

Hydrogen ( $H_2$ ) is a key energy carrier for the future. The introduction of a large-scale hydrogen economy might entail changes in the composition of the atmosphere at both regional and global scale. Research on atmospheric  $H_2$  assesses these changes and the resulting consequences for the environment. The HyCARE initiative aims at facilitating such research.

### **Hydrogen in the atmosphere**

$H_2$  is one of the most abundant trace gases in the atmosphere. The main sources (fossil fuel combustion, biomass burning, photochemical production, biogenic  $N_2$  fixation, oceans) and sinks (uptake by soils, oxidation by OH radicals) are well identified. However, uncertainties of all terms in the  $H_2$  budget are very large and published results on  $H_2$  trends in the atmosphere are contradictory.

### **Environmental impacts of a $H_2$ economy**

It is generally considered that a  $H_2$  economy would have major effects on the composition of the atmosphere. While most of these would be beneficial such as improved regional air quality, the increased usage of  $H_2$  also bares potential risks for the environment due to increased  $H_2$  emissions from production, storage and distribution of  $H_2$ . This could lead to e.g.

- More water vapour in the stratosphere leading to stratospheric cooling, more polar stratospheric clouds and enhanced stratospheric ozone depletion,
- Increase of the tropospheric lifetime of greenhouse gases such as  $CH_4$  and amplification of their radiative effects.

Recent studies disagree about the potential environmental benefits and risks of a  $H_2$  economy. Reliable predictions are also impeded because  $H_2$  emissions are hard to predict and  $H_2$  production pathways and trade-offs are uncertain.

### **Atmospheric hydrogen research in the EU**

Two European FP6 research projects currently aim at a better understanding of atmospheric  $H_2$ . The EUROHYDROS project established a quality-controlled network of continuous  $H_2$  measurements and investigates the European  $H_2$  sources. Computer models simulate regional emissions, the global atmospheric  $H_2$  cycle, and the impact of changing  $H_2$  levels on the environment. The HYMN project analyzes trend variability, global budgets and large-scale interactions with the biosphere. However, current studies are still at an exploratory stage and are partly based on simplified assumptions.

### **Future research needs**

Sustained efforts are required to further improve our understanding on atmospheric  $H_2$ . Appropriate research comprises activities such as:

- continuing the European  $H_2$  related activities (measurement networks, process studies, computer simulations etc.) after the end of the FP6 projects,
- minimizing uncertainties by profiting from advanced cutting-edge tools,
- keeping emission scenarios for models up-to-date through the continuous interaction between industry and academia,
- including more sophisticated air quality and climate issues in experimental and computer scenario  $H_2$  studies.

HyCARE seeks to support such future activities and to help arrange financial support.

Link to the HyCARE webpage: <http://www.fz-juelich.de/icg/icg-2/hycare/>