types for Candidate Combustors Used in Continuous Combustion Engines.

- Achieve Operation with Various Fuels in the Turbine, the Stirling, or Other Suitable Engines.

78-11424M/10-23

Strategies for Attaining Objective

Continuous Combustion Engines

- Test and Evaluate Engine Performance, Emissions and Fuel Economy
- Evaluate Transition Strategies and Problems for New Fuels in Continuous Combustion Engine.

78-11424M/11-23

Strategies for Attaining Objective

Intermittent Combustion Engines

- Assess the Octane and Cetane Requirements of Candidate Engines.
- Achieve Operation of Candidate Engines with Various Fuels.

78-11424M/12-23

Strategies to Attain Objective

Intermittent Combustion Engines

- Test and Evaluate Engine Performance, Emissions and Fuel Economy
- Evaluate Transition Strategies and Problems for New Fuels in Intermittent Combustion Engines.

Objective Related to Synfuels (Gasoline and Diesel Fuel)

- To Evaluate Synthetic Gasoline and Diesel Fuels in Current and Improved Current Engine Types.

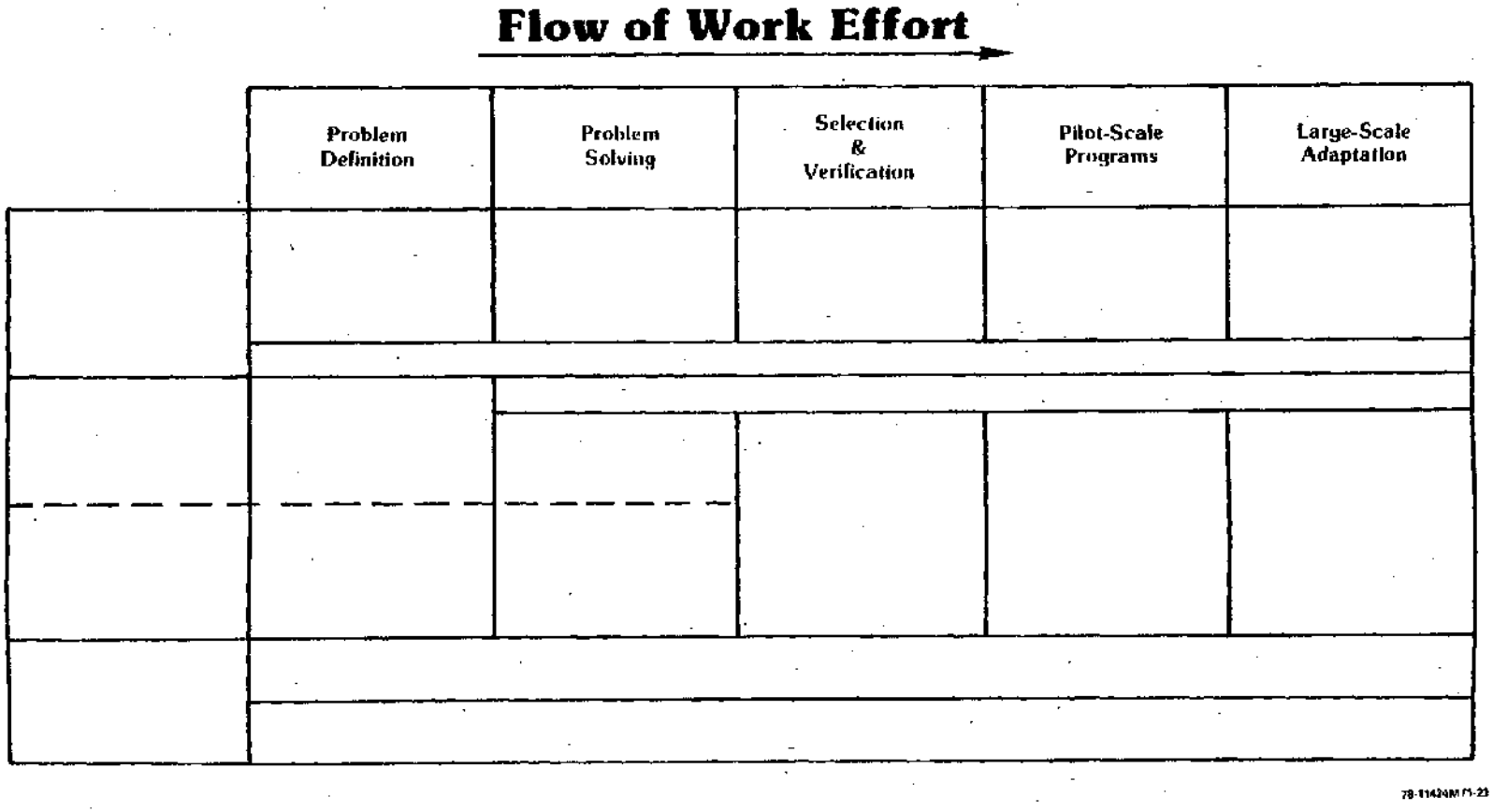
Strategies for Attaining Objective

Synfuels

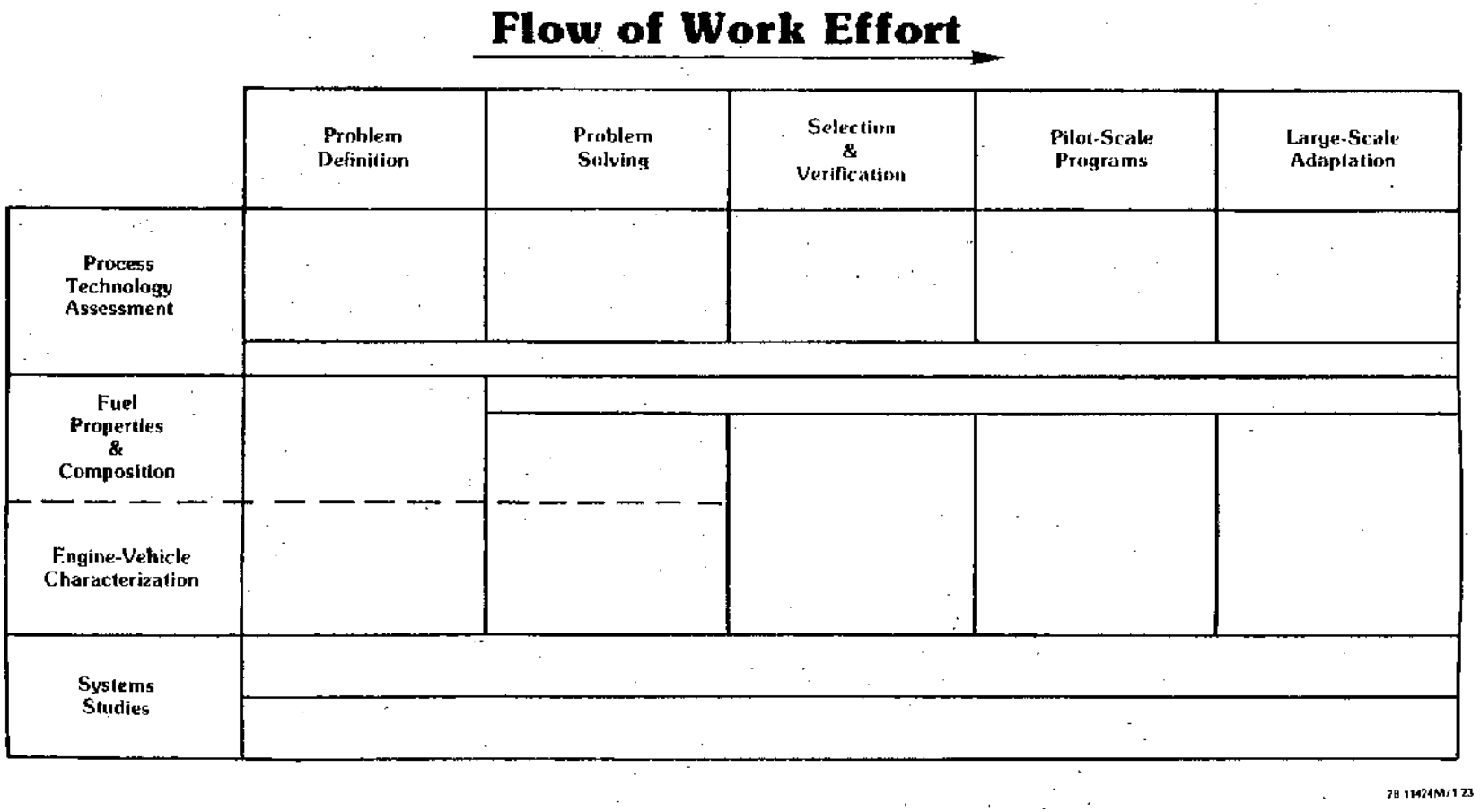
- Evaluate Engine Performance, Efficiency and Emissions
- Evaluate Unregulated Emissions Such As PNAs
- Evaluate Fuel Characteristics

78-11424M/9-23

Project Plan Work Flow



Project Plan Work Flow



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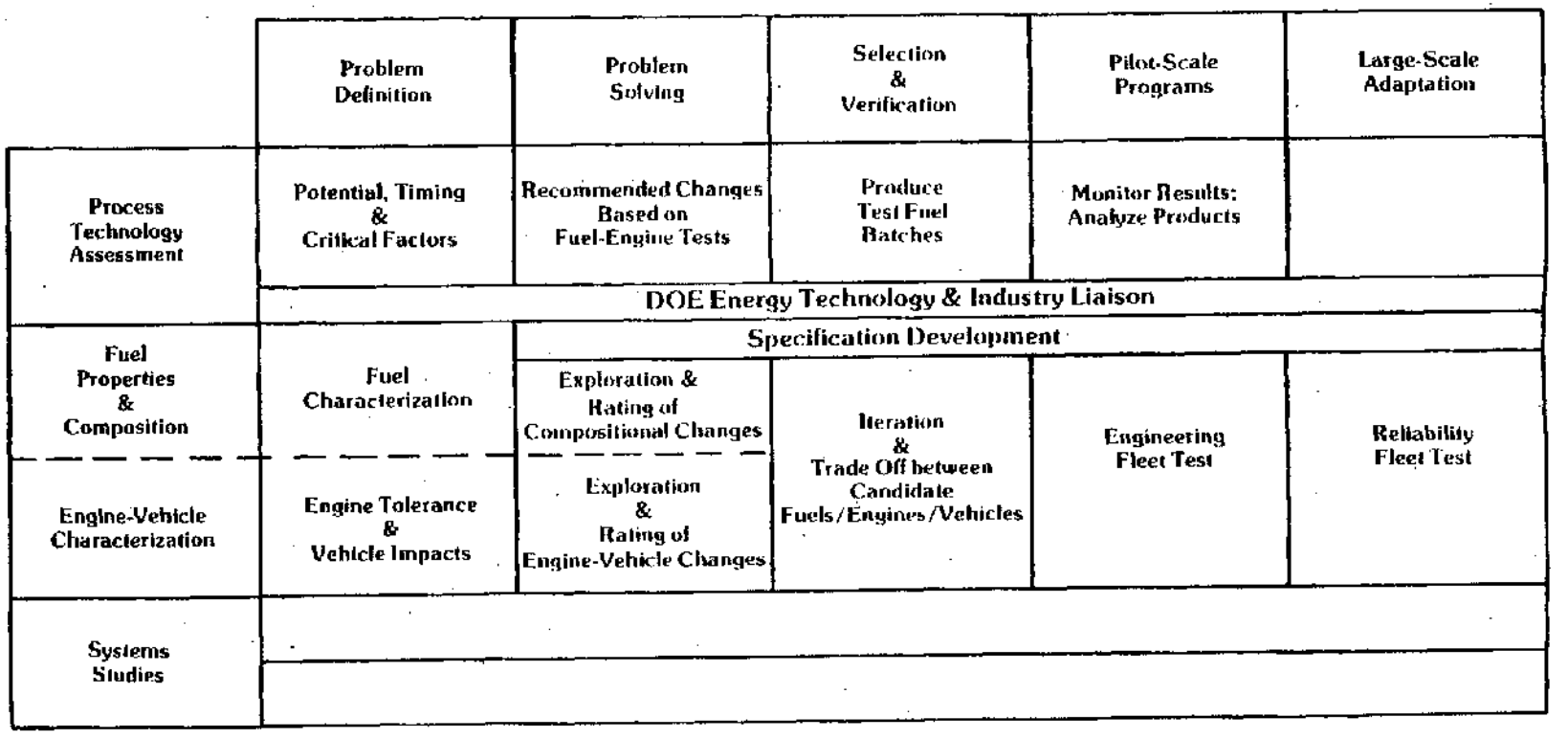
Project Plan Work Flow

Flow of Work Effort →

	Problem Definition	Problem Solving	Selection & Verification	Pilot-Scale Programs	Large-Scale Adaptation
Process Technology Assessment	Potential, Timing & Critical Factors	Recommended Changes Based on Fuel-Engine Tests	Produce Test Fuel Batches	Monitor Results; Analyze Products	
	DOE Energy Technology & Industry Liaison				
Fuel Properties & Composition					
Engine-Vehicle Characterization					
Systems Studies					

Project Plan Work Flow

Flow of Work Effort →



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Process Technology Assessment	Potential, Timing & Critical Factors	Recommended Changes Based on Fuel-Engine Tests	Produce Test Fuel Batches	Monitor Results; Analyze Products	
	DOE Energy Technology & Industry Liaison				
Fuel Properties & Composition	Fuel Characterization	Specification Development			
		Exploration & Rating of Compositional Changes	Iteration & Trade Off between Candidate Fuels/Engines/Vehicles	Engineering Fleet Test	Reliability Fleet Test
Engine-Vehicle Characterization	Engine Tolerance & Vehicle Impacts	Exploration & Rating of Engine-Vehicle Changes			
Systems Studies	Resource—through—End Use Assessments				

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Project Plan Work Flow

Flow of Work Effort →