

Past trends between 1990 and 2005 show that EU-15 is not on track to meet its *Kyoto* target of 8% reduction of greenhouse gasses (GHG) emission from the 1990 level during the period 2008-2012. Moreover the target of the *20-20-20 EU's Plan* of 20% reduction of GHG emission by 2020 would be very difficult without short term energy solutions alternative to fossil fuels and additional regulations.

Hydrogen, with his high energy density value per mass, coupled with *Renewable Energy Sources* (RES), could be the alternative to fossil fuel. Hydrogen is the most appropriate medium to store and convert the discontinuous energy produced by RES, ensuring continuous operations with water as the only by-product of hydrogen combustion.

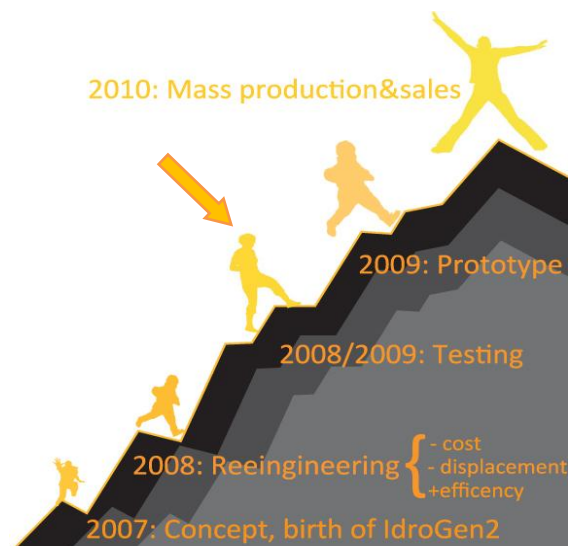


The Company

From the lack of affordable on-site hydrogen generation, an electrolyzer has an average price of 100k€, and from the need of short time environmental impact applications, born *IdroGen2 S.r.l.* in July 2007. The company produces water alkaline electrolyzer units with hydrogen capacity of 1-4 Nm³/h, mainly for industrial demonstration and research markets. The unit produces from pure water H₂ and O₂ through dc electricity from the grid and potentially from RES.

IdroGen2's mission is the design and industrialization of a low cost, modular, highly reliable and easy function *Domestic Electrolyzer* through a reengineering process of the actual product. The electrolyzer will have a market price of 15k€, a capacity of 5 Nm³/h of hydrogen, an electric power of 20kW, 30 bar operating pressure and an efficiency of 90% (the highest available on the market), reached increasing the operation temperature up to 120°C. The module will be highly reliable and safe (MTBF>10 years) and will not be bigger than a conventional domestic fridge allowing for simple installation.

The competitive advantage is the high efficiency and low cost on-site hydrogen generation, potentially everywhere there is the electric grid, with a minimal displacement. The hydrogen cost can be strongly reduced down to 2.8 €/kg using the low cost off peak electricity of the night, an average of 10 hours a day for 50 Nm³ produced every day.



Thanks to the modularity of the unit, higher hydrogen production capacity can be achieved through the concept of *Electrolyzer Farm*: a number of domestic electrolyzers connected together working in parallel, satisfying flexibility and meeting very short response time to any specific power requirements by switching on-off the proper number of single small electrolyzer.

For a real sustainability of the energetic system our electrolyzer could be connected to RES, storing large quantity of energy in large quantity of hydrogen.

Target Markets

On-site generation can find applications with many innovative technologies, as energy vector hydrogen could be introduced in residential and commercial building and transportation sectors. In EU and USA they are the major energy consumers and they are responsible of, respectively, 38% and 30% of GHG emission. Large scale pure hydrogen applications are not immediately sustainable, due to the lack of demand and technology's high costs.

At present the most interesting market is the Hydro-methane one: burning in boilers a blend of 30% in volume of hydrogen and 70% of methane, the saved methane reduces the operating costs and reduces of 30% the CO₂ emission. In 2010 – 2011 *IdroGen2* will sell *Domestic Electrolysers* in joint-venture with *ICI Caldaie S.p.a.*, which has 9% of Italian market share in methane domestic heaters. We are interested in the basement boilers market with power over 35kW. The potential clients are small or medium enterprises working with thermal processes and big residential and commercial buildings with centralised heating supply. The target market dimension was estimated in 27.324 boilers in 2008 with an annual average growth of 20%. Assuming the boiler market constant for the next years our penetration in term of domestic electrolyzers sold for each new boiler is reported in the following table.

MARKET PENETRATION	2009	2010	2011	2012
Boilers market [pcs]	27.324	27.324	27.324	27.324
IdroGen2 Market Share [%]	0	0,1	2,1	2,8
Electrolyzers sold [pcs]	1	24	600	775

The concept of *Electrolyzer Farm* is suitable for transportation applications as hydrogen refueling stations. A fleet of 10 buses can be refueled by a farm of 100 electrolyzer, saving 259 t/year of CO₂ and reaching an hydrogen production cost of 2.9 €/kg and less than 6 years of payback time. For this solution the first contact is an American company, *Atlantic Hydrogen Corp.*, which produces buses and is working for the installation and operation of ten hydrogen stations for the Vancouver 2010 Winter Olympics Games. Five of these station will be based on *IdroGen2*'s electrolyzer farm: a total of 500 electrolyzers.

The other possibility is connected to the growing market of natural gas vehicles (NGV): with a minimal investment every NGV can be readapted to burn Hydro-methane at 20% of hydrogen, maintaining the performance and reducing the GHG emission. Even if the payback time for a gas station for a small electrolyzer farm is 8 years, hydro-methane in the transport sector, with his lower investment cost, could be a way for large scale hydrogen introduction.

Our competitors

The knowhow is the principal entrance barrier: nowadays only four competitors can be considered, manufacturing electrolyser with prices in the range of 80-200 k€. The total market is estimated in a few hundreds units per year with a total turnover of 100 Mil€.

We are ready to grow

The next year is focused on creating the prototype of this new technology and on marketing action, so in the 2010 the product will be ready to be put on the market; for this reason the company in the 2009 will not have a positive gain. Otherwise the forecast to three years demonstrate that the company could survive, thanks to technology that allows to have a good margin: around 40%. In particular the aim of the company is to reach 7000 k€ revenue in 2012, through an exponential growth.

How is it possible?

Idrogen2 has estimated the future scenarios from today to three years, the future view is so limited because in this area the laws and the normative change frequently.

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The company is one of the partners of the European Union in the *H2SusBuilding* project, that cover the 75% of IdroGen2 costs for the next three years, in this way the company could focus only on the product and on the selling strategy. The sales from 2008 are around 100k€ and in 2009 after the production of the prototype, a new backer invest in the company 1500 k€. The company has a solid structure that allow it to be competitive on the market.

The dream team

The company was founded by the owner and CEO Giacomo Coppo, who graduated "cum laude" in Physics and has 5 years of experience in engineering and management of a Swiss electrolyzers company. The cofounder and associate CEO is Lorenzo Tardini, graduated in Mechanical Engineering and with a background in financial and operation management.

Three students of Politecnico of Milan, Italy, belong to the team: Giovanni Ciceri, graduated in October 2008 in Management Engineering, Matteo Colombo and Giovanni Redaelli students of Automation Engineering.

The Hydrogen World Social Returns

A social benefits index has been estimated considering money and pollution savings connected to *Idrogen2* activities. 18,4 tons/year of CO₂ can be locally saved from each plant sold. The value of the saved CO₂ can be estimated in 10 €/ton, as the carbon-tax value: the cost of each ton of CO₂ saved is a social saving in order to achieved the international energy targets.

The domestic electrolyzer purchase is also economically convenient: 2.340 €/year of savings have been estimated for a hydro-methane plant. If the investor is a residential building of 36 apartments, each family will save 66€/year with an initial investment of 375€.

Hydrogen bus fleets refueled by *Electrolyzer Farm* Stations can have great benefits for people, as the quality of the air-breathing, the improvement of the human health and human well-being thanks to the cities air pollution reduction.