

アイスランドの水素エネルギー社会化計画

インギムンドール シグフソン

アイスランド大使館

108-0074 東京都港区高輪 4-18-26

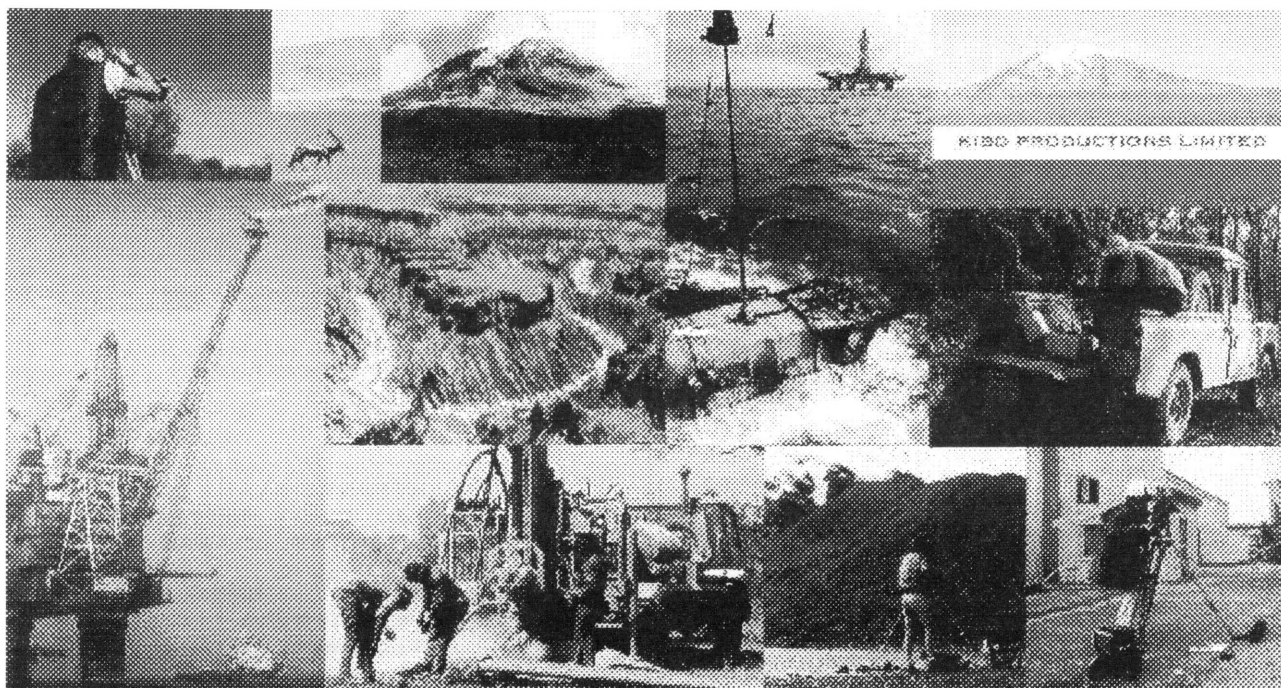
Challenge to The Hydrogen Energy Society in Iceland

Ingimundur Sigfússon

Ambassador of Iceland

Embassy of Iceland

4-18-26 Takanawa, Minato-ku, Tokyo 108-0074



Challenge to The Hydrogen Energy Society in Iceland

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The background

- Iceland possesses no fossil fuels except some peat reservoirs
- However compared to population Iceland possesses abundant energy resources:
 - The economically harnessable hydroenergy has been estimated at 30 TWh/yr of which only 1% has been harnessed.
 - The harnessable geothermal energy has been estimated at 200 TWh/yr (thermal) (equivalent to 20 TWh/yr electricity), of which 1% has been harnessed.

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Type of energy used in Iceland

Energy Type	Percentage
Geothermal	50%
Oil	30%
Hydro	19%
Coal	1%

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Energy consumed in Iceland in different activities

Activity	Percentage
Space Heating	40%
Industry	27%
Transport	16%
Fishing	12%
Residential	5%

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Greenhouse gas emissions


- Transport 1/3
- Fishing Industry 1/3
- Industry and other 1/3

The total antropogenic CO₂ emission (1995 values) =
2.640.000 tonn

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Using hydrogen/methanol as fossil fuels, overall emissions

- By using hydrogen on all vehicles it is possible to reduce Iceland's overall greenhouse gas emissions 33% (methanol 10%)
- By including also the fishing fleet reduction of overall emissions can be reduced to, by using:
 - Hydrogen 66%
 - Methanol 40%



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Hydrogen powered private cars



On-board storage of pressurised hydrogen gas in hydrogen powered PEM fuel cell private cars seems unrealistic mainly for two reasons:

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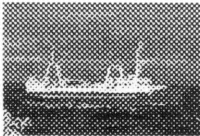
Hydrogen powered private cars

- The operating distance on each filling would be much too short and a very complicated infrastructure for distribution and filling stations would be required
- Thus the concept currently developed to store the hydrogen onboard the cars bound in methanol seems to be the most attractive method

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Hydrogen powered fishing vessels

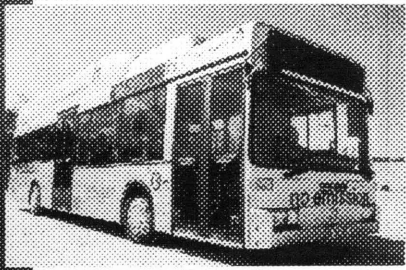
As for the powering of fishing vessels there are in principle no obstacles to further development provided that PEM fuel cells in the megawatt range become commercially available.



As in the case for private cars the hydrogen can be stored onboard fishing vessels bound in methanol

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Hydrogen powered buses



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Hydrogen powered city buses

In the NEBUS the hydrogen is stored on board as pressurised gas in sufficient amount to operate the bus

- ~250 km on each tank filling
- which is the same distance as the Reykjavik city buses travel in each day on the average
- A single bus fleet also can be operated from one filling station which makes no need for complicated infrastructure for distribution of the fuel
- No further purification of electrolytically produced hydrogen is required for use in the PEM fuel cells

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Methanol production

- Metals industries in Iceland (aluminum, ferro-silicon, etc) emit 618.000 tons of CO and CO₂ annually
- This amount mixed with hydrogen can make 450.000 tons of methanol
- If these 450.000 tons methanol could replace some 400.000-450.000 tons of fossil fuel which is more than 60% of the total imports, total greenhouse gas emissions from Iceland could be cut 55%

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Methanol production in Iceland

- Methanol production in Iceland is still far from reality, it is an option to be evaluated
- Some of the participants in the Icelandic venture have concerns regarding using methanol
- The critical issue is the evaluation of the toxicity of methanol

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Icelandic New Energy

- Is a joint-venture company owned by:
 - VestOrku hf (EcoEnergy)*
 - DaimlerChrysler AG
 - Norsk Hydro ASA
 - Shell Hydrogen BV
- Vestorka (EcoEnergy) is owned by Icelandic New Venture Fund, University of Iceland, IceTech, Fertilizer Plant, Suðurnes Regional Heating Corporation, Iceland National Power Company and Reykjavík Energy

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The purpose of the company

"to set up a joint venture company to investigate the potential for eventually replacing the use of fossil fuels in Iceland with "hydrogen based fuels" and create the world's first hydrogen economy"

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But why was Iceland chosen?

- Iceland has the unique circumstance that you can operate a "hydrogen based fuel project" in a CO₂ neutral environment
- Iceland has similar standards and transportation system as most other developed countries and therefore the results can easily be adapted elsewhere
- Iceland has experience in converting from one energy source to another

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But why was Iceland chosen?

- It is very important that the project makes a big impact (real-scale project)
- The new technology needs to be evaluated under severe weather conditions
- The government of Iceland has announced that it is aiming to transform Iceland into a hydrogen society in the near future

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Transformation of Iceland into a hydrogen society

Phase 1. Demonstration and evaluation project running 3 hydrogen buses in Reykjavík



Phase 2. Gradual replacement of the Reykjavik city bus fleet and possibly other bus fleets with fuel cell buses

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Transformation of Icelandic society into a hydrogen society (cont.)

Phase 3.
Introduction of "hydrogen based" fuel cell cars for private transportation

Phase 4.
Fuel cell vessel demonstration and transportation project

Phase 5.
Total replacement of the present fishing fleet by fuel cell powered vessels

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Historical milestones in Icelandic energy economy

Timeline of milestones:

- 1840: Settlement of Iceland
- 1860: Imported coal and coke
- 1880: Imported liquid fossil fuel
- 1900: Hydroelectric energy
- 1940: Geothermal space heating
- 2000: Advent of a hydroelectric hydrogen economy
- 2040: Transformation into hydrogen society completed

Wood and peat

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Icelandic hydrogen society

In this way transformation of Iceland into a hydrogen economy/society could possibly be completed in the years 2030-2040

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