

*The spatial development  
concept of the Polish maritime  
areas in the context of the  
approaching „hydrogen era”*

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BSR EXPERTISE

# Maritime Areas

- Seas are increasingly important resource for all developed countries
- Maritime areas are the driving force for Europe
- EU goal: „developing a thriving maritime economy, without negative impact on the environment”
- Maritime Policy:  
Green Paper → Blue Book
- Broad consultation phase



# The strategic approach

- The process of thinking, debating and shaping the future
- Foresight
  - important tool in shaping the science and technology policy
  - systematic and comprehensive identification of development trends in science and technology
  - identifying areas of critical importance to maximize the economic and social benefits
  - used in all economically developed countries of the world
- Foresight Poland 2020
  - Large development potential, it is impossible to identify the areas in which Poland is a natural leader
  - Development policy based on the selective support of the most promising sectors

# SWOT for Baltic Sea Region

- **S** (Strengths)
  - *significant potential*
  - *experience in networking and cooperation*
- **W** (Weaknesses)
  - *divergent development paths of countries*
  - *differences in advancement of research, innovation and production*
- **O** (Opportunities)
  - *specific knowledge of regions in the area of innovation*
  - *consolidation and coordination of research activities in strategic areas*
- **T** (Threats)
  - *environmental threats - ecological disequilibrium resulting from pollution by nutrients - increasing toxic algae blooms*
  - *economic risks – energy supply risks and lack of adequate infrastructure*

# HYDROGEN

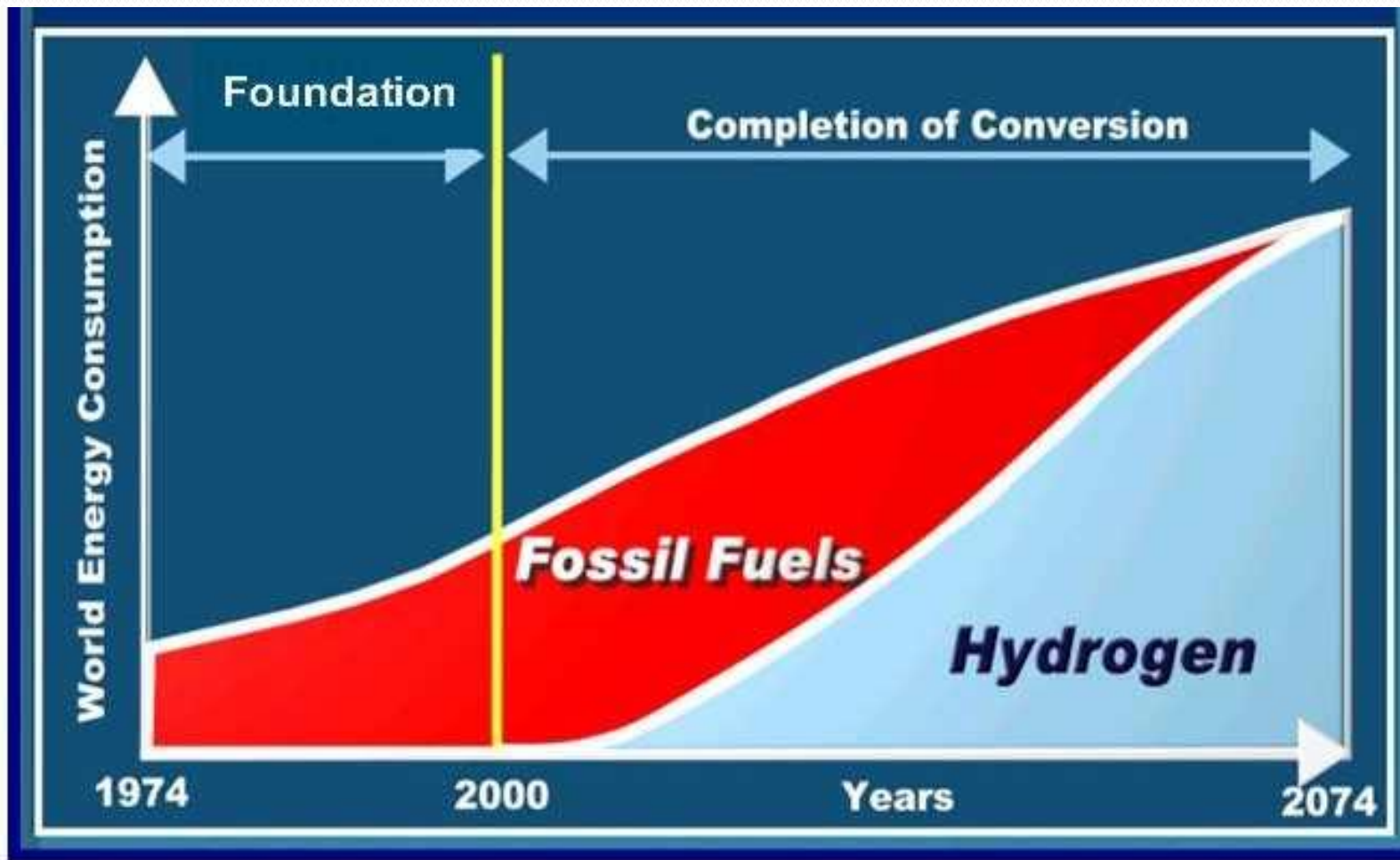


- Widespread in nature and its stocks are virtually inexhaustible
- Does not breach the balance of nature - a product of combustion is pure water
- In physiological terms is an inert substance
- Unlike petroleum-based fuel is not toxic
- Has a high calorific value
- Compared with electricity, it can be easily stored in gaseous, liquid or solid state
- Industry can easily transform their technology to use it as an energy carrier instead of natural gas

# Baltic Sea – the driving force for growth

- How to use the strengths of the Baltic Sea to reduce risks and ensure a higher standard of living of its citizens?
- How to strengthen the weaknesses of the Baltic Sea Region to seize the opportunities and overcome differences in development of states?
- The Baltic Sea should be protected and purified along with the production of clean, renewable energy - based on specific knowledge and research conducted in the region.
- The solution could be the production of hydrogen from toxic cyanobacteria.
- It will allow reducing problems related to the protection of the marine environment and lack of energy security, using the research currently conducted in the region and allowing the transition to a hydrogen economy

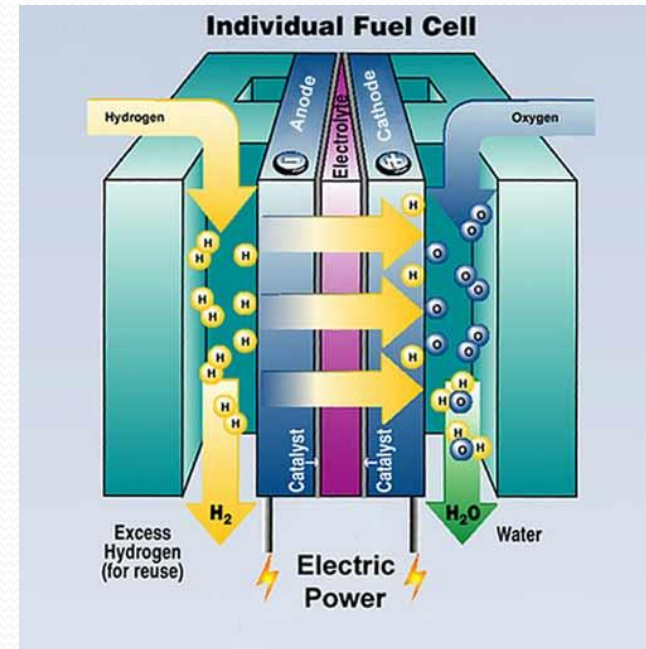
XXI century is called „The Hydrogen Era“



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION  
INTERNATIONAL CENTRE FOR HYDROGEN ENERGY TECHNOLOGIES

# Fuel cells

- Hydrogen is the fuel for fuel cells which are the generators of energy
- Fuel cells are characterized by cleanness and efficiency
- Fuel cell technology is extensively developed in the EU, Japan and USA
- The U.S. agency NASA uses liquid hydrogen to power the space shuttle launched into space since 1970
- Currently, fuel cells are used for the construction of batteries for mobile devices, low and high power generators, stationary power plants and vehicles



Source: [www.hydrogenhighway.ca](http://www.hydrogenhighway.ca)

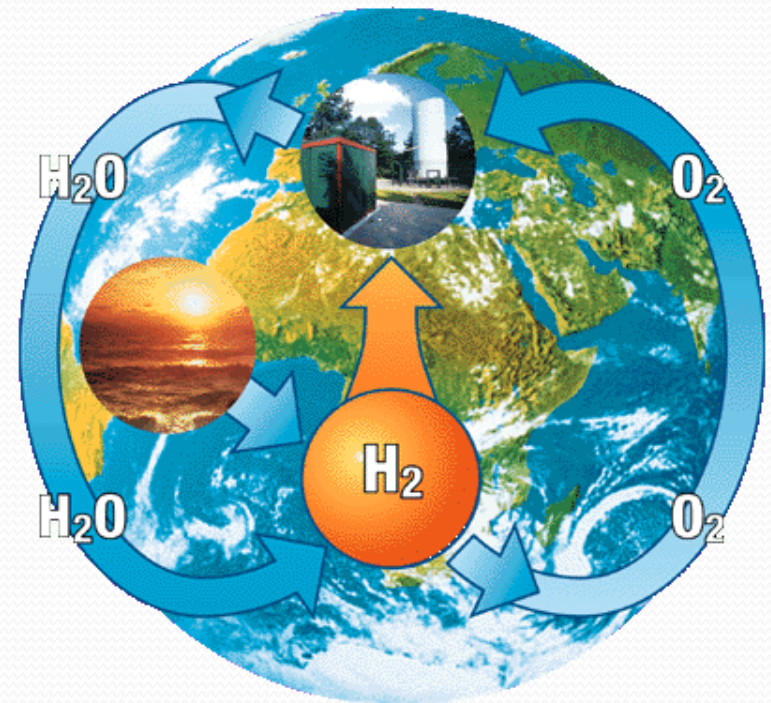
# Storage

- in the form of gas - pressure tank
  - most frequently used in steel cylinders at  $p = 150-400$  at.
  - possibility to use the existing network of pipelines transporting natural gas
  - low cost and great development and reliability but large volumes and high pressures
- in liquid state - liquefied hydrogen
  - technology of producing and storing captured through space flights, the cost of cooling and maintaining hydrogen at low temperature is large
- as a solid - hydrogen associated with alloys of light metals which absorb light and desorb hydrogen at low temperature and low pressure
  - advantages: large capacity and density greater than the cryogenic container, it is the most secure form due to the low pressure
  - disadvantages: high price, the tanks must have heat exchangers

# Production

Most common ways to make hydrogen:

- **Reforming** – convert methane in natural gas using steam
- **Gasification** – breakdown coal or biomass with heat and pressure
- **Electrolysis** - split water with electricity
- **Fotoelectrolysis** – split water with heat
- **Thermochemical** – split water using chemicals and heat
- **Biological** – splitting water using sunlight directly



# Research on biological methods

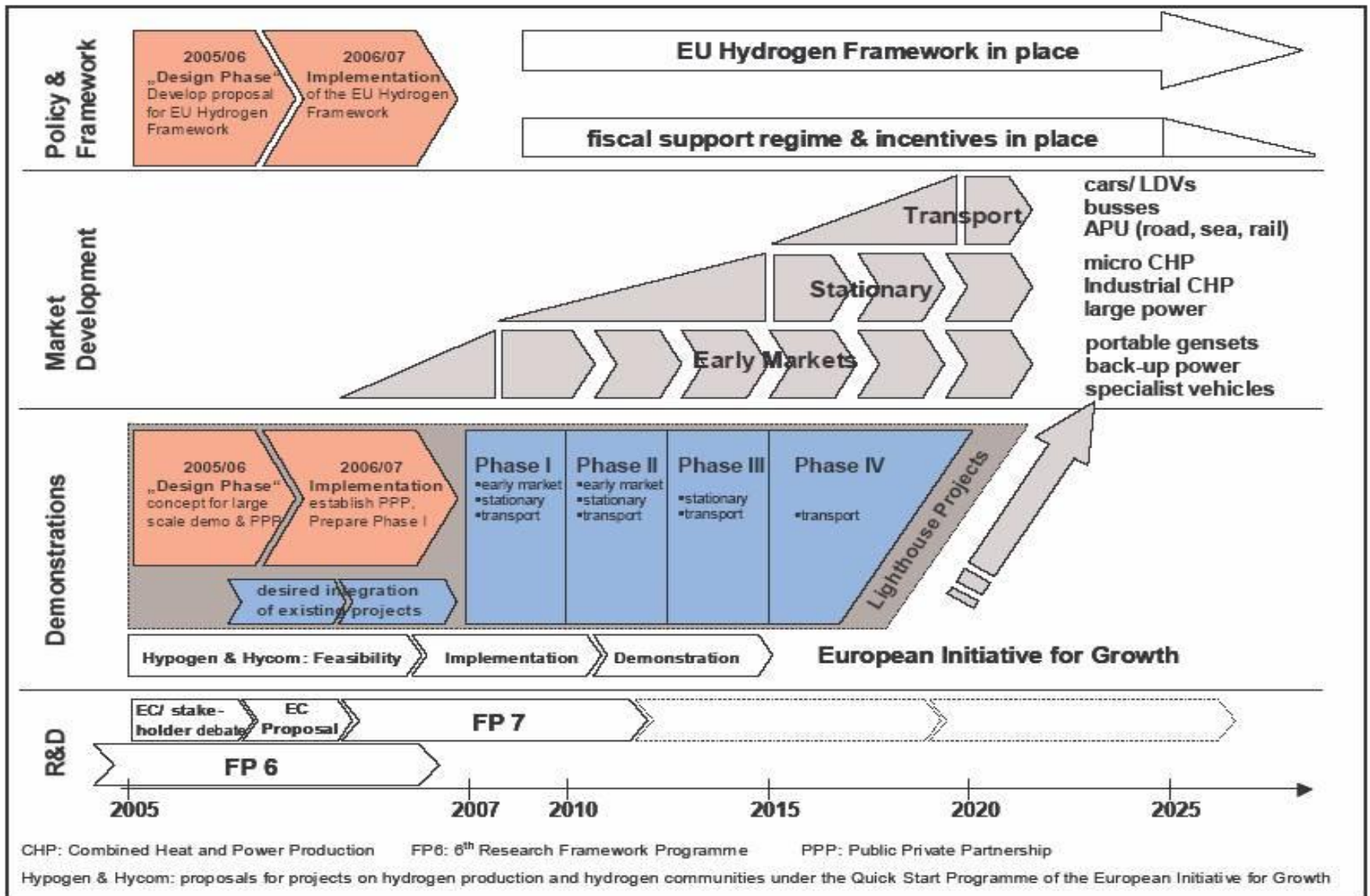
- Many scientists and research centers in many developed countries such as USA, Canada and Japan are working on the new methods of hydrogen production using algae.
- In Sweden (Uppsala University) research focuses on hydrogen production from algae (type Cyanobacteria). Many organisms of this type of bacteria under certain conditions may use the fotobiochemical energy to produce molecular hydrogen.
- Also in Poland, research is carried out by prof. Stanislaw Karpinski (SGGW) in Warsaw on the project associated with the production of hydrogen from the organisms and especially cyanobacteria.

However, for the cyanobacteria alongside mussels to become our allies in the treatment of the marine resources in 2035 we should be more actively involved in current research related to hydrogen economy conducted in the EU.

# EU research engagement

- In 2008 the Council of the European Union adopted a regulation establishing a "joint initiative on fuel cells and hydrogen technologies"
- The initiative is a research program designed to speed up development of fuel cells and hydrogen technologies in Europe over the next six years, and thereby enable their sales between 2010 and 2020. The EU contribution amounts to 470 million
- The initiative aims to:
  - place Europe at the forefront when it comes to fuel cell and hydrogen technologies;
  - achieve a breakthrough on the market for fuel cells and hydrogen technologies by increasing the number of research activities.
- The issue of research on hydrogen and fuel cells has been included in FP7. It is believed that in the FP8 the use of hydrogen technology will be also strongly emphasized.

# Hydrogen development Road Map



# Towards hydrogen economy

- European Platform for Hydrogen and Fuel Cell launched in 2008 a scientific project called HyWays-Hydrogen Energy In Europe. This program aims to reduce oil use in the transport sector by 40% before 2050.
- The EU member states such as Denmark, Finland, Germany, Norway, etc. carry out a series of national programs related to the use of hydrogen fuel cells.
- In the forefront of research maintain United States which after September 11, accelerated the development of hydrogen technologies, seeing them as an opportunity for energy independence.
- In California, there was an "hydrogen highway" opened ,equipped with the infrastructure of hydrogen filling stations.
- In Europe, the initiative "hydrogen communities" was created declaring the introduction of hydrogen to the local transport in the coast regions of Norway, Denmark, Sweden and Germany. The project is funded by the EU.

# Poland is engaging

- Baltic EcoEnergy Cluster (BKEE), established in June 2007, the leading unit is IMP PAN, Gdańsk.
- BKEE initiated a research program under which the University of Warmia and Mazury in Olsztyn, started the project on production and biomass from energy crops such as algae and cyanobacteria to produce biogas with high methane and hydrogen content. Algae used in the production will be harvested when they bloom in the Gulf of Gdansk and the Vistula submersion. Completion of the project in 2013.



# Transporting infrastructure

- Hydrogen produced in the sea may be transported ie. through pipelines
- Such transportation can use existing equipment and pipelines such as those used by the company Petrobaltic (Lotos Group) to transport natural gas from drilling platform to shore
- Oil from the platform is sent through the submarine pipelines to a tanker, which transports it to the North Port. Gas is transported by a pipeline to Władysławowo, where it is used to drive the turbines of a local power plant
- Constant control of the marine environment in connection with oil mining is an excellent material for comparative assessment of the impact of exploitation on the environment and the changes taking place
- During the preparation before building the "hydrogen stations" on the land, an experience of the company Lotos can be used - LOTOS Group is currently building a Hydrogen Generation Unit



# Recommendations

Technologies related to production of hydrogen, particularly from toxic algae, are growing rapidly worldwide and in the Baltic Sea Region

Poland should :

- take active role in promoting the successful introduction of hydrogen energy
- ensure that the long -term investments in hydrogen energy technology will contribute to common welfare in the form of more sustainable energy systems and new profitable businesses
- **support regional clusters engaged in the hydrogen energy technology** (recommended in the European Strategy for Maritime Research and the Green Paper)

Clusters can help improve the competitiveness of economy as a result of sharing knowledge, conducting joint research and developing innovations jointly, organizing education and training, sharing information about innovative methods of organization or jointly promoting new products and technologies.

# Recommendations

In particular, sustainable clusters can take up actions such as:

- conduct coherent information and awareness campaigns on hydrogen economy and innovation. The campaigns should be directed to decision-makers and the wider public.
- foster closer co-operation on research and development in strategically defined key areas of hydrogen and fuel cell technologies where Polish research and Polish industry have the best opportunities. Publicly funded research should focus on areas where industry (of today or tomorrow) can utilise the results.
- promote innovation in Polish industry through demonstration projects, lighthouse projects and stimulation of niche markets – forming an early home market for Polish industry.
- engage stronger in international co-operation. i.e. expansion of the BKEE cluster to Westpomerania region and engage in the Scadinawian Hydrogen Highway Partnership

# Making hydrogen happen

- The people who will make the hydrogen economy a reality are all represented in this room
- Research in the science of energy and biology will play a key role
- The benefits are significant

# Thank You!

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