

Research path within the SMART-H2



UNIVERSITY OF ICELAND
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Overview



HÁSKÓLI ÍSLANDS

- 1. THE SMART-H₂ STRUCTURE**
- 2. CONTEXT WITH FORMER RESEARCH**
- 3. GOALS**
- 4. ISSUES AND TIMELINE FOR**
- 5. CURRENT STATUS AND STUDIES**
- 6. PREPARATIONS**
 1. Hydrogen station
 2. Ship
 3. Publications
 4. Conclusions



Vistorka - SMART H2 Project steering committee



SMART H₂ FC - path

**SMART H₂ Research
path**
UNIVERSITY OF ICELAND

SMART ICE-H₂ path

FC vehicles

H₂ infrastructure

Boat demo

– ICE vehicles

Hybrids, Battery
Plug-ins
Methane
Other
(availability)

ECONOMICS

Cost-benefit analysis

National impact

ENVIRONMENT

Emissions

LCA / well to wheel

SOCIAL RESEARCH

Social surveys

Social acceptance

**Impact Assessment
Different Fuels and Vehicles in Iceland**

*Direct
management* ———

*Information
pathways* - - - -

**Support for
governmental policy**

Research SMART-H2

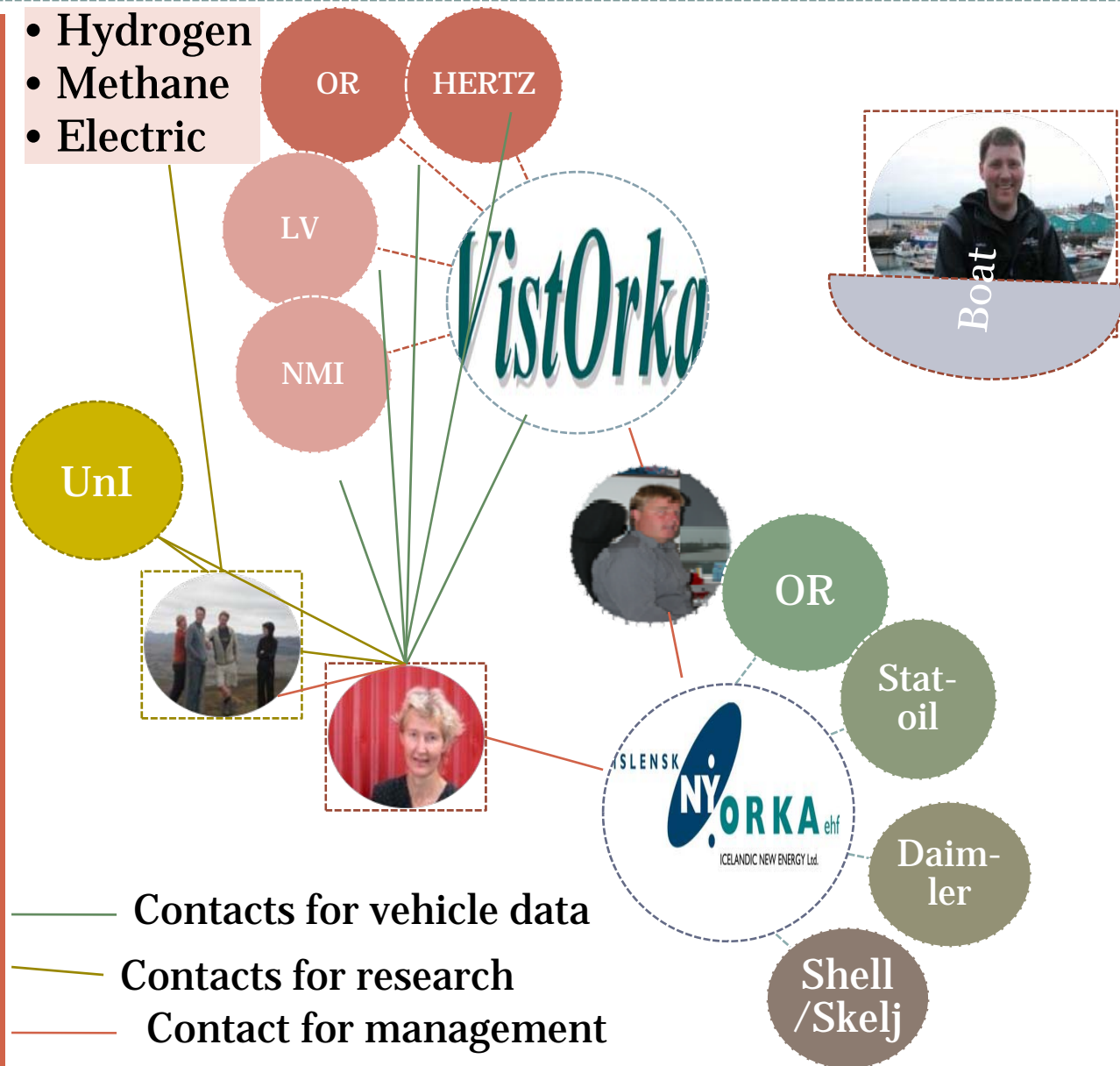
Context with associated companies

Context with former research

Goals

Issues and timeline

Preparations



Research SMART-H2

Context with
associated
companies

*Context with former
research*

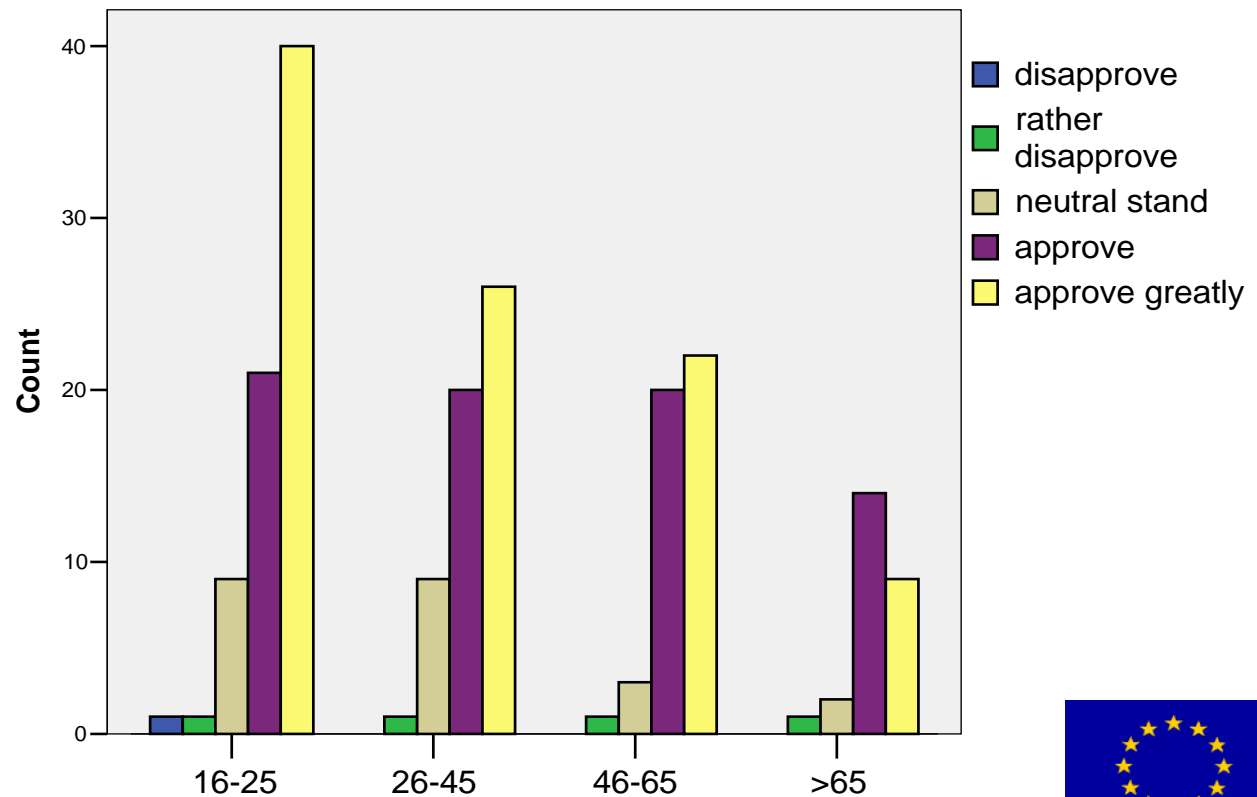
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What is your reaction to the idea that hydrogen should replace oil as the main fuel for buses, cars and vessels (Reykjavik, 2001 2004, 2005)?



Hydrogen vehicles – hydrogen economy

Reykjavik



93% posit



34% posit



62% posit



43% posit

Percentage of interviewees

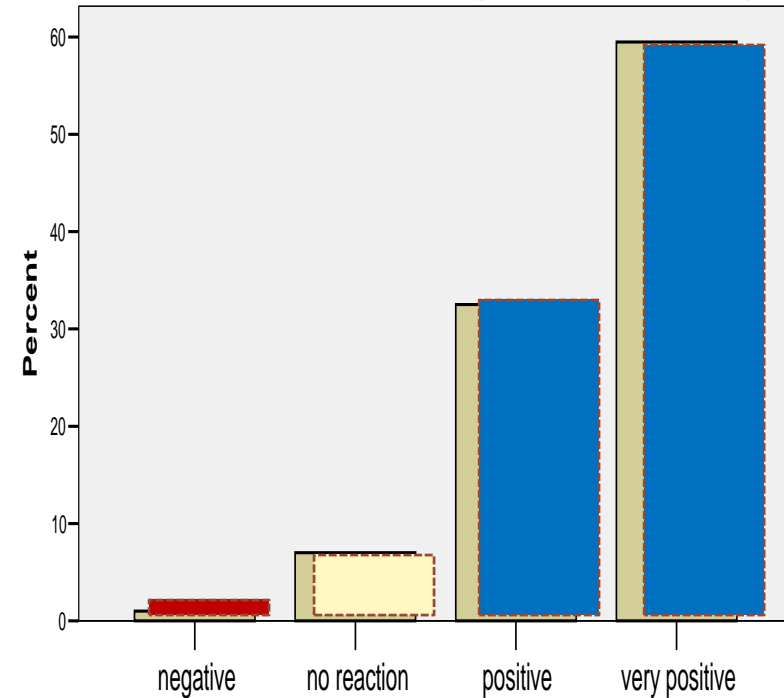
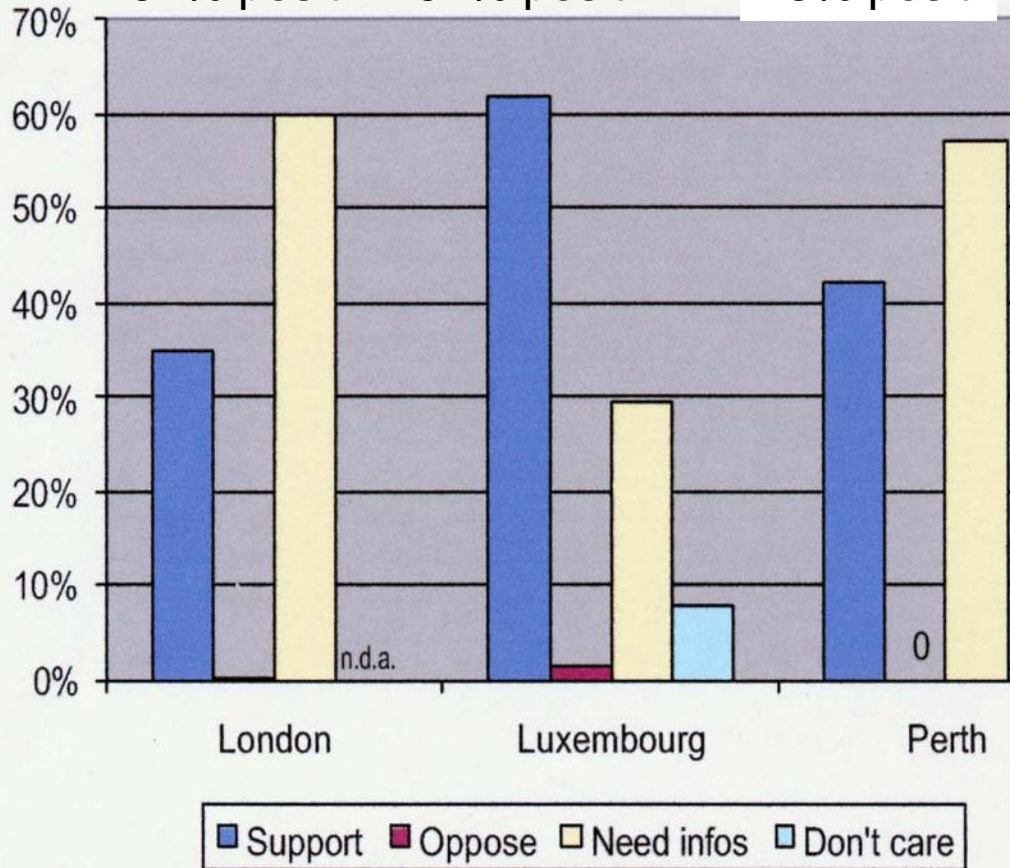


Fig. 3: 'How would you feel about hydrogen powered vehicles being introduced in London/Luxembourg/Perth?'

Research SMART-H2

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- Free associations with hydrogen
- London – Luxemburg - Perth

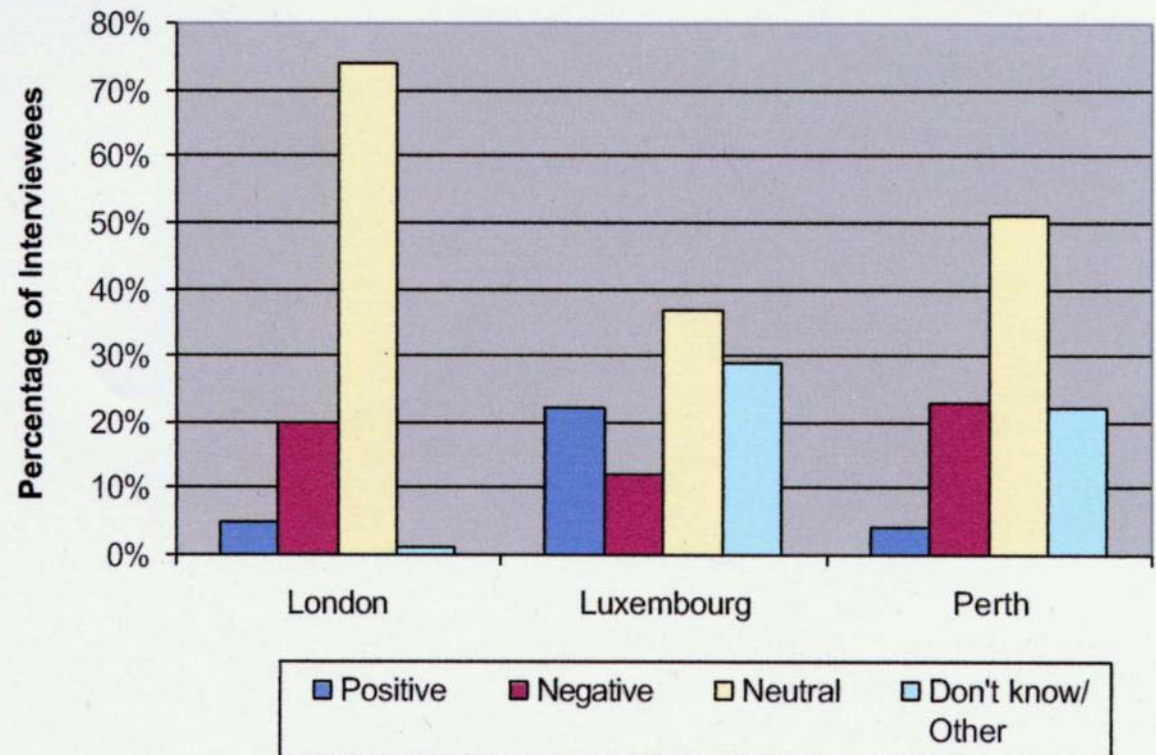


Fig. 1: Free associations to hydrogen

Research SMART-H2

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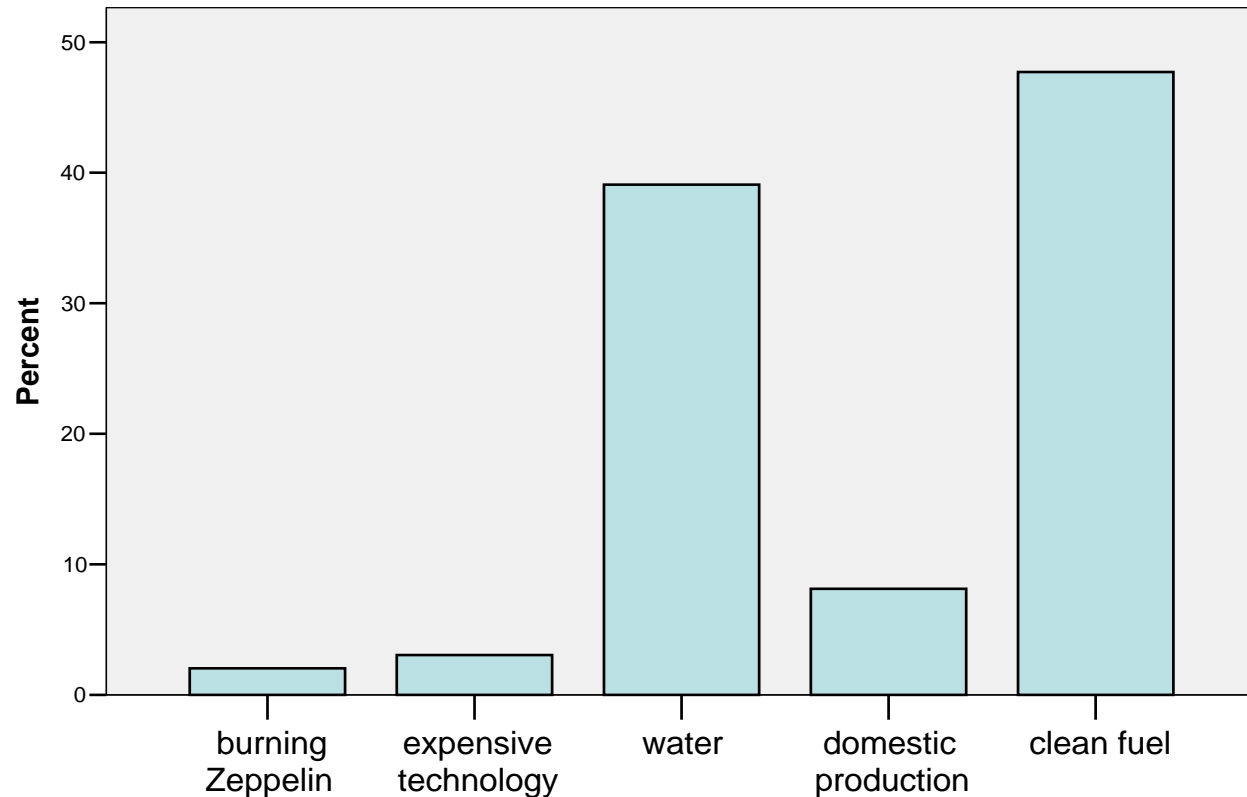
Goals

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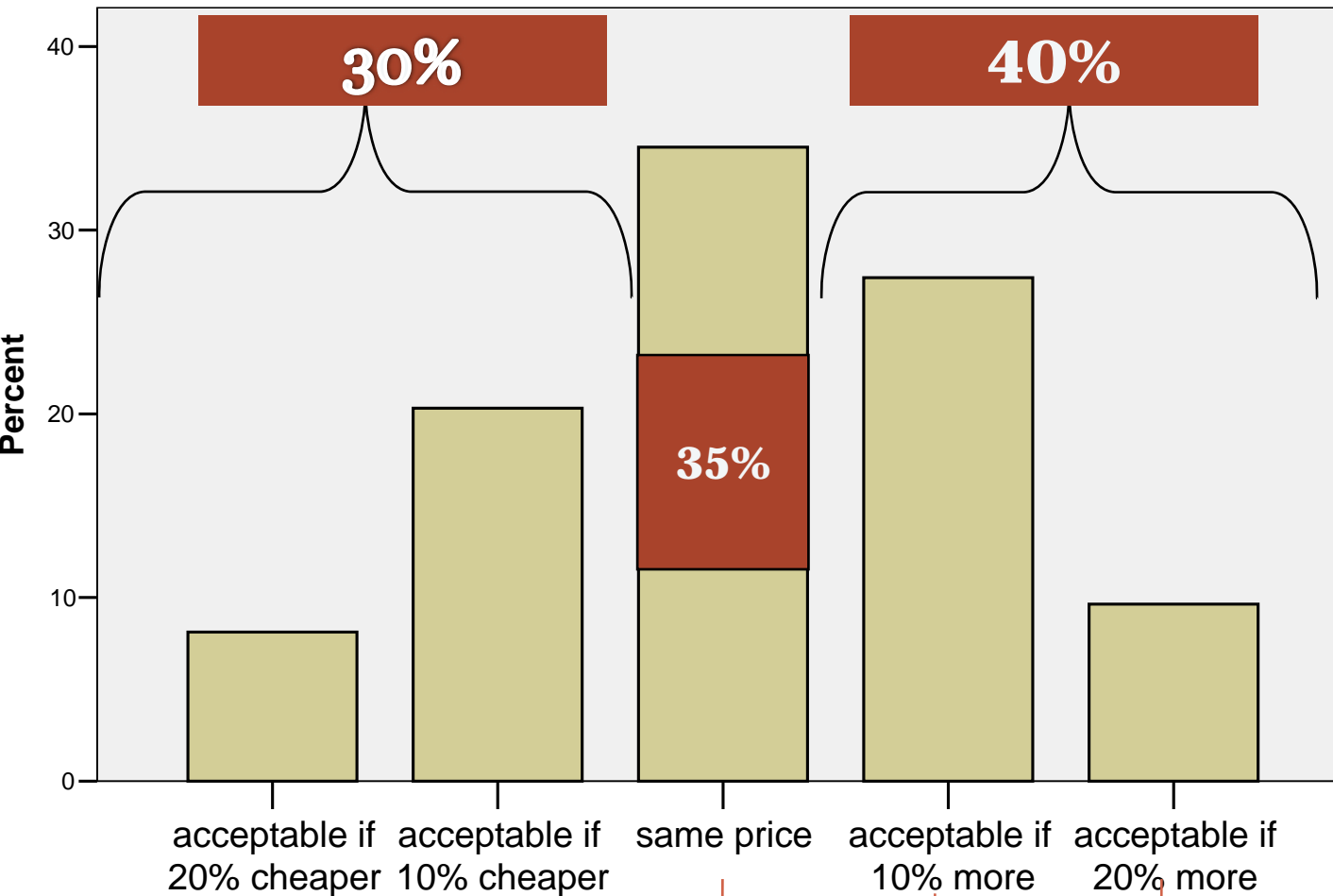
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- Free associations with the word **vetni**
(*hydrogen*) Reykjavik 2004



Presumably hydrogen will be more expensive fuel than gasoline. Which price would accept (2004)?



Price of gasoline in 2008

2004



INE's main EU projects after ECTOS 2004 – 2007, useful framework



HY-Approval preparing for the
pan-European hydrogen
station; Infrastructure

HyFleetCUTE – prolonged
testing with buses and
station, techn and society.

Sustainable Green Fleets
promoting clean vehicles

NEEDS, new energy technology
and related externalities

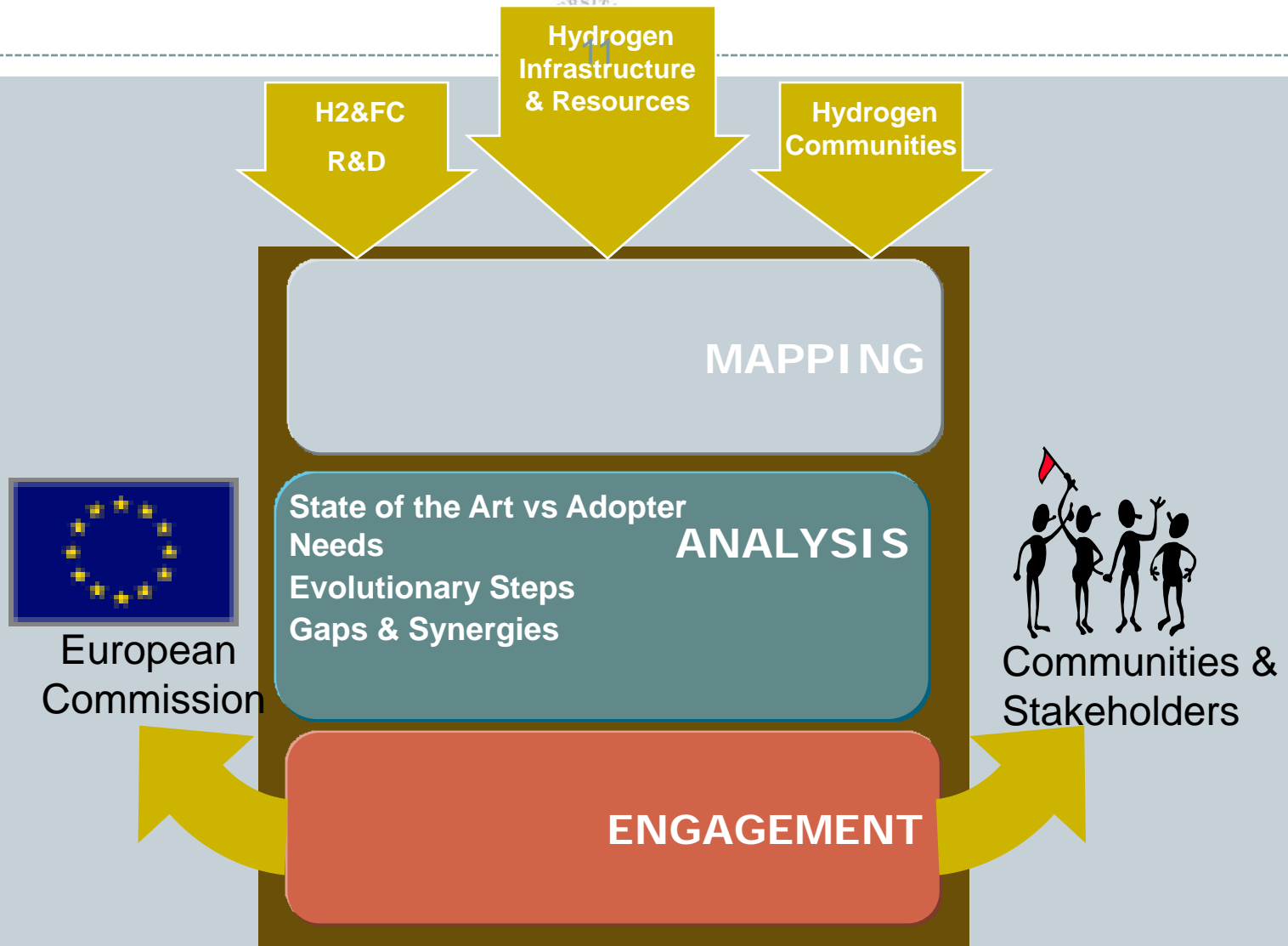
R2Hycom; collections on
technology, communities,
know how, economic and
social capital to facilitate
hydrogen integration

Involving stakeholders during the
introduction of clean energy

HyApproval

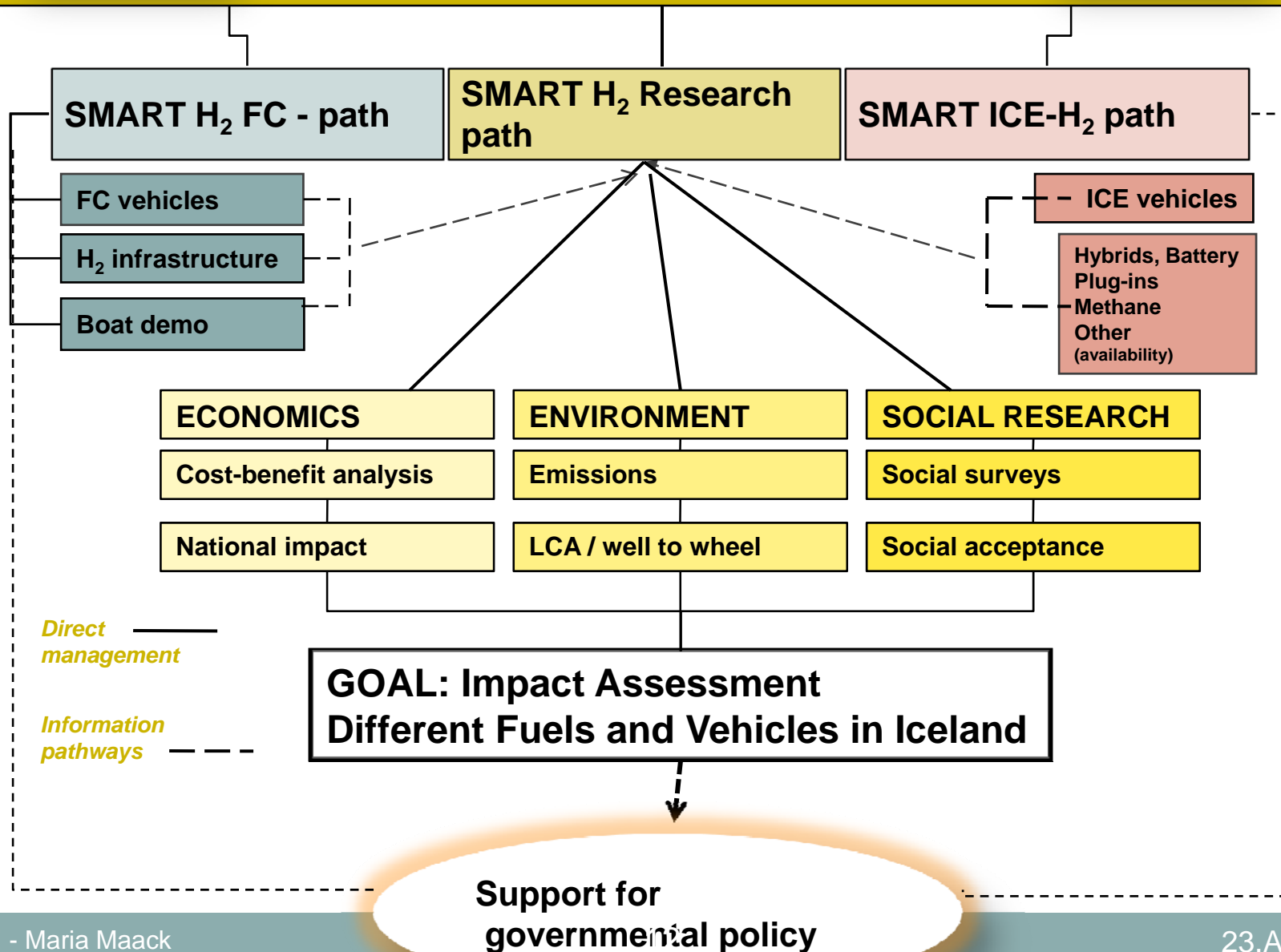


The Roads2HyCom Think Tank





Vistorka - SMART H2 Project steering committee



Research SMART-H2

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*Current status and
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| | | 2007 | 2008 | 2009 | 2010 |
|----|----------------------|------------------|--------------------|----------|--------------|
| 1 | Mgmt | | | | |
| 2 | Vision | WORKSHOP | jan | | |
| 3 | Outline accepted | OUTLINE ACCEPTED | feb | revision | |
| 4 | Interviews | | | | SOCIO |
| 5 | Tourists | | MARKETIN | Dec 08 | |
| 6 | Data format | | TECHN | Jun 08 | |
| 7 | Oil economy | | ECONOMIC | Jun 08 | |
| 8 | Quality WTT | | ENVIRO/ECONMIC | 08-09 | |
| 9 | H2WTT | | ENVIRO/ECONIC | Jun 08 | |
| 10 | Data col- lection | | SOCIAL / TECHNICAL | 07 - 09 | |
| 11 | Nose/tail | | | | |
| 13 | TTW | | | Sep 09 | |
| 14 | process tests | | vetni | Apr 08 | metan etanól |
| 15 | results | | | | |

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- **Card reader, station**

- Fuel (kg)
- Odometer end (km)
- Date /time



- **Forms in vehicles**

- °C
- Pressure
- Gender
- Impressions of drivers



- **Maintenance bay**

- Number & nature of failures
- Spare parts



- Methane similar
- Electric similar

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Bíll no.....

Owner of car/eigandi bíls

Please facilitate our research by fill ing out the blue boxeshank you so much! Vinsanlegafyllið út bláu reitina í hvert skipti sem bíl er skilað takk takk!

| Date Dagsetning | Sex and age of driver Kyn/ aldur ökumanns | | | ODO meter after use / km staða | Amount of tanked fuel? Hve mikið var kg H ₂ eða lítrar eldsneytis /fuel | How were driving conditions/Hvernig var færðin | | |
|--------------------|--|----|-------|--------------------------------------|---|---|------------------|--------------------------------|
| dd/mm/ar | kvk | kk | aldur | km staða | | ice / hálka | wet / blautt | C°? |
| | | | | | | dry / þurr | heavy traffic | out of town /untanbæja r |

What is your imp
and filling? Write
you ma

Hvað finnst þér
eiginleika, áfyllin
óvænt, hvað m

SMART-H₂ - „findings”



- Water from engine mixes with oil in Prius
- The team added an engine heater
 - Does fuel efficiency change?
 - Does the oil /water mix disappear?



| Month | Average Out-door Temp | Average fuel consumpt |
|-------|-----------------------|---------------------------------|
| Jan | -0,2°C | 1,76 kg/100km |
| Feb | -0,2°C | 1,76 kg/100km |
| March | +0,8°C | 1,48 kg/100km With Motor heater |

- No meter at the electricity heater
- The vehicle was always heated before use, but mostly overnight

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SMART-H₂

Vantar mynd
frá Marlu Maack

Hydrogen is a type of fuel that is manufactured by splitting water particles in a process called electrolysis, splitting hydrogen from oxygen. The hydrogen is collected in pressure tanks while the oxygen is released into the atmosphere.

Vatni er elysaðt sem blöð og til með því að láta súfnagn (þagnir) farið verður. Við þá koma vatnsmóðirnar í þessu loftslagi, vatni og súfnu. Vatnið er afhafið í þessu loftslagi og súfnu er dregin út frá loftslagi.



When hydrogen is used in Fuel Cells, its energy content is transformed into electricity while the hydrogen reacts with oxygen in the atmosphere and returns to its previous state of water.

Hydrogen is made from water and reacts to water at the release of energy. The energy given off is an electric current that can power any type of motor.

Þegar vatni er notað í rafstöðum losnar oxíð þess í formi rafstraums og vatnið gengur í samband við súfnu og vatnið er afhafið.

Vatnið er afhafið á vatni og vatnið er afhafið. Vatnið er afhafið á vatni og vatnið er afhafið.



A hydrogen fuel cell has been installed on the White-Water ferry, serving as the main power source for the electrical equipment on board. It replaces an auxiliary power unit that was on board. Since the fuel cell is a silent power module, it gives the captain the possibility to shut down the main engine when refueling is close and offer you to watch in silence.

Í þessu ferðunum hefur verið notað fyrst um borð í ferðunum. Þetta er fyrsta ferðin sem hefur verið notað. Þetta er fyrsta ferðin sem hefur verið notað. Þetta er fyrsta ferðin sem hefur verið notað.



The main reasons for testing hydrogen as a type of fuel are:

- Fuel security and price of oil
- Decreased emission
- Self reliance

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A hydrogen refueling station stands at Gröðla 3 in Reykjavík. It also produces the hydrogen through electrolysis, compresses it and stores. Hydrogen car drivers can fill up their tanks at the refueling station, which is open to public. Customers must follow instructions carefully to prevent any mishaps. Hydrogen is stored under much pressure and all hydrogen equipment is carefully regulated.



Vatnið er afhafið á vatni og vatnið er afhafið. Vatnið er afhafið á vatni og vatnið er afhafið. Vatnið er afhafið á vatni og vatnið er afhafið.

Hydrogen experiments began in Reykjavík, Iceland, with the experimental use of hydrogen buses in 2009-2010. The latest hydrogen project, SMART-H₂, has installed a fuel cell aboard a boat and runs 30 service vehicles in the streets of Reykjavík. Data on these vehicles is constantly being collected as well as on other similar vehicles driving around the city.



Tilraunir með vatnið hefur verið notað fyrst um borð í ferðunum. Þetta er fyrsta ferðin sem hefur verið notað. Þetta er fyrsta ferðin sem hefur verið notað. Þetta er fyrsta ferðin sem hefur verið notað.

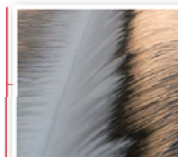
On top of the fuel cell experiment on board the Sling, the SMART-H₂ project also has 30 hydrogen vehicles driving in the company's service fleet. Data is collected on their performance as well as on the user's experience. Similar data will be collected on battery cars, methane vehicles and plug-in hybrid cars.



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Abilities to use fuel cell as a type of fuel are:

- Fuel security and price of oil
- Decreased emission
- Self reliance



Elding
ADVENTURE AT SEA

VARMARAF

ISLENSK NYORKA hf
ISLANDIC NEW ENERGY

ICELANDIC HYDROGEN

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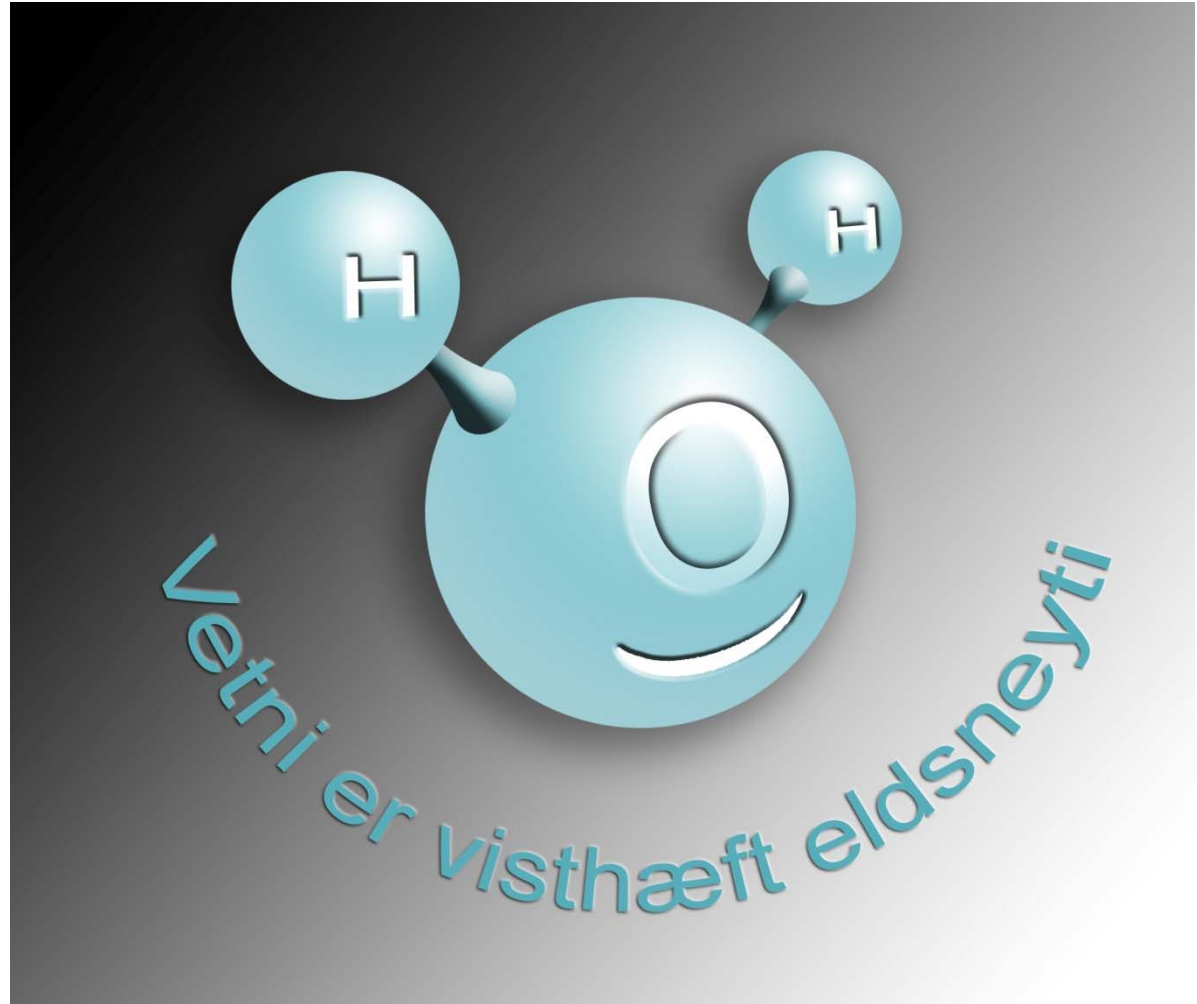
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We make Hydrogen happen!