

# Welcome to Trondheim and SINTEF

**Dr. Steffen Møller-Holst**

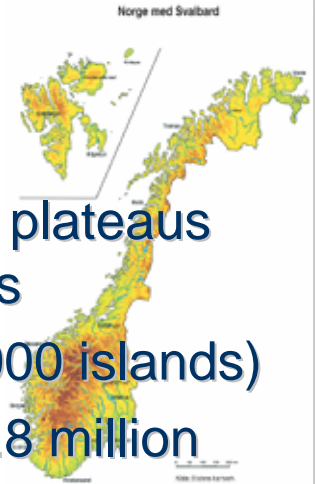
Research Manager H<sub>2</sub> & Fuel Cells

FC-Tools, Trondheim, June 23<sup>rd</sup>, 2009



# Norway - characteristics...

- A cold country...
- Only 3 % arable land
- 70 % consists of high plateaus and rugged mountains
- A long coastline (50.000 islands)
- Small population of 4.8 million



# Founding Nidaros in year 997

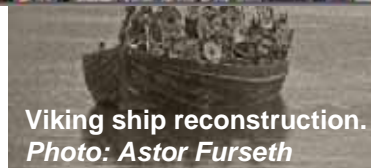


King Olav Tryggvason



Peter Nicolai Arbo

Prevails as the religious capitol of Norway



Viking ship reconstruction.  
Photo: Astor Furseth



Cicignon's city plan from 1681



# Norway in the 1800s

- Population doubled (1 to 2,2 mill.)
- Agricultural output stagnated. Fertilizer was becoming increasingly important
- Poverty and malnutrition
- Substantial emigration to America (800 000 (1825-1925))
- Norway to a large extent relied on natural resources:
  - Fishery, mining and timber export
- Some mechanical and textile industry emerged
- A large international fleet was established
- British Chemist William Crookes (1898):
  - *“The world would be saved if nitrogen could be added to the soil”*



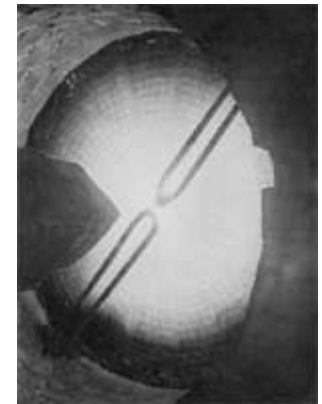
Source: <http://www.hydro.com/en/About-Hydro/Our-history/>

# Norway in the early 1900s

## ■ Creativity:

- Race to find the right process to extract / bind  $N_2$  from the air:
  - *Prof. Kristian Birkeland & Samuel Eyde*
  - *Otto Schönherr/Johannes Hessberger, “Badiche” (BASF)*
  - *Bradley and Lovejoy (Atmospheric Products Co.), Niagara falls*

## ■ Birkeland & Eyde succeeded (1903) with the arc technology; an invention which proved critical to mankind



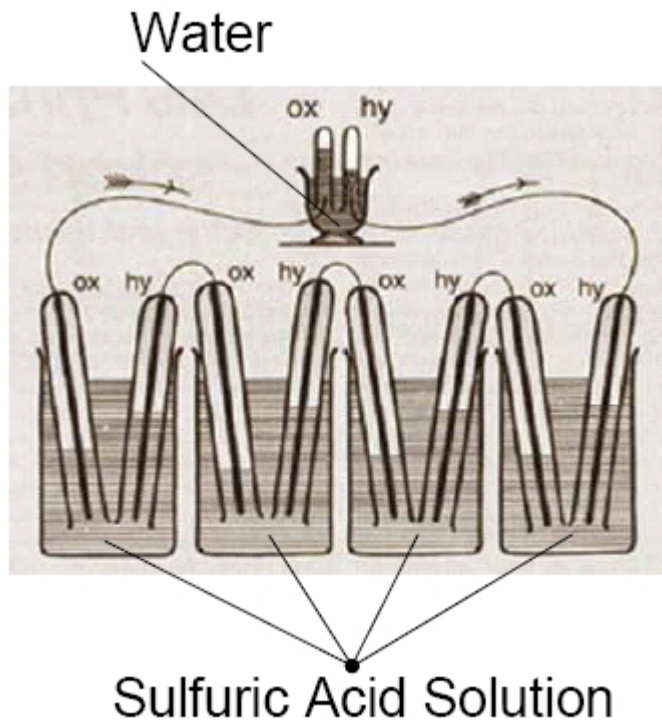
## ■ Establishment of Norsk Hydro (1905)



## ■ What about education in Technical Disciplines?

Source: <http://www.hydro.com/en/About-Hydro/Our-history/>

# Year 1838

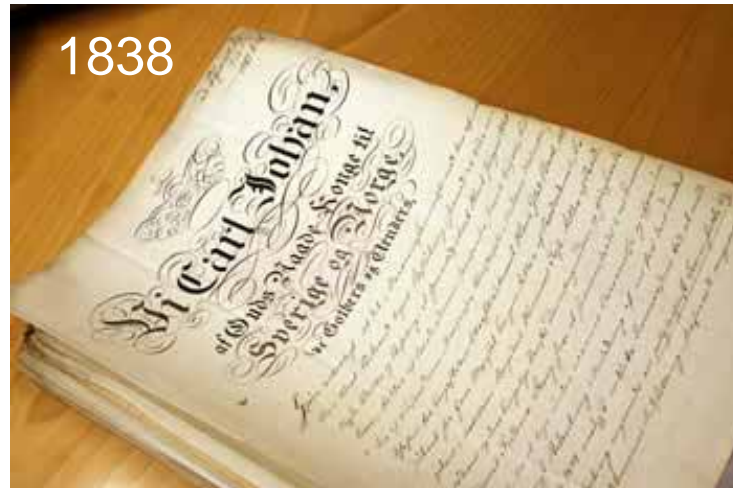


*King Carl III Johan\* of Sweden and Norway declares the need for technical education*

*\* In Sweden named Carl XIV Johan*

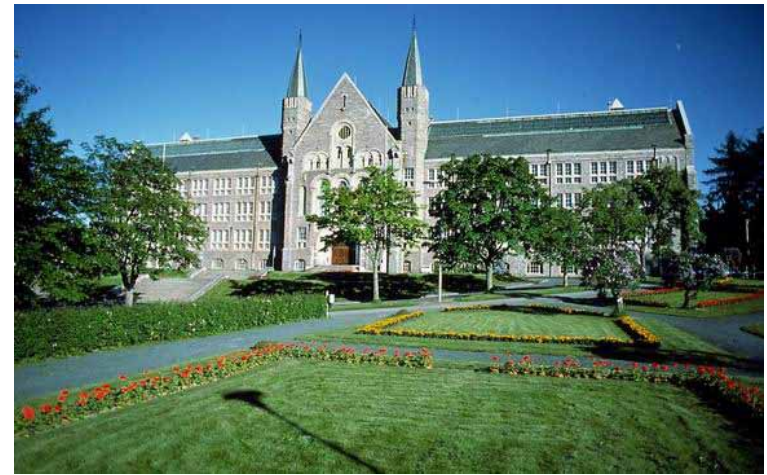


# It took 72 years to reach agreement!



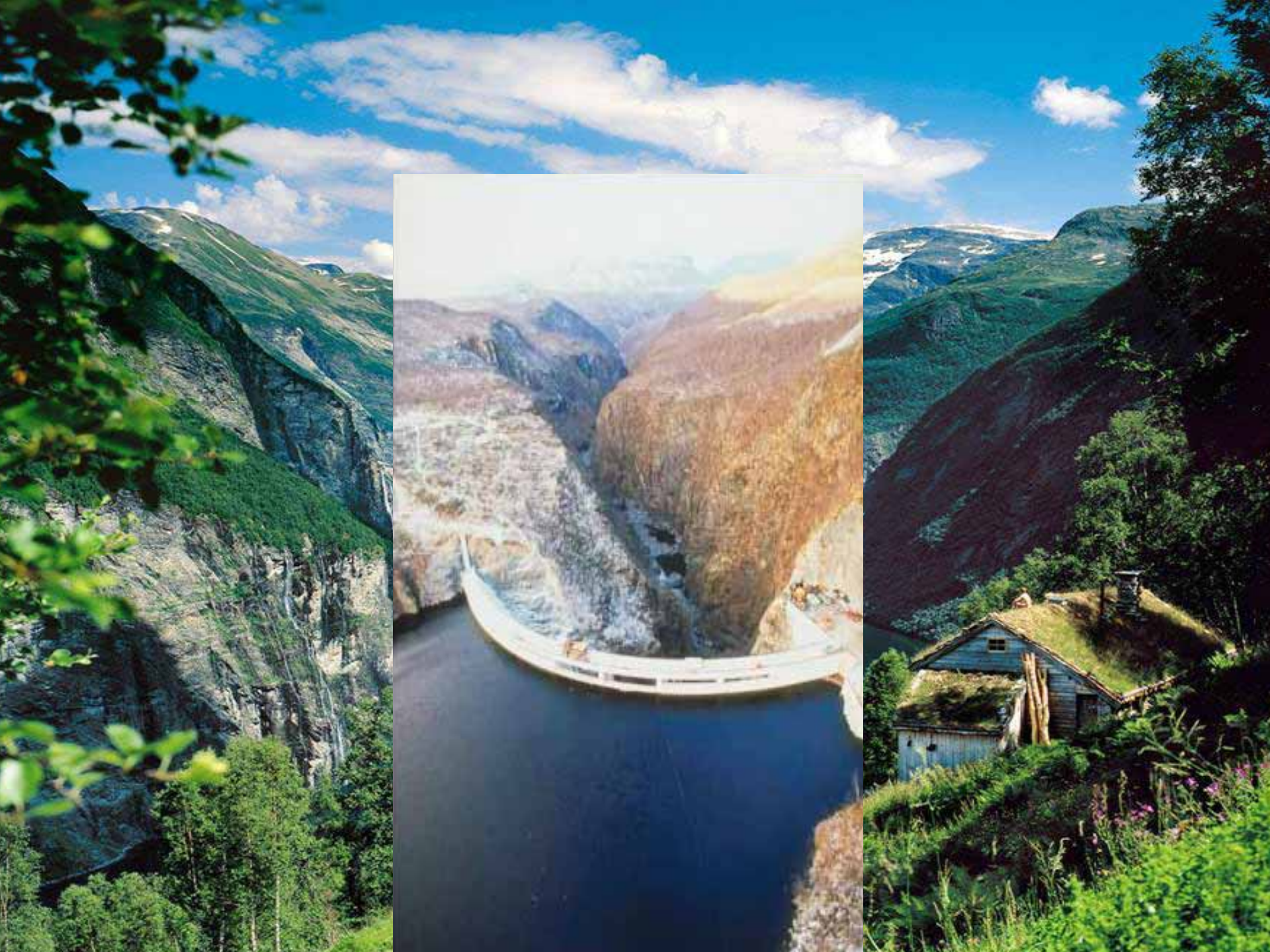
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*\* In Sweden named Carl XIV Johan*



*Inauguration of NTH in 1910 by King Håkon VII*







# Hydro Power → Electrochemical Industry



- Hydro-electric power formed the basis for power intensive industries:
  - Initially Norsk Hydro's fertilizer production
  - From 1928 hydrogen production by electrolysis for ammonia
- Following World War II
  - *Aluminium production*
  - *Electrochemical- and Electrometallurgical industry*played a crucial role in the re-building
- Currently ~ 1/4 of stationary domestic power consumption



*Karmøy Plant, Photo: Tor Alvseike, Hydro*

## Our vision

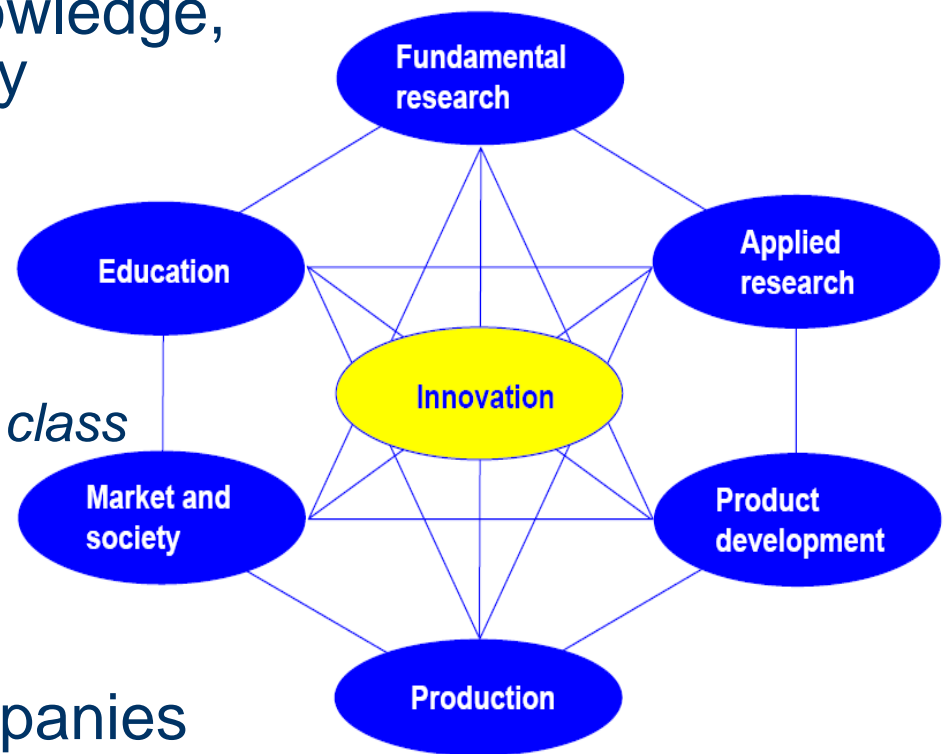
*Technology for a better society*

## Our role

We create value through knowledge, research and innovation by

- *Developing technology*
- *Supplying system solutions for sustainable development*
- *Building and operating high class research laboratories*

- thereby facilitating the establishment of new companies



Ca 2150 employees

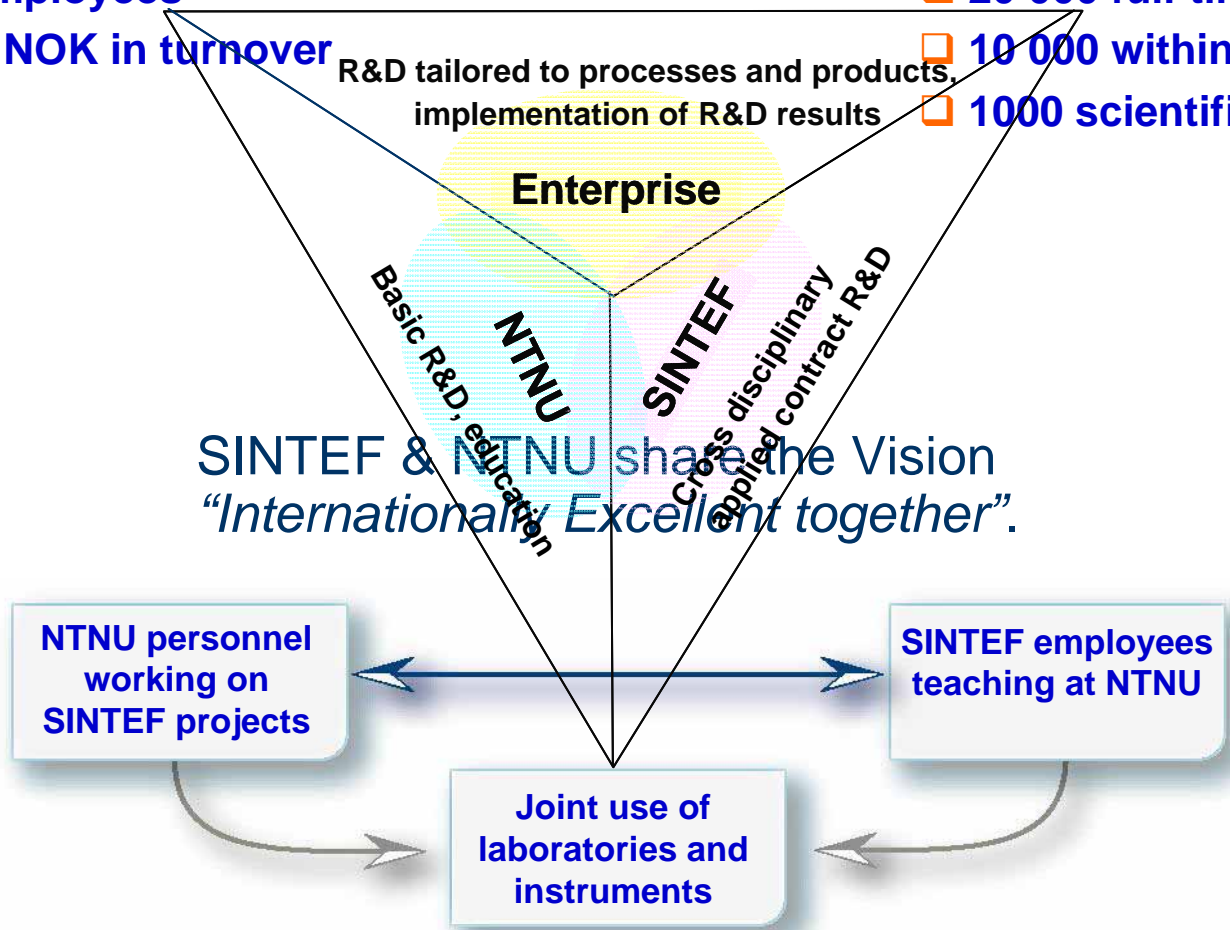
2,3 Billion NOK in turnover

20 000 full-time students

10 000 within technology

1000 scientific employees

R&D tailored to processes and products,  
implementation of R&D results



# **SINTEF** 's characteristics

- **Multidisciplinary research groups with international top-level competence in specific fields**
- **Perceive opportunities, and work to create successful outcomes for our customers and partners**
- **Commit to social responsibility and maintain high ethical standards in all our activities**



# SINTEF 's main asset



- **Employees:**
  - 2145 from 64 countries
  - 43 % of the researchers holds a PhD
  - Female share of researchers increased from 18 to 26% since 2004
- **Our basic values:**  
*Honesty, Generosity, Courage and Loyalty*

# Emission-free air-conditioning

- Current air-conditioning systems add to the greenhouse effect when their working media leak.
- Norwegian CO<sub>2</sub> vehicle air-conditioning technology is licensed to two major Japanese manufacturers.
- First cars with these systems rolled off Toyota's production lines in 2002.
- EU requires air-conditioning systems in new cars to be changed by 2011. Germany recommends the automotive industry to apply CO<sub>2</sub>-based systems.



Technology for a better society

- A result of the CARE-W project  
(Computer-Aided REhabilitation of Water networks)

# Watching over Las Vegas' water

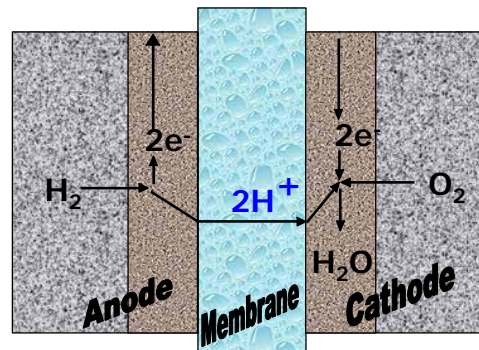
- Ensures that the right pipeline is replaced at the right time

- The software package sold to local authorities in the US and to 10 – 15 Norwegian local authorities

# Why hydrogen and fuel cells?

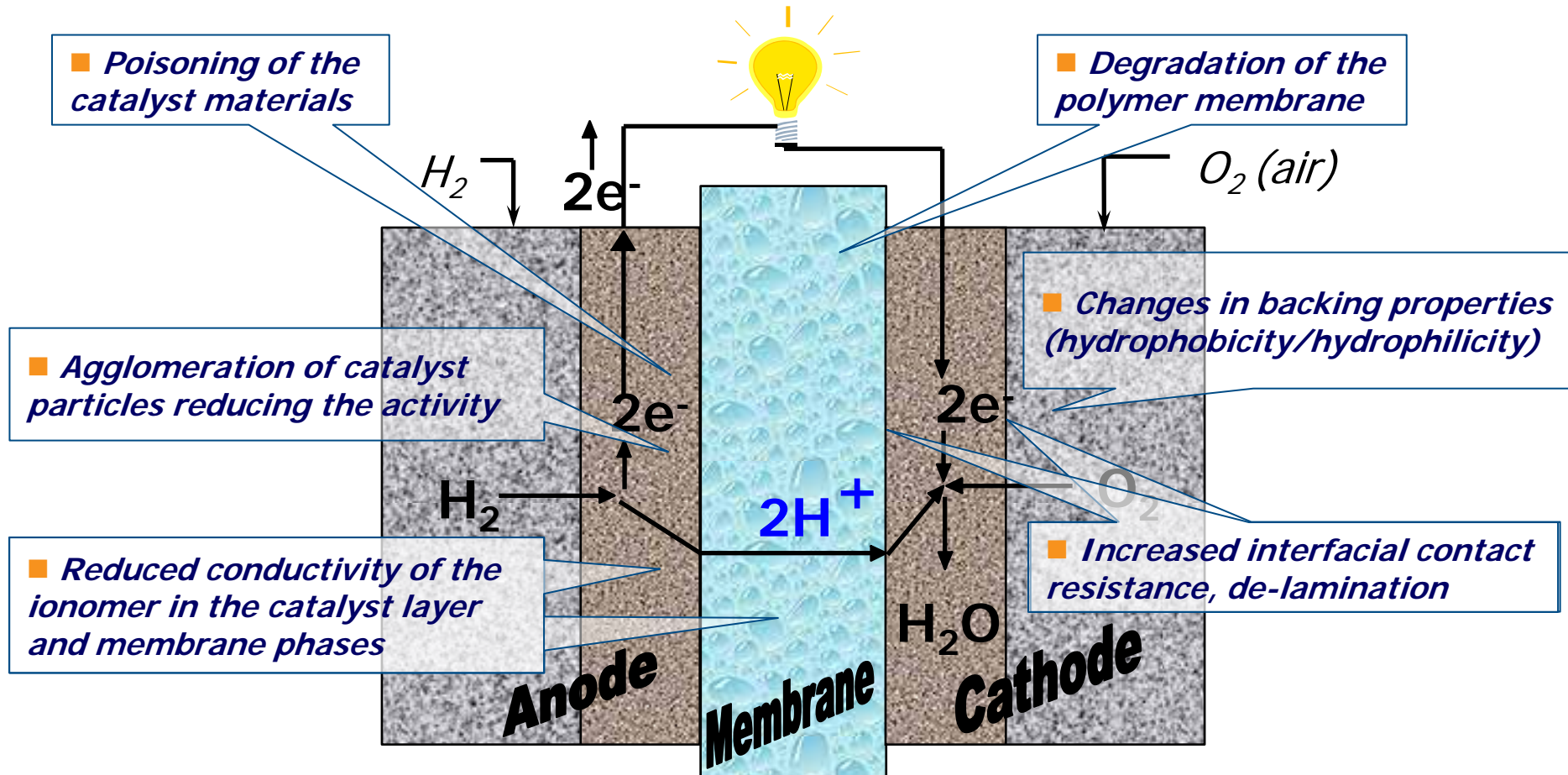
- Strong expertise within electrochemical processes
- Large scale H<sub>2</sub>-production from electrolysis since 1928
- World Class competence within materials technology
- Solid Oxide Fuel Cells (since mid 1980s)
  - Two large national programs (NorCell and Mjølnær)
  - Experimental as well as theoretical/modelling work

- PEM Fuel Cells



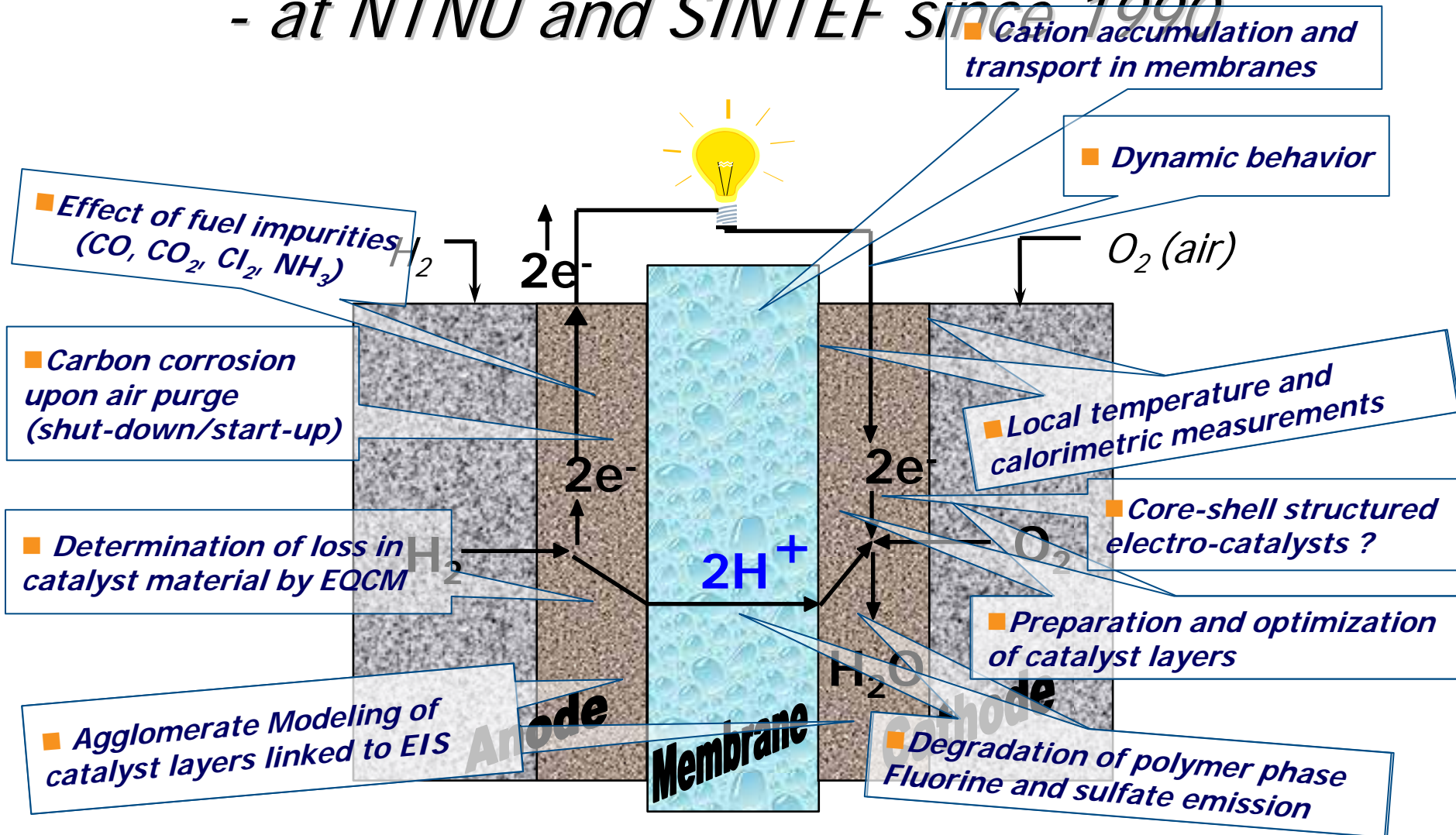


# Degradation in PEM fuel cells



# Activities within PEM fuel cells

- at NTNU and SINTEF since 1990



2009-09-15

# N.ERGHY members as of Oct. 2008



**Totalling: 57 members**

**€ ~ 250 M€**

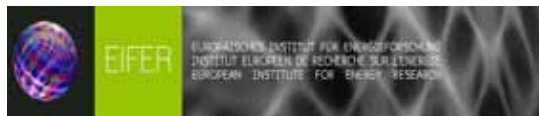
**> 2000 researchers**



Forschungszentrum Jülich in der Helmholtz-Gemeinschaft



CESI RICERCA



# N.ERGHY members as of Oct. 2008



research on fuel cells & hydrogen

57 members from 16 countries

1 in EL, NL, CZ, CH, PT, AT

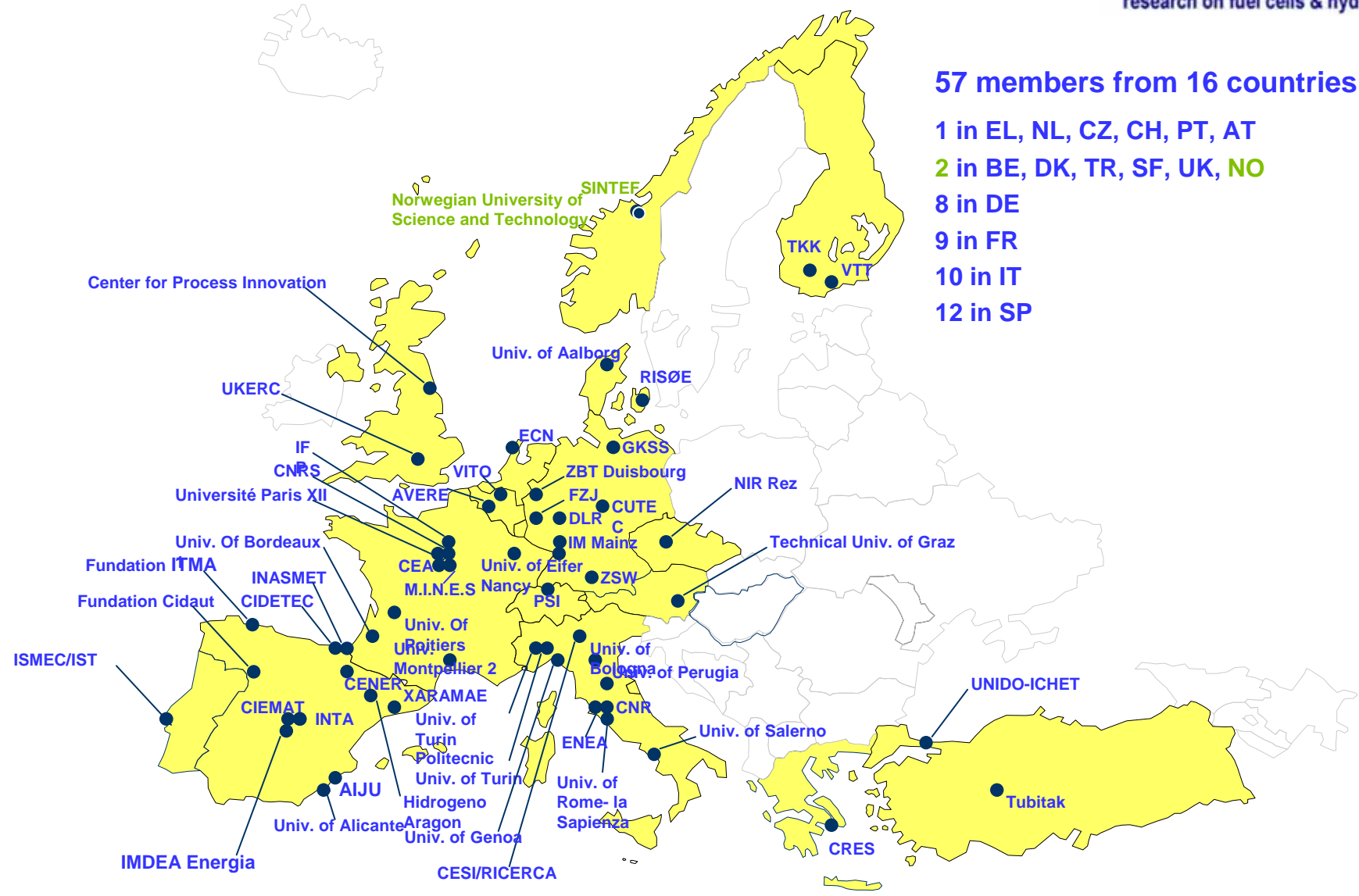
2 in BE, DK, TR, SF, UK, NO

8 in DE

9 in FR

10 in IT

12 in SP



# International engagement

## New European Research Grouping for fuel cells and Hydrogen

- *N.ERGHY, Official partner in Fuel Cell and Hydrogen JU*
- *Represents the R&D-community*
- *Budget for FCH JU:*
  - *940 mill € (2008-2013)*
- *Cooperates with Industrial Grouping on prioritizing R&D activities*
- *FCH JU 1<sup>st</sup> call:*
  - *3 projects invited to negotiations; “KEEPEMALIVE” (ECN)*
- *Second call to be launched June 30<sup>th</sup>*



**N.ERGHY's Executive Board**

Wish you all a  
fruitful symposium!

Thank you for  
participation