



SCHWEIZERISCHER BUNDESRAT
 CONSEIL FÉDÉRAL SUISSE
 CONSIGLIO FEDERALE SVIZZERO

Agence internationale de l'énergie (AIE) de l'OCDE, à Paris,
 Programmes de recherche

Beschluss

Décision

Decisione

919

30 MAI 1984

Vu la proposition du DFTCE du 3 mai 1984

Vu les résultats de la procédure de co-rapport, il est

décidé

1. Le Conseil fédéral prend connaissance du rapport du Département fédéral des transports, des communications et de l'énergie et décide de la participation de la Suisse à:
 - 1 projet du Programme relatif à l'analyse de système en matière de technologies énergétiques du 25.2.1981
 - Projet II: Echange d'informations
 - 1 projet du Programme de recherche et de développement en matière de production d'hydrogène à partir de l'eau du 6.10.1977
 - Projet VII: Stockage d'hydrogène, conversion et sécurité
2. La Délégation suisse à l'OCDE est habilitée à annoncer la participation de la Suisse au projet II de l'Accord d'exécution du programme relatif à l'analyse de système en matière de technologies énergétiques et au projet VII de l'Accord d'exécution du programme de recherche et de développement en matière de production d'hydrogène à partir de l'eau.

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Pour extrait conforme,
 le secrétaire:



3003 Berne, le 3 mai 1984

Distribué

Au C o n s e i l f é d é r a l

Agence internationale de l'énergie (AIE)
de l'OCDE, à Paris, Programmes de recherche

Participation de la Suisse à 2 nouveaux projets

I. Généralités

L'Assemblée fédérale a approuvé le 17 septembre 1979 la participation de la Suisse à des programmes de recherche de l'Agence internationale de l'énergie (AIE) dans le domaine de l'énergie. L'Arrêté fédéral du 5 octobre 1979, autorisant le Conseil fédéral à conclure des accords avec l'Agence internationale de l'énergie sur la recherche et le développement dans le domaine énergétique, est entré en vigueur le 1er février 1980 (RO 1980, 1983).

Il s'agit, dans la présente proposition, de la participation de la Suisse aux projets suivants:

- 1 projet du Programme relatif à l'analyse de système en matière de technologies énergétiques du 25.2.1981
- 1 projet du Programme de recherche et développement en matière de production d'hydrogène à partir de l'eau du 6.10.1977.

II. Programme relatif à l'analyse de systèmes en matière de technologies énergétiques

Un Accord d'exécution portant sur un programme de coopération dans le domaine de l'analyse de systèmes en matière de technologies énergétiques a été signé, à Paris, le 13 novembre 1980 dans le cadre des activités de recherche et de développement de l'AIE. Le Conseil fédéral a pris le 25 février 1981 la décision de participer à ce programme.

Les travaux préparatoires auxquels la Suisse a participé dès 1976 ont permis de développer en commun un programme de calcul (MARKAL) et de caractériser un grand nombre de technologies et sources d'énergie nouvelles, afin d'évaluer jusqu'au delà de l'an 2000 l'optimisation de leurs contributions à la couverture de la demande en énergie dans les quinze pays participants.

Dans le projet correspondant à l'annexe I de l'Accord d'exécution du 13.11.1980, la méthode de calcul a été fortement améliorée, l'inventaire des technologies a été élargi pour inclure des nouvelles technologies et sources renouvelables d'énergie et divers scénarios nationaux de demande future possible ont été calculés. Ces travaux ont été coordonnés par un centre situé à la Kernforschungsanlage (KFA) à Jülich (RFA). C'est au cours de cette phase que le groupe d'analystes à l'Institut fédéral de recherches en matière de réacteurs (EIR) a pu contribuer, en collaboration avec le Département d'économétrie de l'Université de Genève, à certains travaux de la Commission fédérale de l'énergie.

Projet II: Echange d'information

L'Annexe II à l'Accord d'exécution prévoit de se concentrer sur l'échange d'informations, le développement du savoir-faire et l'amélioration sur le plan international des capacités scientifiques d'analyse de systèmes énergétiques. La KFA Jülich maintient son rôle d'agent exécutif et de coordonnateur du projet.

Chaque pays assume les coûts de sa contribution nationale, l'envoi de ses délégués aux séances, le séjour de ses experts à Jülich et sa participation aux frais d'exploitation du centre. Ces quatre postes sont pris en charge en Suisse par l'Institut fédéral de recherches en matière de réacteurs, à Würenlingen, tant sur le plan scientifique que financier. La contribution suisse au financement de la coordination du projet s'élèvera à environ 12'000.-- fr. par an, pendant 3 ans et sera payée par l'IFR sur son budget ordinaire.

III. Programme de recherche et de développement en matière de production d'hydrogène à partir de l'eau

Le Conseil fédéral a décidé le 6.10.1977, sous réserve d'approbation par l'Assemblée fédérale, de participer à un projet du programme "Production d'hydrogène à partir de l'eau" de l'AIE. Le 9.5.1979, il étendait la participation suisse à un deuxième projet, puis le 12.11.1980 à un troisième projet. Deux projets sont achevés aujourd'hui. Le projet VII pour lequel la participation suisse est maintenant soumise à l'approbation du Conseil fédéral est prévu de durer jusqu'au 30.6.1986.

L'hydrogène est un vecteur énergétique secondaire comme l'électricité qui permet au niveau de l'utilisateur une conversion en énergie calorifique, mécanique ou électrique. Il ne pose que peu de problèmes à l'environnement et offre entre autre un potentiel intéressant de substitution des carburants fossiles dans le domaine des transports. Des travaux de recherche importants sont cependant encore nécessaires aussi bien dans le domaine de la production que du transport, du stockage et de l'utilisation finale.

Les projets du programme hydrogène de l'AIE auxquels la Suisse a participé jusqu'ici portaient sur les problèmes liés à la production.

Projet VII: Stockage d'hydrogène, conversion et sécurité

L'Annexe VII de l'Accord d'exécution définit le cadre de la collaboration dans la recherche sur l'hydrogène en tant qu vecteur énergétique. L'expérience acquise dans les trois sous-projets sera mise en commun entre les 6 pays participants. Par ailleurs, il est aussi prévu d'échanger des chercheurs et de l'appareillage scientifique.

La contribution suisse proposée se concentre sur le domaine du stockage de l'hydrogène. Il est prévu que la Suisse joue dans ce domaine un rôle de coordination entre participants. Les travaux seraient effectués à l'Ecole polytechnique fédérale de Zürich, l'Université de Genève et l'Institut fédéral de recherche en matière de réacteurs.

Chaque pays participant assume les coûts relatifs à sa contribution. Le financement (environ 400'000.-- fr.) est assuré jusqu'à fin 1985 par le Fonds national pour la recherche énergétique NEFF.

La durée du projet est prévue de s'étendre au moins jusqu'au 30.6.1986. Elle peut cependant être prolongée par le Comité Exécutif du programme hydrogène. Au cas où le financement ne serait plus assuré, le retrait de la participation suisse à ce projet est envisagé. Il est possible avec un préavis de 12 mois, ou même sans délai, si le Comité Exécutif l'approuve.

IV. Proposition

Le "Comité consultatif pour la recherche énergétique" (COCRE), organe interne de la Confédération qui réunit les délégués des Services de l'Administration et du Conseil des Ecoles polytechniques fédérales, s'est prononcé en faveur d'une participation suisse aux deux projets proposés, après s'être assuré de l'intérêt des milieux concernés.

Après consultation de l'Administration fédérale des finances, de l'Office fédéral des affaires économiques extérieures, de l'Office fédéral de l'éducation et de la science et de l'Office fédéral de la justice, nous vous soumettons ce qui suit:

Extrait du procès-verbal

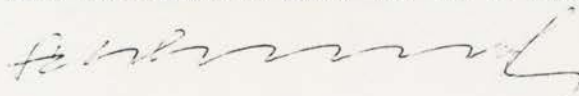
P r o p o s i t i o n

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DEPARTEMENT FEDERAL DES TRANSPORTS,
DES COMMUNICATIONS ET DE L'ENERGIE



Schlumpf

Appendices: - Programme Analyse de système, Annexe II
- Programme Hydrogène, Annexe VII

Pour co-rapport:

DFI

DFEP

DFF proposition du DFTCE du 1 mai 1984

DFJP

Extrait du procès-verbal:

DFAE (Direction du droit international public)
 DFI (Office fédéral de l'éducation et de la science)
 DFJP (Office fédéral de la justice)
 DFF (Administration fédérale des finances)
 DFEP (Office fédéral des affaires économiques extérieures)
 DFTCE (Office fédéral de l'énergie)

* Le projet du Programme relatif à l'analyse de systèmes en matière de technologies énergétiques du 13.1.1984

- Projet II: Echange d'informations

* Le projet du Programme de recherche et de développement en matière de production d'hydrogène à partir de l'eau du 6.10.1977

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Pour extrait conforme,

le secrétaire:

Agence internationale de l'énergie (AIE) de l'OCDE, à Paris,
Programmes de recherche

Vu la proposition du DFTCE du 3 mai 1984

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Pour extrait conforme,
le secrétaire:

OECD

ORGANISATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT

OCDE
ORGANISATION DE COOPERATION ET
DE DEVELOPPEMENT ECONOMIQUES

15th April, 1983

International Energy Agency

To: Participants in the Energy Technology Systems Analysis Project

Annex II

Dear Colleague,

Enclosed for your information is the new Annex II to the Implementing Agreement for a Programme of Energy Technology Systems Analysis, revised to reflect the discussion in the Executive Committee on 11th March, 1983. Also enclosed is a work proposal for this Task prepared by the Operating Agent in response to a request by the Executive Committee for greater specificity with respect to the proposed programme.

By virtue of the approval of the Executive Committee, this Annex II has become part of the Implementing Agreement. If you wish to participate in this Task, you should confirm your intention to do so by giving a Notice of Participation to the Executive Director of the Agency, sent to my attention.

Yours sincerely,

Susan Pearce

Susan Pearce
Office for Energy Research, Development
and Technology Applications

4448E

Energy Technology Systems Analysis Project (ETSAP)

Information Exchange Project

ANNEX II
INFORMATION EXCHANGE PROJECT

3. Specific responsibilities of the Operating Agent

1. Objective

The objective of this Task is for Participants to carry out a continuous exchange of information related to energy modelling, energy systems analysis and energy technology assessment in order to share experiences, stimulate co-operative studies and benefit from common analysis.

2. Means

The objectives shall be achieved by:

- (a) The exchange of work reports, memoranda and documents in the English language containing descriptions of methods, data inputs and results of energy systems studies;
- (b) Periodic workshops or seminar meetings (approximately 2 per year) for the project Participants and invited visitors dealing with national, regional and/or inter-regional aspects of:
 - (i) Energy supply and pricing;
 - (ii) Energy demand;
 - (iii) Energy modelling methods;
 - (iv) Energy technology characteristics;
 - (v) Energy systems characteristics;
- (c) The maintenance of the computer model MARKAL including the corresponding computer programmes and the consultative services of the support centre at KFA Jülich for MARKAL applications;
- (d) Preparation and distribution of a periodic newsletter (up to 3 per year) summarizing information resulting from the activities mentioned under paragraphs (a), (b) and (c) above.
- (e) Meetings held for the purpose of establishing new Tasks under the Implementing Agreement.

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- (a) Project Staff. For the purpose of carrying out the above objective, the Operating Agent shall establish within ninety days after the Annex has entered into force a Project Staff composed of a full-time project head, a part-time secretary and a student.
- (b) Co-ordination. The Operating Agent shall be responsible for overall co-ordination of the Task.
- (c) Access to Support Centre at KFA Jülich. The Operating Agent shall accept visits by persons from each of the other Participants at KFA Jülich subject to prior notification and agreement between the Participants concerned and the Operating Agent on timing and duration of the visit.
- (d) Additional Services of the Operating Agent. Services of the Operating Agent concerning MARKAL development, application and training may be provided in a bilateral agreement between the Operating Agent and any interested Participant.
- (e) MARKAL Availability. The versions of the Matrix Generator developed at KFA Jülich and Brookhaven National Laboratory during the period of Annex I, Programme of Equations and Report Generating Systems, current at the time of this Annex entering into force, shall continue to be made available by the Operating Agent in tape form to any IEA country and to the Commission of the European Communities without fee but upon payment of a charge covering tape costs and shipment. The Optimization Routine and the Matrix Generator language to be used in this Task are proprietary and are only available by arrangement with the commercial supplier.
- (f) Preparation of Draft Programme of Work and Reports. The Operating Agent will prepare and submit to the Executive Committee prior to its first meeting a draft programme of work for the three year period of the Task. The Operating Agent will prepare, and submit to the Executive Committee for approval, at the termination of this

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Annex, a draft final report on the activities carried out during the period of this Annex. Following approval, the Operating Agent will transmit the report to the Agency and to the members of the IEA Committee on Energy Research and Development.

The Committee on Energy Research and Development may, during this Task, propose additions to the Programme of Work. The Executive Committee shall, acting by unanimity, decide whether these proposals will be added to the Programme.

4. Funding

(a) Common Financial Obligations. Based upon a Project Staff as described in paragraph 3 above, the Operating Agent estimates the annual costs of the Support Centre in 1983 prices at DM 207,000. $\text{€ } 85,13 =$
The actual costs of maintaining and operating the Support Centre $\text{€ } 13,5$
will be divided equally among all Participants. If the number of $\frac{1}{255}$
the Participants changes, the shares of contribution to the costs will be adjusted proportionally. New Participants will pay the full share of the costs beginning with the project year in which they become Participants.

(b) Individual Financial Obligations. Aside from the contributions described in sub-paragraph (a) above each Participant shall bear all the costs it incurs in carrying out this Task.

5. Time Schedule

This Annex will enter into force on 1st July, 1983 and will remain in force for a period of three years. It may be extended by agreement of two or more Participants acting in the Executive Committee and taking into account any recommendation of the Agency's Committee on Energy Research and Development concerning the term of this Annex which shall thereafter apply only to these Participants. It may be extended by agreement of two or more Participants acting in the Executive Committee and taking into account any recommendation of the Agency's Committee on Energy Research and Development concerning the term of this Annex which shall thereafter apply only to these

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Participants. The Operating Agent may resign, without giving notice, with effect from the commencement of any period of extension of the Task.

6. Operating Agent

The Kernforschungsanlage Jülich GmbH (Germany).

7. Information and Intellectual Property

(a) Executive Committee Powers. The publication, distribution, handling, protection and ownership of information and intellectual property arising from this Annex shall be determined by the Executive Committee, acting by unanimity, in conformity with this Agreement.

(b) Right to Publish. Subject only to copyright restrictions, the Participants in this Annex (referred to in this Annex as the "Participants") shall have the right to publish all information provided to or arising from this Annex except proprietary information, but they shall not publish it with a view to profit, except as agreed by the Executive Committee, acting by unanimity.

(c) Proprietary Information. The Operating Agent and the Participants shall take all necessary measures in accordance with this Annex, the laws of their respective countries, and international law to protect proprietary information. For the purposes of this Annex proprietary information shall mean information of a confidential nature such as trade secrets and know-how (for example, computer programmes, design procedures and techniques, chemical composition of materials, or manufacturing methods, processes, or treatments) that is appropriately marked, provided such information:

- (1) Is not generally known or publicly available from other sources;
- (2) Has not previously been made available by the owner to others without obligation concerning its confidentiality; and

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(3) Is not already in the possession of the recipient Participant without obligation concerning its confidentiality.

It shall be the responsibility of each Participant supplying proprietary information to identify the information as such and to ensure that it is appropriately marked.

(d) Production of Relevant Information by Governments. The Operating Agent should encourage the governments of all Agency Participating Countries to make available or to identify to the Operating Agent all published or otherwise freely available information known to them that is relevant to the Task. The Participants should notify the Operating Agent of all pre-existing information, and information developed independently of the Task known to them which is relevant to the Task and which can be made available to the Task without contractual or legal limitations.

(e) Production of Available Information by Participants. Each Participant agrees to provide to the Operating Agent all previously existing information and information developed independently of the Annex, which is needed by the Operating Agent to carry out its function in this Task and which is freely at the disposal of the Participant and the transmission of which is not subject to any contractual and/or legal limitations:

(1) If no substantial cost is incurred by the Participant in making such information available, at no charge to the Task;

(2) If substantial costs must be incurred by the Participant to make such information available, at such charges to the Task as shall be agreed between the Operating Agent and the Participant with the approval of the Executive Committee.

(f) Use of Confidential Information. If a Participant has access to confidential information which would be useful to the Operating Agent in conducting studies, assessments, analyses, or evaluations, such information may be communicated to the Operating Agent but

shall not become part of reports, handbooks, or other documentation, nor be communicated to the other Participants except as may be agreed between the Operating Agent and the Participant which supplies such information.

(g) Acquisition of Information for the Task. Each Participant shall inform the Operating Agent of the existence of information known to the Participant that can be of value to the Task, but which is not freely available, and the Participant shall endeavour to make the information available to the Task under reasonable conditions, in which event the Executive Committee may, acting unanimously, decide to acquire such information.

(h) Reports on Work Performed under the Task. The Operating Agent shall provide reports on all work performed under the Task and the results thereof, including studies, assessments, analyses, evaluations and other documentation, but excluding proprietary information, to the Participants.

(i) Copyright. The Operating Agent may take appropriate measures necessary to protect copyrightable materials generated under this Task. Copyrights obtained shall be the property of the Operating Agent for the benefit of the Participants, provided, however, that Participants may reproduce and distribute such material, but shall not publish it with a view to profit, except as otherwise directed by the Executive Committee.

(j) Authors. Each Participant shall, without prejudice to any rights of authors under its national laws, take necessary steps to provide the co-operation with its authors required to carry out the provisions of this paragraph. Each Participant will assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.

8. Results

The results of this Task shall be:

- (a) Maintenance and improvement of an international capability for the analysis of new energy technologies and their future prospects; and
- (b) Periodic reports on workshops or seminar meetings and on analytical studies undertaken in connection with the Task.

10. Participants

The participants in the programme shall be the following:

1. The Government of the Netherlands

2. The Government of the Federal Republic of Germany

3. The Government of the United Kingdom

4. The Government of the French Republic

5. The Government of the Swiss Confederation

6. The Government of the Italian Republic

7. The Government of the Federal Republic of Austria

8. The Government of the Federal Republic of Yugoslavia

9. The Government of the People's Republic of China

10. The Government of the Democratic People's Republic of Korea

11. The Government of the Republic of North Vietnam

12. The Government of the Republic of South Vietnam

13. The Government of the Republic of Cuba

14. The Government of the Republic of the Congo

15. The Government of the Republic of the Democratic Republic of Congo

16. The Government of the Republic of the Central African Republic

17. The Government of the Republic of the Ivory Coast

18. The Government of the Republic of the Upper Volta

19. The Government of the Republic of the Benin

20. The Government of the Republic of the Niger

21. The Government of the Republic of the Chad

22. The Government of the Republic of the Mali

23. The Government of the Republic of the Senegal

24. The Government of the Republic of the Gambia

25. The Government of the Republic of the Guinea

26. The Government of the Republic of the Sierra Leone

27. The Government of the Republic of the Liberia

28. The Government of the Republic of the Ivory Coast

29. The Government of the Republic of the Ghana

30. The Government of the Republic of the Nigeria

31. The Government of the Republic of the Cameroon

32. The Government of the Republic of the Gabon

33. The Government of the Republic of the Congo

34. The Government of the Republic of the Zaire

35. The Government of the Republic of the Angola

36. The Government of the Republic of the Namibia

37. The Government of the Republic of the South Africa

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Work Proposal

The main subjects for the User's Club programme are:

1. Postoptimal Analysis
2. Energy Supply Modelling
3. Energy Demand Modelling
4. Technology Characterization

1. Postoptimal Analysis

The topic "Postoptimal Analysis" will be subdivided in three points:

a) Flow Analysis

The detailed analysis of energy and cost flow in the model (see J. Gundermann, G.C. Tosato, KFA Memo No. 360, Sept. 1981 and M. Finnis, Jul.-Spez-92, October 1980) will allow the participants to get a better understanding of the results of the MARKAL model. The study of the dual solution enables the analyst to find inconsistencies in the model. In this frame the question of demand-price consistency will be handled.

b) Range Analysis

The analysis of the range output which can be provided by the optimization software allows the energy system analyst to check the stability of the solution.

c) Parametric Studies

The topic "Parametric Studies" includes software activities (Question: How to use the parametrization capabilities of the optimizing software?) and the study of effects caused by continuously introduced changes of model elements (e.g. changing investment cost for an advanced power plant starting from the most optimistic view and going stepwise in the direction of the most pessimistic investment cost assumption).

2. Energy Supply Modelling

The task "Energy Supply Modelling" will provide the participants with a comparison of the MARKAL model with two of the main competitors in the field of energy supply system modelling: EFOM and MESSAGE. Further investigations of other energy supply models and submodels (e.g. for electricity generation, refineries) would be desirable. As a result of that information exchange activity a concept for future changes of the MARKAL model can be discussed.

3. Energy Demand Modelling

Due to the fact that nearly each country is using its own method/model to estimate the energy demands given to the energy supply models an exchange of know-how and experience would be valuable. In this context the possibility of coupling economy-energy models can be discussed.

4. Technology Characterization

In phase III of the ETSAP project the data management system MINERVA has been developed and implemented on the computer system Cam at KFA Jülich. At the moment the data management system includes all the technology data collected during phase III of the project. The MINERVA system allows the printing of the available technology data. Future updates which might be desired by single participants or by a future common technology characterization workshop are possible. In order to facilitate the construction of MARKAL input data sets the MINERVA system has to be expanded to bring the data in a format which can be processed by the matrix and report generators in use in the ETSAP project. This task could be combined with an extended data validator based on cross country comparison of the related data.

Hydrogen Storage, Conversion and Safety

1. Objective. The objective of this Task is to develop and evaluate technologies which are essential for the use of hydrogen as an energy carrier.

2. Scope. The scope of the work to be accomplished by the Participants will include the following interdependent Subtasks:

Subtask A : Hydrogen Storage: includes technologies relating to the storage of hydrogen as a compressed gas, as a liquid or as a hydride.

Subtask B : Hydrogen Energy Conversion: includes technologies relating to the conversion of the energy content of hydrogen into mechanical or electrical energy.

Subtask C : Hydrogen Safety: includes technologies relating to the development of safety criteria for the design, construction and operation of systems for hydrogen transport, storage and energy conversion.

The Participants will perform the activities contained in Table 1. Each Participant agrees to carry out the particular Subtasks assigned to it in Table 2.

Table 1: Summary of Initial Co-operative Activities

Subtask	Title	Canada	Germany	Japan	Sweden	Switzerland	United States
A. Storage	<ul style="list-style-type: none"> a) Metal hydride storage b) Liquid hydrogen storage c) Underground bulk storage d) Encapsulation in glass e) End-use systems analysis 	X X X	X	X	X X	X	X X
B. Conversion	<ul style="list-style-type: none"> a) Hydrogen fueled engine (Otto, Diesel, gas turbine) b) Fuel cell vehicle c) Combustion 	X	X X	X X			
C. Safety	Design parameters <ul style="list-style-type: none"> a) Material, type of loading, gas conditions b) Alteration of material properties by H₂ embrittlement under the conditions of a) 		X X	X X			X X
Capacity	Man-Years in 1983	9	6	12	1	7	12

Total capacity in 1983: 47 Man Years

Table 2: Initial Individual Contributions

Country/ Subtask	Subject	1983	
		Thousand US dollars	Man-Years included (MY)
Can 1/A	Microencapsulation in glass	160	(1,5MY)
Can 2/A	Safety test LH ₂ tank	165	(1,5MY)
Can 3/B	Hydrogen generation from liquid carriers	160	(1,5MY)
Can 4/B	Direct Injection Hydrogen-fueled engine with compression ignition	80	(0,5MY)
Can 5/B	Direct Injection Hydrogen-fueled diesel engine with ignition assist	70	(0,5MY)
Can 6/B	Gasturbine Hydrogen combustion research	250	(2,5MY)
Can 7/B	Ammonia-fuelled reciprocating engine	40	(0,5MY)
Can 8/A	Hydrogen end-use systems analysis	45	(0,5MY)
Ger 1/A	Magnetic refrigeration for liquefaction of Hydrogen	start 1984	
Ger 2/C	Effect of Hydrogen on low cycle fatigue behaviour in steels	330	(2MY)
Ger 3/B	Automobiles driven by nuclear energy (fuel cell)	370	(2,0MY)
Ger 4/B	Internal combustion engine	170	(2MY)

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Country/ Subtask	Subject	1983	
		Thousand US dollars	Man-Years included (MY)
Jap 1/A	Hydrogen storage by metal hydride	165	(3MY)
Jap 2/C	Hydrogen embrittlement of steels	84	(2MY)
Jap 3/B	Hydrogen transport by metal hydride	257	(3MY)
Jap 4/B	Direct low pressure Hydrogen injection engine	100	(2MY)
Jap 5/B	Flame combustion and catalytic combustion	100	(2MY)
Swe 1/A	Underground bulk storage of Hydrogen in mined caverns	60	(0,5MY)
Swe 2/A	Structure and dynamics of metal hydrides	42	(0,5MY)
Swi 1/A	Hydrogen storage by metal hydrides	200	(7MY)
USA 1/A	Cryogenic liquefaction using magn. refrigeration	600	(6MY)
USA 2/A *)	Mass/heat flow enhancement (metal hydride heat pump)	120	(1,5MY)
USA 3/A	Advanced metal hydride storage rare earth transition metals	170	(1MY)
USA 4/C	Hydrogen embrittlement (fatigue crack growth)	270	(2,5MY)
USA 5/C	Fundamental embrittlement (grain boundaries, multi-axial stresses)	80	(1MY)

*) The USA shall not provide arising inventions covered by patents, if any, in accordance with paragraph 9(1) of this Annex relating to the development and testing of a heat/mass flow enhancement device for a metal hydride assembly.

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Means

- a) Information Exchange: Each Participant shall provide to all Participants information arising from its work under this Task and shall submit to the Operating Agent by November 15 of each year a progress report on its work. The Operating Agent shall compile these reports and provide a copy of each report to each Participant.
- b) Exchange of Researchers and Equipment: The Participants may exchange researchers and equipment, on terms to be agreed upon in writing by the Participants involved in such an exchange. Upon agreement of such an exchange the Participants shall communicate the exchange to the Operating Agent. Each Participant shall on a regular basis provide the Operating Agent with reports on the performance of such exchanges, which the Operating Agent shall compile and distribute to all Participants.
- c) Workshops: The Participants will annually hold technical workshops to provide status of progress, identify problems which might have arisen, and discuss possible new directions of the work.
- d) Joint Experiments: The co-ordinated activities should, as far as possible, lead to the definition and performance of common projects. Co-operation in these activities shall require an amendment to this Annex.
- e) Contact Persons. Each Participant shall designate a person to be available to the other Participants and to the Operating Agent as the technical contact point for the work to be performed under this Annex.

Results

- a) The results of activities under this Annex shall be:

Subtask A. Storage

- (1) Metal hydride storage. Improvement of basic understanding of metal hydrogen interactions to develop better hydrogen storage materials.

- (2) Liquid hydrogen storage. Generation of test data necessary for the design and the fabrication of liquid hydrogen onboard storage systems and establishment of a data base for magnetic refrigeration technology and for the design of a compact medium sized hydrogen liquefier.
- (3) Underground bulk storage. Determination of optimal layout of mined caverns for liquid or compressed hydrogen gas storage.
- (4) Encapsulation in glass. Experimental demonstration of hydrogen storage systems based on high pressure microencapsulation in glass.

Subtask B. Conversion

- (1) Hydrogen fueled engine. Experimental demonstration of various hydrogen fueled engines (Otto, Diesel, gasturbine) with low and high pressure injection systems.
- (2) Fuel cell vehicle. Experimental demonstration of electric traction by electricity from hydrogen fuel cells.
- (3) Combustion. Research and Development on catalytic combustion techniques with hydrogen.

Subtask C. Safety

Improvement of design parameters of storage, transport and end use systems minimizing the possibility of hydrogen related failures.

- b) The Subtask results will be documented in individual reports to be prepared by each Participant on its specific field of work assigned to it in Table 2. In addition, each Participant will prepare a comprehensive report on its work under this Annex containing detailed recommendations for possible common projects to be performed by the Participants.

5. Time Schedule. This Annex will enter into force on 24th May 1983 and will remain in force until 30th June, 1986. It may be extended by agreement of two or more of the Participants acting in the Executive Committee and taking into account any recommendation of the Agency's Committee on Energy Research and Development concerning the term of this Annex which shall thereafter apply only to these Participants.
6. Responsibilities of the Operating Agent. The Operating Agent shall be responsible for the overall management of this Annex and for implementing the decisions of the Executive Committee.
7. Funding.
- a) Each Participant shall bear its own costs in carrying out the task, including costs of calculating, reporting and travel expenses of representatives.
 - b) The cost of meeting organisation shall be borne by the Host Country.
8. Operating Agent. Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt e.V. (DFVLR).
9. Information and Intellectual Property.
- a) Executive Committee's Powers. The publication, distribution, handling, protection and ownership of information and intellectual property arising from activities conducted under this Annex shall be determined by the Executive Committee acting by unanimity, in conformity with this Agreement.
 - b) The Right to Publish. Subject only to patent and copyright restrictions of this Annex, the Participants shall have the right to publish all information provided to or arising from this Annex, except proprietary information.
 - c) Proprietary Information. The Participants and the Operating Agent shall take all necessary measures in accordance with this paragraph,

the laws of their respective countries, and international law to protect proprietary information, provided to or arising from this Task. For the purpose of this Annex, proprietary information shall mean information of a confidential nature such as trade secrets and know-how (for example: computer programmes, design procedures and techniques, chemical composition of materials, or manufacturing methods, processes or treatments) which is appropriately marked, provided such information:

- (1) Is not generally known or publicly available from other sources;
- (2) Has not previously been made available by the owner to others without obligation concerning its confidentiality; and
- (3) Is not already in the possession of the recipient Participant without obligation concerning its confidentiality.

It shall be the responsibility of each Participant supplying proprietary information and of the Operating Agent in respect of the arising proprietary information to identify the information as such and to ensure that it is properly marked.

- d) Identification of Information by Governments. The Operating Agent shall encourage the governments of all Agency Participating Countries to make available or identify to the Operating Agent all published or otherwise freely available information known to them that is relevant to the Task.
- e) Identification of Information by Participants. The Participants shall identify to the Operating Agent all pre-existing information and information developed independently of their undertakings in this Annex known to the Participants, which is relevant to the Task and which:
 - (1) Can be made available to the Task without contractual or legal limitations;
 - (2) Will or can only be made available to the Task with contractual or legal limitations.

- f) Reports on Work Performed under the Task. The Operating Agent shall provide reports on all work performed under this Task and the results thereof, other than proprietary information, to the Executive Committee.
- g) Arising Inventions. Inventions made or conceived in the course of or under this Task (arising inventions) shall be owned in all countries by the inventing Participant. Information regarding inventions on which patent protection is to be obtained by a Participant shall not be published or publicly disclosed by the other Participants until patent application has been filed, provided, however, that this restriction on publication or disclosure shall not extend beyond six months from the date of receipt of such information. It shall be the responsibility of the inventing Participant or of the Operating Agent to appropriately mark reports which disclose inventions which have not been appropriately protected by the filing of a patent application.
- h) License of Proprietary Information and Patents Needed for Task. Each Participant agrees to license all pre-existing proprietary information and pre-existing patents solely-owned or controlled by it, which are necessary for use in the Task, and all arising proprietary information and inventions covered by patents to any other Participant for use in its undertakings in this Annex only, at no cost to the other Participants. If such proprietary information or patents are partially owned or controlled by a Participant, then efforts shall be made by the Participant to reduce or eliminate as far as possible the benefits that might accrue to it.
- i) License of Proprietary Information and Patents for Other Reasons. Each Participant agrees to license all pre-existing proprietary information and patents solely owned or controlled by it which are necessary for practicing the results of the undertakings in this Annex and which have been utilized in the Task, and all arising proprietary information and inventions covered by patents to the other Participants, their governments, and the nationals of their respective countries designated by them on reasonable terms and conditions for use in all countries for hydrogen storage, conversion and safety.

The Participants agree to license all arising proprietary information and inventions covered by patents to all Agency Participating Countries on reasonable terms and conditions for use in their own country in order to meet their energy needs.

- j) Copyrights. Each Participant may and the Operating Agent shall take appropriate measures necessary to protect copyrightable material generated under the Task. Copyrights obtained shall be the property of the Participant or the Operating Agent, provided, however, that other Participants may reproduce and distribute such material but shall not publish it with a view to profit.
- k) Inventors and Authors. Each Annex Participant will, without prejudice to any rights of inventors or authors under its national laws, take all necessary steps to provide the co-operation from its authors and inventors required to carry out the provisions of this Article. Each Annex Participant will assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.
- l) Determination of "National". The Executive Committee may establish guidelines to determine what constitutes a "national" of a Participant.

10. Participants in this Annex. The Contracting Parties which are Participants in this Annex are the following:

- [The Department of Energy, Mines & Resources (Canada)]
- [The Kernforschungsanlage Jülich GmbH (Germany)]
- [The Government of Japan]
- [The Energy Research Commission (Sweden)]
- [L'Office Fédéral de l'Education et de la Science du
Département Fédéral de l'Intérieur]
- [The Department of Energy (United States of America)]