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The TES project
A joint initiative for an additional fuel infrastructure

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1. Introduction

In May 1998, the German Government, in cooperation with Aral, BMW, DaimlerChrysler, MAN, RWE, Shell and Volkswagen, launched the ''Transportation Energy Strategy (TES)'' project.

Based on the vision of

(a) international leadership in the field of alternative fuel and propulsion systems within the next 10 years,

(b) creating a crisis-free energy supply for European transport and

(c) sustainable mobility,

the parties involved agreed, to develop a strategy for one, or a maximum of two, alternative fuels.

An overview of the present state of the project is described including the challenges and objectives.

2. Challenges for the automotive industry, energy suppliers and politics

2.1. Securing Germany's position as an automotive manufacturing location

The worldwide success of Germany's automotive industry has an important influence on the success of its economy, budget and the prosperity of its society.

To secure and strengthen competitiveness under the existing framework of high labour costs, expensive social system and heavy fiscal charges, leadership in the field of technology is of great importance.

As a result, the automotive and petroleum industries are investing significantly in research and development. Last year, the German automotive industry alone spent nearly EURO 10 billion.

Unlike traditional product innovations, new alternative energy and propulsion systems cannot be transferred into the market by one company alone. To implement a widespread infrastructure for alternative energies, a joint strategy between the automotive and energy industries, supported by politics, is necessary.

USA and Japan are separately working on innovative energy and propulsion techniques with significant support from their respective governments. For example, the US Government has already allocated US$1 billion to the PNGV program.

Activities from our competitors demand that we act quickly in order to remain a credible force in this rapidly changing field.

2.2. Securing the energy supply for mobility and transport

Mobility and transport services are completely dependent on secure oil supplies. An oil crisis would not only damage the automobile manufacturers but also the entire economy.

Experts regard the security of oil supplies very differently. Therefore, we asked Arthur D. Little (ADL) to further investigate this issue.

Taking certain assumptions into consideration, — reduced oil consumption, discovery of new oil fields, improved extraction of existing oil fields due to new technologies, expansion of production capacities within OPEC by 50%, large scale commercial use of oil sands and shales

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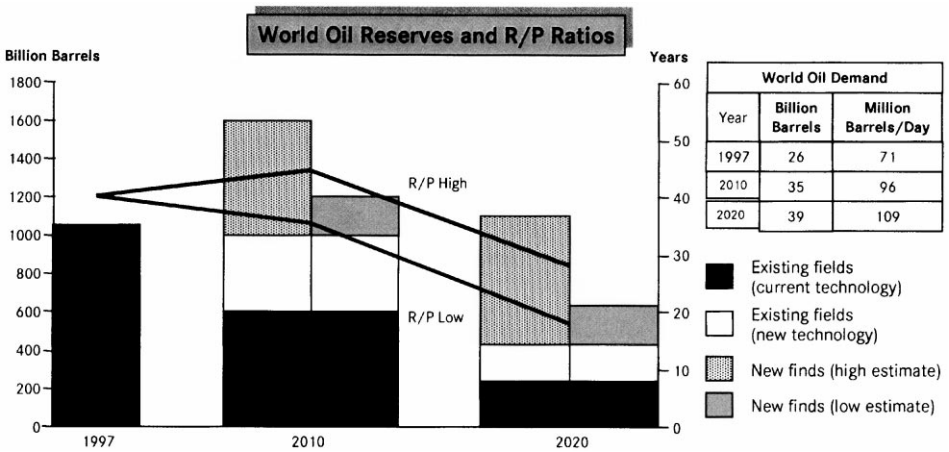

Fig. 1. Application of improved extraction technology together with new field developments will maintain global R/P ratios at healthy levels and expected improvements in finding/developing technology will provide a further cushion.

— ADL concluded that oil supplies will be more than sufficient, even in the year 2020 (Fig. 1).

The International Energy Agency (IEA), on the other hand, reported, that no further large oil deposits will be discovered — supported by the fact that since World War II only one giant oil field has been discovered, in the North Sea — that oil production will reach its peak towards 2015 (Fig. 2) and that worldwide oil prices will increase.

According to the principle of precaution, we should prepare to switch from crude oil to competitive alternatives as soon as possible. Other good reasons in favour of this recommendation are: (a) the expected decline in North Sea oil production, which will increase Europe's dependency on politically unstable oil-producing countries once again (Europe currently produces approximately 50% of its own oil) and (b) time-consuming automotive development, long production periods and service life of approximately 15 years; this means that vehicles developed today will be the foremost form of transportation in 2020, at a time when conventional oil production could have reached or even exceeded its peak.

2.3. Reduction of emissions caused by the transportation sector

In present environmental politics, the reduction of CO_2 emissions has top priority. According to the resolutions of the EU's Environment Ministers (June 1998), Germany must carry the main burden of the reduction in greenhouse gases as committed by the EU — around 75%.

The German automobile industry wants to reduce the specific CO_2 emissions for new passenger cars by 25% before 2005, in comparison to 1990 levels. However, due to the sharp growth in traffic caused by reunification, the total CO_2 emissions cannot be lowered below the reference level of 1990 (Fig. 3). A decline in emissions is expected around 2005, due to an improved efficiency of a new generation of vehicles. However, new automotive technology alone will not be sufficient to lower CO_2

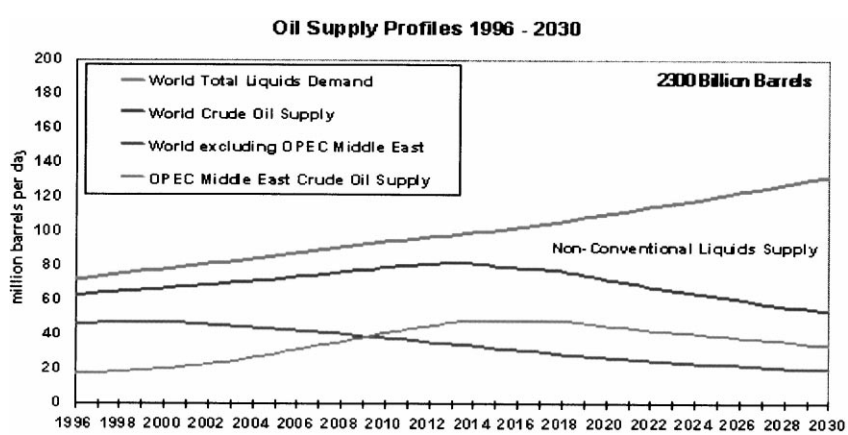

Fig. 2. IEA projections show conventional oil production peak in 2013/2014.

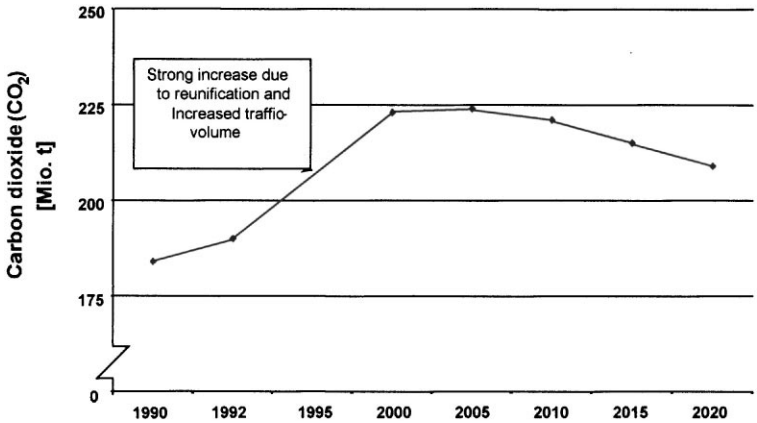

Fig. 3. CO_2 emissions in traffic will decrease from 2005 even though traffic volume will increase.

emissions to 1990 levels. Therefore, the challenge will be to use energy forms low in or free of CO_2. In order to meet CO_2 reduction targets, as well as to ensure stable economic growth and a secure mobility, we should prepare now for the use of alternative energy and propulsion systems.

2.4. Challenges for politics

There exists not only competition between companies, but also between economic regions.

As a result, politicians must set international benchmarks, and develop frameworks to strengthen competition, i.e.:

- setting the pre-requisites for large future investments for the implementation of an infrastructure for renewable fuels,
- supporting the implementation of international standards for new fuel specifications and security standards for vehicles and service stations,
- avoiding international agreements which burden the competitiveness of the economy.

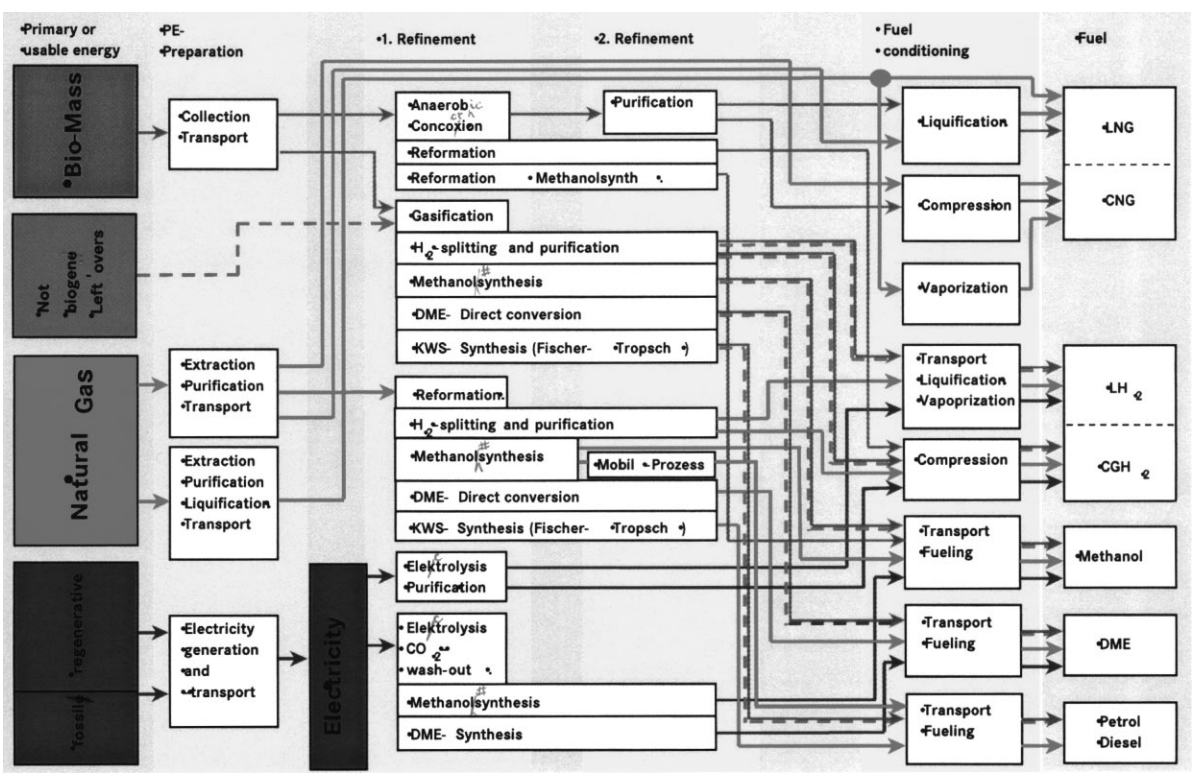

Fig. 4.

3. Strategic and political goals

In synchronisation with the above-mentioned challenges, the following strategic and political goals are considered the most important for TES:

(a) enabling the industry to become the international technology and market leader in the field of alternative fuel and propulsion systems,

(b) securing employment and, possibly to create new jobs,

(c) securing fuel resources for transport and transport-dependent industries,

(d) further reducing emissions including CO_2 over the entire energy chain.

4. Evaluation and selection of alternative fuels

In a multi-layered analysis and evaluation procedure, fuels will be selected from a pool of 10 alternatives. These fuels will meet the aforementioned goals and fundamental demands of the energy and automotive industry.

The evaluation procedures developed for this selection process, the evaluation methods, as well as the database were created largely by ''Ludwig Bölkow Systemtechnik'', and have been discussed and considered positive by politicians and a committee of leading scientists.

In phase 1 of the selection procedure, five fuels — natural gas including biogas, dimethyl ether (DME), methanol, synthetic gasoline/diesel and hydrogen — were selected.

These fuels were thoroughly analysed by studying roughly 70 production chains (well-to-tank), based on the present and future state of technology (Fig. 4).

They were evaluated based on their potential suitability for vehicle segments in large-scale production (compact passenger cars, long distance trucks) and alternative forms of propulsion systems (internal combustion engine and fuel cells).

Based on preliminary results it becomes obvious, that no single production chain completely meets all necessary criteria. In short, the less costly pathes have higher CO_2 emissions, while pathes low in CO_2 are more costly to produce. Also, various of these production chains do not completely meet the TES supply objective — a minimum share of 30% of the European fuel market for at least 50 years.

However, due to the multitude of production chains for methanol and hydrogen it seems worthwhile to further investigate these two alternatives and to develop a joint strategy for their implementation as additional fuels by the end of 2000.

The numerous production possibilities for hydrogen and methanol provide the opportunities for

- inexhaustible and renewable resources,
- long-term economic growth,
- secure fuel supply in Europe.

5. Final remarks

For DaimlerChrysler, fitness to face the future means, that our activities include the awareness of the finite nature of our natural resources and the need to preserve a healthy environment as well as productivity and competitiveness.

Renewable energies have an enormous capacity for environmental improvements and product innovations. In turn, they will determine our ability to compete and survive in the future and will result in qualified jobs.

Bearing these advantages in mind, as well as for strategic, industrial, economic and environmental reasons, renewable energies and fuel efficient propulsion systems will enjoy high priority.