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- Get early information about the results of the HYVOLUTION project
- Get access to the IIG – Part of the HYVOLUTION webpage
- Contribute your opinions and experiences to the project team
- Get access to workshops and conferences dedicated to members of the IIG
- Get contacts to research capability all over Europe
- Get in touch with potential costumers and business partners working in the field of hydrogen-technology

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## Contact

HYVOLUTION is an integrated project, funded by the European Commission in the Sixth Framework Programme.

In HYVOLUTION, 11 EU countries, Turkey, Russia and South Africa are represented. The project started January 2006 and will last until December 2010.

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# HYVOLUTION

Industrial Interest Group

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## HYVOLUTION
## Non-Thermal Production of Pure Hydrogen from Biomass

HYVOLUTION is an Integrated Project (IP) supported by the European Commission under the 6th Framework Programme aiming to develop a blueprint for an industrial bioprocess for decentral hydrogen production from locally produced biomass. This bioprocess adds to the number and diversity of H2 production routes giving greater security of supply at the local and regional level. Moreover, this IP contributes a complementary strategy to fulfill the increased demand for renewable hydrogen expected in the transition to the Hydrogen Economy.

### Bio processes for hydrogen production

In recent years, various hydrogen productive anaerobic fermentation and photofermentation processes have been developed and investigated. Both process concepts are based on the growth of bacteria whose metabolism releases hydrogen from organic substrates. It has been estimated, that a single-stage operation of these processes is economically not feasible.

### The HYVOLUTION approach

The novel approach in HYVOLUTION is based on a combined bioprocess employing thermophilic and phototrophic bacteria, to provide a high hydrogen production efficiency in small-scale, cost effective industries. The process starts with the selection and the possibly necessary pre-treatment of biomass to provide a suitable feedstock. A dark fermentation step producing hydrogen and carbon dioxide by means of thermophilic bacteria and a photo-fermentation stage are connected in a serial mode. Within the photo-fermentation stage phototrophic purple bacteria being exposed to sunlight can be used for hydrogen production on the basis of bacterial growth. The microorganisms produce hydrogen and carbon dioxide under anoxic conditions by using the chemical energy of organic acids and additional light energy of the sun. The process conditions of the thermophilic reactor have to be adjusted in such a way, that the liquid effluent of the thermophilic stage contains organic acids as intermediates. These can be used as substrate for the second stage. The entire bioprocess is optimized in terms of yield and rate of hydrogen production through integrating fundamental and technological approaches. The main technological objective is the construction of prototype modules of the plant which, when assembled, form the basis of a blue print for the whole chain for converting biomass into pure hydrogen. Within the project, a dedicated gas upgrading system is also developed for efficiency at small-scale production units to provide pure hydrogen as the final product. Production costs

will be reduced by system integration combining mass and energy balances. The impact of small-scale hydrogen production plants is addressed in socio-economic analyses. In HYVOLUTION, 11 EU countries, Turkey and Russia are represented.

## The aim of HYVOLUTION

The aim of HYVOLUTION is to make a blue-print for an industrial bioprocess for decentral hydrogen production at small-scale from locally produced biomass. The target of this industry will be to deliver a 10-25 % coverage of the EU demand for hydrogen, for use in power or bio-fuel production, at 10 Euro/GJ.

### Scientific and Technological Objectives

The main scientific objective of this project is the development of a 2-stage bioprocess for the cost-effective production of pure hydrogen from multiple biomass feedstocks. The bioprocess starts with a thermophilic fermentation of feedstock to hydrogen, $CO_2$ and intermediates. In a consecutive photo-heterotrophic fermentation, all intermediates will be converted to more hydrogen and $CO_2$, to achieve an efficiency of 75% (nearly 9 moles of hydrogen per mole of hexose).

The main technological objective is the construction of prototype modules of the plant which, when assembled, form the basis of a blue print for the whole chain for converting biomass to pure hydrogen.