Idrogen²

Social Return on Investment Analysis

Global Social Venture Competition 2009

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Executive Summary

Idrogen2 seeks to introduce and promote in the energy market a sustainable and profitable way for onsite generation of hydrogen by an electrolyzer unit. Idrogen2 seeks to use the engines of business and scientific innovation to catalyze a future of distributed and clean hydrogen generation that improves the social, environmental and economic sustainability of the building and transportation sectors worldwide.

Idrogen2's products are based on the well known electrolysis technology that produces hydrogen and oxygen from pure water through DC electric power. Five years experience in electrolyzers engineering and manufacturing brought the company to developing the Idrogen2 Electrolyzer Unit with 90% transformation efficiency, 30bar operating pressure which can be priced in the market at 15k€. The product will be able to compete against others onsite generation technologies thanks to its better efficiency, higher operating pressure, at less than a quarter of average electrolyzer selling price (100K€). The Electrolyzer Unit will be the platform for two new products.

First to hit the market will be the Domestic Electrolyzer that produces $5Nm^3/h$ of hydrogen directly next to the demand. This will be the mass market product coupled with an innovative burner, developed by our partner ICI Caldaie S.p.a.. The hydrogen from the Domestic Electrolyzer will be blended with natural gas in a 70/30 ration (70% methane), the blend called Hydromethane, will be the fuel for the new burner. The hydrogen will be generated during the off peak hours (the night) using low tariffs electric power, allowing significant savings. The payback for the householders will be 7 years coming with a reduction of 18 tons a year of CO2 emission in urban areas. Other applications will be exploited ones the public awareness of hydrogen small scale onsite generation will grow (gold and glass manufacturing, etc.).

Idrogen2's second product will be the Electrolyzer Farm; larger scale hydrogen generation will be obtained by connecting together multiple modules using the same base technology of the Domestic Electrolyzer. The large scale hydrogen generated could be used as a combustion source for building heating or as agent in fuel cells to generate electric power for both stationary and transportation applications. The Farm is aimed to commercial and industrial and institutional costumers. Municipalities are faced with a combination of constraint and requirements that will facilitate the market entry for this product: mandated requirements to use renewable energy sources, high fuel costs and pushes to reduce air pollution in urban areas. Idrogen2 is partner of EU in the *H2SusBuild* project that aims to the diffusion of hydrogen generated from renewable electricity sources (wind, solar, etc.) to satisfy buildings needs of electricity and heat.

The social return on investment (SROI) analysis presented in this document monetizes the social and environmental returns associated with both the two Idrogen2's products. The introduction of these products to municipalities around the world will have two primary social and environmental benefits:

1. Reduction of CO2 and NOx emissions into the atmosphere
2. Families energy bill savings

Introduction

Europe has to achieve by 2020 the ambitious targets of the 20-20-20 Energy Plan:

- 20% reduction of Green House Gas (GHG) emission from the 1990 level
- 20% cut of energy primary consumption improving energy efficiency
- 20% increase of Renewable Energy level in the global EU energy mix
- 10% of minimum penetration of biofuels in the vehicles fuel consumption

Past trends between 1990 and 2005 show that the EU-15 is not on track to meet these targets: we rapidly have to understand in which sectors and on which technologies focus investments in research and development.

In US and Europe Building and Transportation Sectors are the major energy consumers and are responsible of respectively the 38% and the 30% of GHG emissions, due to the strong dependence on fossil fuel. In residential and commercial buildings more than 40% of the total energy consumption is used for heating, cooling and electricity. With a potential of CO_2 emission reduction of 1 billion tons per year, the building sector in EU alone can almost fulfill the 20-20-20's GHG targets.

In the last decades industries invested more and more in hydrogen technologies researches to find a sustainable and profitable way to generate hydrogen to store and produce electrical energy. Hydrogen can be obtained from fossil sources (Dirty Hydrogen): natural gas steam reforming, oil refining, coal gasification and thermal power generation coupled with electrolysis or as “Green Hydrogen” from CO_2 free sources through electrolysis coupled with nuclear, solar, wind, hydro or geothermal electric power.

The use of hydrogen in industrial applications is an established market of 7 million tons a year only in Europe consumed by Ammonia, Petrochemical, Metallurgic, Pharmaceutical, Food and Electronics Industries. Emerging markets are Automotive and Stationary applications where hydrogen could be an alternative to fossil fuels.

Even if there have been great discussions about the hydrogen use in automotive or stationary energy generation, currently there is not a real hydrogen market for energetic purpose. Main barriers are: large scale hydrogen production is not economically and environmentally affordable, storage and transportation costs and the low efficiency and high cost of fuel cells.

Small and medium onsite generation through water electrolysis is the solution and could be the first step for a real hydrogen market and hydrogen economy. Producing only the exact quantity needed wherever there is the electric grid will strongly reduce the cost and will contribute to the familiarity of people with hydrogen as part of their future life. Besides energetic applications, there are also lots of small and medium enterprises, as goldsmith or glass artisans, which could take advantage from their own production of hydrogen.

Water electrolysis to produce gaseous hydrogen and oxygen is a well-know process: hydrogen and oxygen are produced from pure water through DC electric power. At present time the market does not offer an electrolyser suitable for domestic applications, with high reliability, small dimension, small capital investment, reduced operational costs and producible on large scale at competitive costs: the today's average price of an electrolyzer with up to 10 Nm^3/h of hydrogen production capacity is 100k€.

Idrogen2's Business overview

The mission

IdroGen2 S.r.l. was born in July 2007 to address the need of affordable on-site hydrogen generation which can provide short time positive environmental impacts.

The company mission is:

> ***Design and industrialize a low cost, highly reliable and easy to operate Domestic Electrolyzer offering to our clients a sustainable and profitable way to match their hydrogen and energy needs.***

Current product

Since the beginning of 2008, after only one year from the start of the business, Idrogen2 launched on the market its first product line: Industrial Electrolyzer. The core technology is alkaline electrolysis, the product was aiming mainly to industrial demonstration and scientific research market.

The technical specifications of the Industrial Electrolyzer are reported in Table1:

Hydrogen production capacity	1-4 Nm^3/h	Operating temperature	80°C
Power	5-20 kW	Hydrogen purity	99.8%
Conversion Efficiency*	75%	Oxygen purity	99.2%
	4.6kWh/Nm^3-H_2	Unit volume	9 m^3
Alkaline electrolyte	KOH	Reliability****	MTBF > 10 years
Operating pressure**	30 bar	Unit market price***	90k€
Certifications	Complies with all applicable EU certifications and safety standards on hydrogen appliances and pressure equipment (namely ATEX and PED directive). CE mark applied by an external certification body covering the whole production.		

*The top level commercially available; **The highest available on the market; ***The average of the market is 100k€;

Table1: Industrial Electrolyzer specifications

This product is already competitive on the electrolyzers market: the conversion efficiency aligned with best in class, the price of 90k€ is within the range of competitors, the generation pressure is the highest on the market. No other competitors is able to offer 30 bar generation pressure which allows lower investment in the compression system to store the gas. The company has successfully completed the ISO9000 certification for its quality management system.

Domestic Electrolyzer

In parallel with the production and sales of the Industrial Electrolyzer, Idrogen2 had started a continuous reengineering effort to allow effective commercialization of low cost onsite hydrogen generator. This effort will lead, by July 2009, to the development of the new stand alone Domestic Electrolyser prototype suitable for performance evaluation as well as functional optimization.

The prototype will be the strategic platform for the Idrogen2 new product line that will progressively substitute the current Industrial Electrolyzer allowing mass production, cost reduction and business expansion.

The reengineering process has four main targets:

1. increase efficiency up to 90%
2. reduce the selling price down to 15k€
3. reduce the volume to one third
4. maintain high reliability

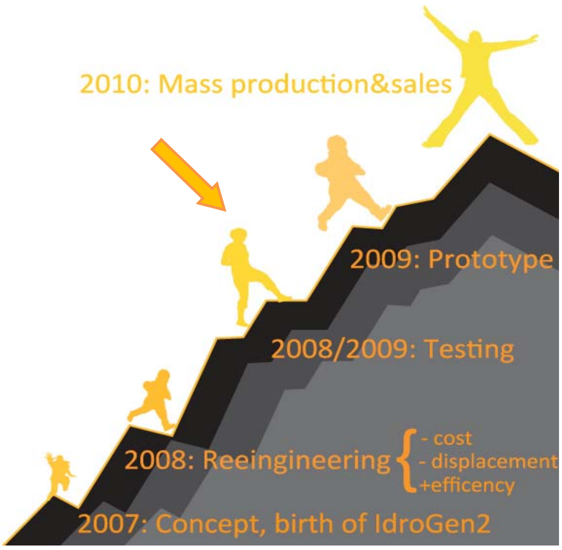

Figure 1: Product status

Current product efficiency and reliability are strongly related to the quality of materials and components and to the time consuming and delicate manufacturing process. Scaling up production alone will not be enough to reach the required production target cost without significant changes in component and raw material specification and cost as well as improvement in the assembly process efficiency.

For each target developments have been done:

- Efficiency reaches 90% (3.9kWh/Nm^3 of hydrogen) thanks to the increase of operating temperature up to 120°C. New high performance materials were used for the core components to allow reliable operation at high temperature.
- Target selling price will be achieved by manufacturing cost reduction: bill of material has been completely revised for reducing material content and cost; assembly time has been reduced through process optimization and industrialization. Customized components are used only for the core operations (electrolysis system, control board, ect.), while the secondary functions are performed by components off the shelf. As result the prototype will have a selling price of 40k€ that will be reduced by 2010 down to the target price by mass production.
- Volume reduction and high reliability are consequences of the first two steps of the process. The unit will not be bigger than a standard domestic fridge.

The Idrogen2's knowhow in electrolyzers engineering and manufacturing as well as in product industrialization and production management have been the keys of the success of the reengineering process that brought to the first industrialized water electrolyzer ready for large scale production.

The Domestic Electrolyzer developed has the following specifications:

Hydrogen production capacity	5 Nm^3/h	Operating temperature	120°C
Power	20 kW	Hydrogen purity	99.8%
Conversione Efficiency	90%	Oxygen purity	99.2%
	3.9kWh/Nm^3-H_2	Unit volume	3 m^3
Alkaline electrolyte	KOH	Reliability****	MTBF > 10 years
Operating pressure	30 bar	Unit market price	15k€

Table2: Domestic Electrolyzer specifications

Value Chain

The analysis of Idrogen2's company and the business, where it operates, developed by the Porter's value chain allows to describe the company as a limited block of activities that could be divided on the basis of each activity's contribution to the output realization. The Figure 2 shows the main division of the activities, Primary that are the operation directly settled to put the product on the market and the Support that allows the best performance of the primary activities.

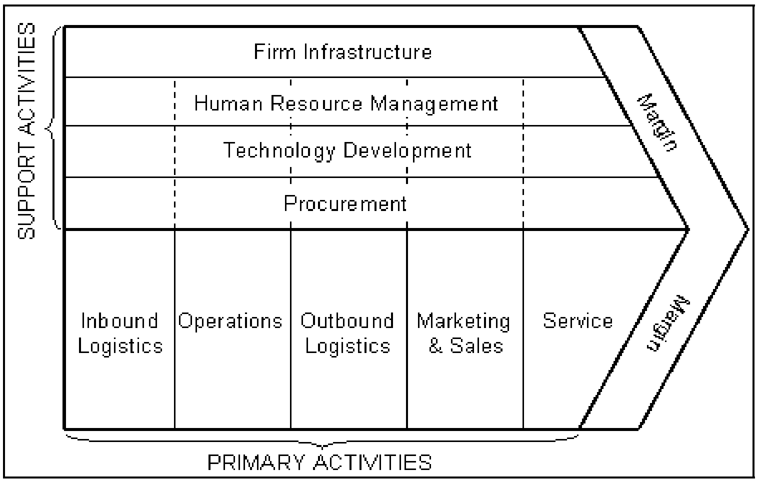

Figure 2: Value chain

Primary Activities

All activity that are focused directly to put the product on the market, so for Idrogen2 are fundamental the partnership with:

- ICI Caldaie, that commercializes boilers able to support the Idrogen2 technology.
- European Union, that on one side finances the company and on the other side promotes the technology that uses hydrogen, with a stronger marketing effort under the project H2SusBuild

The activities of marketing & sales are made by the clients that have the direct link with the final customers and that are the market leader. On the other side the effort of Idrogen2 is to catch the other opportunities in the worldwide market, in particular in USA, the Country showing the largest interest into hydrogen refueling station.

The operations are managed by Idrogen2 thank to know-how of the management to build a product in an efficient way with good quality and innovative. Instead the inbound logistic is managed by suppliers, then the outbound logistic is managed by a specific company through a partnership.

Support Activities

For the development of Idrogen2 the Human Resource Management, in fact the company has a plan of recruitment both for management and for blue collars. Also the Technology Development is a key activity in order to became a leader, the re-engineering of technology is necessary to have a competitive product.

So the know-how and the skills of the management's team is the core competence both for the survival and for the growth of the Idrogen2.

Competitive advantage

Technology comparison

The most known ways to generate hydrogen are the steam reforming of natural gas, that is the most diffused technology, and water electrolysis. Table 3 shows the comparison between the state of art of the two technologies.

Steam reforming of natural gas NG	
Reaction:	$CH_4 + H_2O + Heat = 3H_2 + CO$ and $CO + H_2O + Heat = CO_2 + H_2$
Energy efficiency	80 - 85%
Production pressure	10 - 25 bar
Plant size	300-50.000Nm^3/h

Water electrolysis	
Reaction:	$2H_2O + Electricity = 2H_2 + O_2$
Energy efficiency	70 - 75%
Production pressure	1 - 200 bar
Equipment size	1-200 Nm^3/h

Table3: Hydrogen generation technologies

Steam reforming is more suitable for large scale applications: the better efficiency and the larger hydrogen generation capacity allow lower production cost. Even if the technology is economically profitable, it is not environmentally sustainable due to the emission of CO_2 and CO. On the contrary electrolysis, if coupled with a clean source of electricity, produces clean hydrogen at higher pressure and thanks to its flexibility and lower initial investment is more suitable for small scale and diffused applications.

Idrogen2 Domestic Electrolyzer is based on alkaline technology which is currently far more reliable, flexible and efficient than the other water electrolyser types. Table 4 shows the state of art of the three main water electrolyzers technologies for small and medium scale hydrogen generation.

	Acid	Alkaline	PEM
Electrolyte	H_2SO_4 liquid	KOH Liquid	PEM Solid
Efficiency	+ +	+	-
Robustness	+	+ +	=
Reliability	-	+ +	- -
Op. Temperature	< 80 °C	60 – 120 °C	< 90 °C
Pressure	< 10 bar	< 30 bar	< 15 bar
Gas purity	-	=	+ +
Investment Cost	-	+	=
Maintenance Cost	-	+ +	- -
Maintenance operator safety	- -	-	+ +

Table 4: Water electrolyzer technologies

Among the three technologies, alkaline is the most mature one and grants the best tradeoff between high efficiency and high reliability at the higher pressure. PEM technology is the most recent one and it is not enough reliable and efficient to compete on the commercial market till further researches and developments will been done. Idrogen2's Domestic Electrolyzer is the solution to the high cost of traditional alkaline electrolyzers that has always been the barrier for larger market penetration.

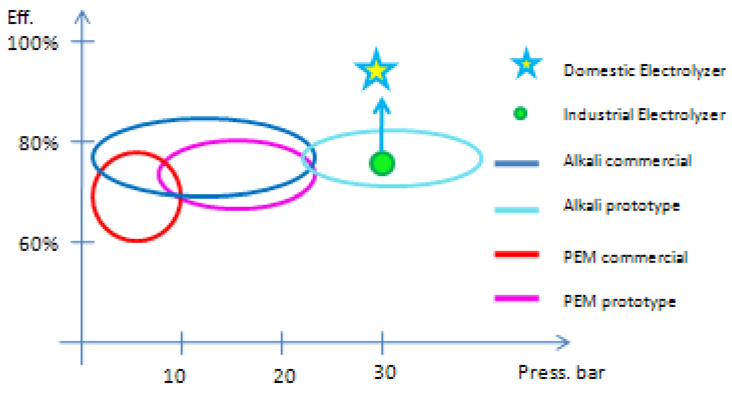

Figure 3: Electrolyzer state of art

The chart of Figure 3 shows the state of art of alkaline and PEM electrolyzers and the prototypes of both the technologies which are under development by competitors. Though competitors are looking to improve PEM technology, to provide better efficiency and higher operating pressure, their performance targets are still lower than alkaline technology.

Economical and environmental advantages of electrolysis

As previously underlined water electrolysis has higher hydrogen generation cost than steam reforming due to the lower efficiency, smaller production capacity and mostly to the higher cost of electric power compared to the natural gas.

To compete with steam reforming Idrogen2 value proposition, beyond increased efficiency and lower initial cost is focused on operating the unit only during off peak hours of the electric grid, leveraging on the low tariffs offered by utilities companies (as low as 50% of the peak hours ones and varies Country to Country). Domestic Electrolyzer is a very constant and predictable load of 20kW for 10 hours a day, this could allow even more convenient customized energy contracts.

In Europe off peak electricity is also advantageous for the environmental impact: when the demand is low fossil fuel power stations operate at a part load while nuclear power plants still operate at full load. As result, the energy production mix generates less CO2 than during peak hours.

Hydrogen generation through electrolysers can very effectively be used to store energy from renewable energy sources (RES) and release it as electric energy through fuel cells as the demand requires. This completely “clean” cycle will help to overcome one of the main obstacle to mass diffusion of RES: the discontinuous and uncontrolled energy generation.

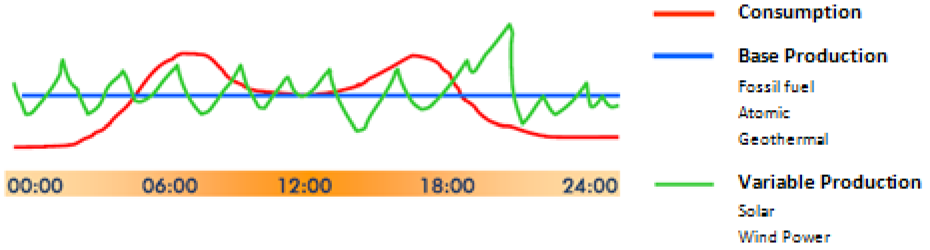

Figure 4: Electricity consumption

Renewable sources strongly depend on metrological conditions (e.g. solar cells cannot produce energy during night, wind generators need more that 3 m/s wind speed in order to be efficient). As result, the electric power generated varies a lot without control during the day without matching the demand of the grid.

Hydrogen produced can also be directly burned to generate heat, with water as the only by-product of combustion.

Electrolyzer Farm

To address larger scale potential hydrogen demand of residential districts or large commercial buildings and eventually hydrogen fueling stations for transportation, Idrogen2 developed a product based on the core technology of the Domestic Electrolyzer: the Electrolyzer Farm.

The product consist on a number of Domestic Electrolysers (100 on average) connected together and working in parallel in order to achieve large hydrogen production capacity. The Farm can flexibly match the hydrogen demand by switching ON-OFF the proper number of single electrolyser modules, while granting redundancy and close to 100% functionality.

The Farm is not just a simple connection of many small electrolyzers, indeed all the electric and hydrogen distribution system is fully redesigned and a centralized control unit supervises the whole system operation.

As for the Domestic Electrolyzer operating the Farm during off load hours will grant lower operating cost as well as better usage of RES.

Market analysis

Domestic Electrolyzer’s Target markets

Domestic Electrolyzer can easily attend the most various applications thanks to its modularity. The interested customers in the very next future can be:

- Goldsmiths, glass, jewels producers and steel processors who needs small quantities of hydrogen for artisanal productions. They can save a quantity of money on the cost and the accessibility of hydrogen
- Isolated small energy users who need to store the energy produced from a small RES generator (photovoltaic or wind power)
- All SME and buildings using burner and boiler plants with power >35kW for heating processes

It’s interesting to go into more depth this last point, because hydrogen for heating is the most realistic and viable application at present. The purpose is to burn in gas boilers a blend of 30% (in volume) of hydrogen and 70% of methane instead of pure methane. This blend, called hydromethane, can be used with technologies already existing and diffused, overcoming problems related to the launch of a completely new technology. An actual boiler can be set to burn hydromethane only by changing the burner, with a 1k€ investment; if the investment is in a brand a new boiler thus cost is reduced to zero . ICI Caldaie, a big Italian boilers producer, is already developing a burner suitable to burn hydromethane with various concentrations. The partnership with ICI Caldaie allows development and market diffusion of a unique combinative electrolyzer-boiler plant. The calorific power per volume of hydrogen is lower than methane one, but the presence of hydrogen increases the efficiency of the flame in the burner and heat transfer to the boiler, so that the effective colorific power of the blend is unchanged with respect to the whole boiling process.

Burning hydromethane allows a 30% savings on CO2 produced from an ordinary CNG boiler, and another 50% of NOx. The saving in the economics is due to the cost of hydrogen as produced in the off-peak hours much cheaper than CNG. The interest of public institutions to finance eco-sustainable projects and the saving in the emissions will produce other money savings, an example of that will be sown in the following pages.

In two years hydromethane boilers will be present on the market, so it’s interesting to watch more carefully the market to face, starting form the Italian one where our partner ICI Caldaie is present with 9% of the share. The principal kinds of boilers present on the market can be divided in “basement” or “mural”, and in “traditional” or “hy-tech” (condensation). The basement kind sales are higher than the mural ones, and hy-tech have increased sells of 35% in the last years. We’re interested with basement condensation boilers with power >35kW. To evaluate the potentiality of sales we estimated the Italian boiler market studying the annual report from “Assotermica”.

In the last years the traditional technologies experimented a really collapse (-22%) while the markets of condensation and other hy-tech boilers has grown a lot (+40% 2007, +140% 2006). All told, the whole market lost 1-2% in 2007, but it will be stable at least until 2010. The demand of boilers for substitution covers the 85% of the total, it means that a big slice of the market don’t depend from the buildings market course.

The number of pieces (with interesting characteristics for hydromethane plant) sold in the last years are shown in the Table 5 (data in 2005 and 2008 have been estimated):

	2005	2006	2007	2008
Market [pcs]	17.913	20.907	23.901	27.324

Table 5: Boilers market

It's possible to observe a growth of about 14%. But for the future it has prudently been supposed constant. The estimation consider initially to enter in a slice of the ICI market percentage: ICI holds 9% of the Italians' producers market, we suppose to enter in 7% of it. We start in 2010, then improve constantly our presence in the market (+20% until 2011, due to the actual crisis, +35% until 2015, this is the growth of others hy-tech boilers).

Table 6 shows Idrogen2's penetration in the new boiler market:

	2009	2010	2011	2012
Market [pcs]	27.324	27.324	27.324	27.324
Quote [%]	0,0	0,1	0,2	0,7
Sales [pcs]	4	20	60	210

Table 6: New boilers market penetration

An interesting option is the introduction of hydro-methane technology on already existing plant. It's possible to estimate that in the last four years 90045 boilers, compatibles with our plant, have been sold. With an about 1 k€ starting investment, an existing boiler can be adapted for hydro-methane changing the burner. Assuming the same percentage of market penetration previously exposed, the forecasting of demands in the next years are:

	2009	2010	2011	2012
Market [pcs]	90.045	90.045	90.045	90.045
Quote [%]	0,0	0,0	0,05	0,1
Sales [pcs]	0	4	21	113

Table 7: Old boilers market penetration

For the next four years, the Domestic Electrolyzer's forecast for the hydromethane market are the sum of the two penetrations:

	2009	2010	2011	2012
Sales [pcs]	4	24	81	323

Table 8: Total market penetration

Electrolyzer Farm's Target markets

The Farm can be designed for each specific applications varying the number of modules. The potential costumers are every application that needs large and medium scale hydrogen both for process and energetic usage:

- Process applications like ammonia production, petrochemical, glass and metal industries, etc. Electrolyzer Farm is economical and environmental competitive compared to steam reforming when coupled with large scale RES or nuclear power.

- Companies that produce electrical energy by nuclear energy (in US, France, UK, etc.) or renewable energy (in Italy, Spain, UK, Denmark, etc.). The Electrolyser Farm allows to match the production and consumption of electrical energy in a more efficient way, by storing the off peak energy produced in excess and supplying it when the grid demands it.
- Small and medium enterprises (SME) as well as large residential and commercial building can use the Farm to satisfy their heating and electric needs in a more sustainable way. In the future more and more emission regulations will apply to SME and to Buildings, as already started in North Europe (Denmark, Finland) with Building Carbon Tax pilot projects.
- The most quoted market for Electrolyzer Farm is certainly the Automotive Sector. Europe and US are strictly controlling through regulations the emissions of vehicles and new engine technologies are constantly under research and development. Hydrogen as fuel for vehicles could be introduces first in the public transportation sector using the municipalities economic support to create urban bus fleets. The Farm coupled with storage and distribution systems can provide hydrogen for refueling station.

Among the Farm's potential markets, automotive is the largest one and larger investment have already been done to find a sustainable application of hydrogen. Since other large investment are expected to be done in the future, hydrogen stations are analyzed below in detail as highest potential application of Electrolyser Farms, which could eventually contribute to seriously start the application of hydrogen as fuel for vehicles.

US and especially California demonstrate large attention to the hydrogen potential in the transportation sector as an alternative to fossil fuel. A recent study of the Department of Energy (DOE) of U.S., shows that the expected fuel cell hydrogen passenger vehicles penetration into the market will be 1% in 2020, 2% in 2030 and 50% by 2050. 284 stations were identified as potential national hydrogen fueling infrastructure backbone, with a total cost of $837 million to meet 2020 need.

Because of high costs of infrastructure, especially during the transition period, there is incentive to look for innovative ways to reduce costs and increase infrastructure use. One possible way is to focus on locating infrastructure at existing federal facilities. Given the right incentives, federal facilities could provide a good starting point for a transitional hydrogen infrastructure because they offer broad geographic coverage. In particular, federal agencies that have been proactive with the introduction of other alternative fuels into their fleets may have an interest in pursuing hydrogen for not only their fleet, but also for co-generation (heat and electricity) and public fueling. The results of first buses fleet projects in California are encouraging investment in hydrogen vehicles research and development.

Hydromethane can represent a transitional path to hydrogen refueling stations thanks to the increasing diffusion of compressed natural gas vehicles (CNGV). Data of 2007 show that since 2000 CNGV had an average growth of 30.6% worldwide, especially in developing countries with large gas resources as Asia (50%) and South America (28%). Only in Brazil there are more than 1.4 Million CNGV, 1.6 Million in Argentina and 3.4 Million in the entire South America with about 3000 refueling station. On the contrary in developed countries the penetration of gas technology is reduced due to the abundance of imported oil. However, also in Europe CNGV percentage is increasing due to the high cost of the gasoline: since 2000 the average growth was 13%, especially in Italy where CNGV reach the level of 1.1% of the total. In 2007 in Europe more than 1.800 natural gas fueling station were operating.

The scenario in the U.S. is different: 147.000 natural gas vehicles contribute with only 0.1% to the total growing only of 3.7% since 2000, but the number of station is considerably high: 1.340 refueling station that shows the great interest from the Govern in this alternative fuel.

Recent study demonstrated that hydromethane at 20% of hydrogen can reduce the emission of 12% CO_2 and 30% NOx of CNG vehicles maintaining the same performance. Last generation CNGV can burn the blend without any modifications to the engine, while the oldest models can be readapted to hydromethane with the simple installation of a kit with an average cost of 50€.

The Abel diagram above represents the capacity of Domestic Electrolyzer and of Electrolyzer Farm to respond to different needs of different customers, covering together all the hydrogen applications.

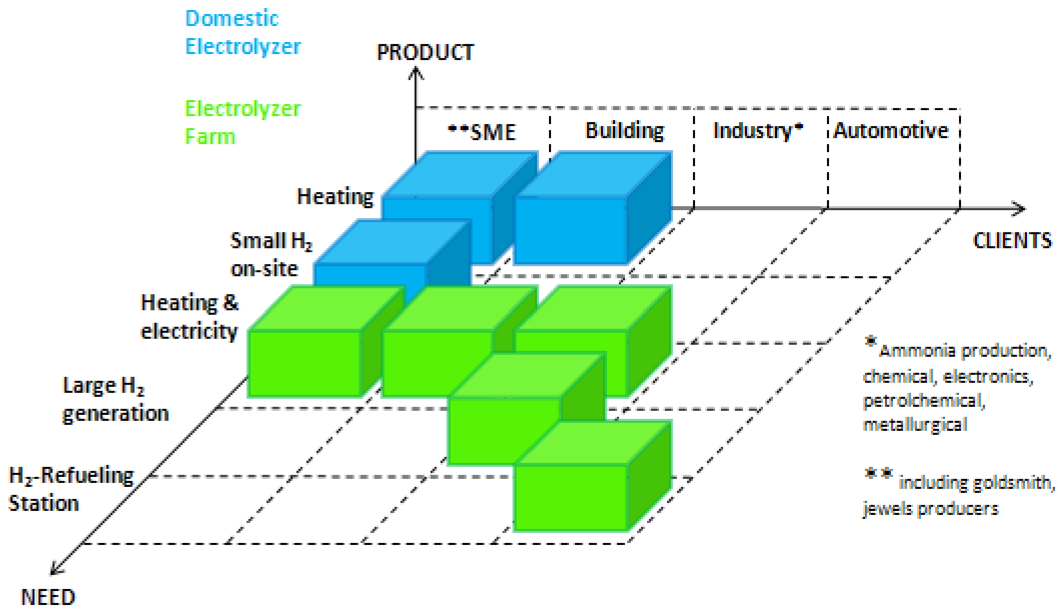

Figure 5: Idrogen2's products

Business cases

In this section the two most significant business cases are presented to show the economical sustainability of the Domestic Electrolyzer and Electrolyzer Farm:

- Domestic Electrolyzer: hydromethane for centralized building heat
- Electrolyzer Farm: hydrogen refueling station

Each case analysis is organized in a first part of description of the business target, a section of hypothesis and assumptions, a description of the analysis process and then the economical results presentation.

Hydromethane plant

The first situation considered is a customer with an heating application in Lombardia, Italy which buys an electrolyzer for the production of hydrogen for the supply of a new hydro-methane boiler. The choice to analyse an Italian situation is because in Italy there are the best conditions for this kind of investment: there's a wide gas supply net and gas boilers are really diffused. In Lombardia, moreover, there are an high institutional sensibility about eco-sustainable technologies. The following technical details have been assumed:

Basic assumptions:

- The price of a Domestic Electrolyzer unit is 15k€
- The required heat power is 100kW, with a boiler efficiency of 90% working 12 hours per day for 180 days per year
- The natural gas price has been considered 0.4€/m3 as the average in Italy
- The electrolysis water price has been considered 0.7€/m3 as the average in Lombardia
- The Electrolyzer operates only during the off peak hours (10h/day) and use electricity from the grid to simplify the analysis
- The peak electricity cost in Italy in 2008 was 0.15€/kWh for Industrial applications. We can suppose to reach an off peak price of 0.045€/kWh, with a particular contract for a quite big appliance working constantly by night
- Electrolyzer life time is considered over 20 years
- We suppose to spend 50€ per year for the maintenance of the plant
- The entire quantity of hydrogen produced every day is totally consumed by the boiler
- We analyze only the return of the investment on the electrolyzer

In this operative conditions there's a saving of 9000m3 of methane, burning until the 35% of hydrogen in the blend. In this way the onsite production of 18,5 tons of CO_2 has been saved. Moreover, since in many countries signing Kyoto's protocol is into force the "Carbon tax", considering 10 euro saved for each ton of CO_2 not produced, the savings in money grows to 2331€ per year and the return of the investment is in 6,4 years.

The results about the saves in these cases are illustrated in the following Table 9 and Table 10:

	Value	Unit
Unit Price	15.000	€
Operation Life	20	Years
Mantainance cost	50	€/Year
Hydrogen dayly capacity	50	Nm^3
CH4 savings per year	9.000	m^3

	Value	Unit
Ammortization cost	1,10	€/Nm^3
Mantainance cost	0,07	€/Nm^3
Water cost	0,07	€/Nm^3
Electricity cost	2,38	€/Nm^3
Total hydrogen production cost	3,62	€/Nm^3

Table 9: Data and costs

Savings	Value	Unit
Gas saving	3.870	€
Total savings	2.147	€
Payback Time	7	Years

Savings (With Carbon Tax)	Value	Unit
Gas saving	3.870	€
Total savings	2.331	€
Payback Time	6,4	Years

Table 10: Final results

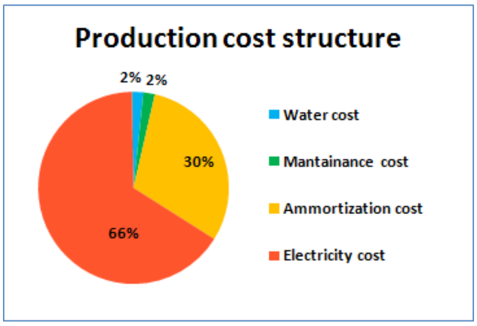

Figure 6: Production cost structure

The graph of Figure 6 shows the composition of the hydrogen production cost: the price of the electricity is the main cost factor, followed by the amortization of the investment. Thanks to the increasing attention of Europe Union on new energy solutions and especially hydrogen in building applications, Idrogen2 is a partner in the EU's project H2SusBuild, the purchase of the unit will be economically sustained.

Hydrogen Station

The business case considered is a municipality of California, U.S. which wants to create an hydrogen fuel cell bus fleet to contribute to the urban and extra-urban transportation system. The analysis shows the economical and environmental convenience of an Electrolyzer Farm of 100 modules as hydrogen generation technology for one central refueling station.

Basic assumptions:

- Hydrogen is sold by weight to make the analysis independent from the storage pressure
- The electrolysis water price has been considered 0.85$/m3 as the average in California
- The Electrolyzer Farm operates only during the off peak hours (10h/day) and use electricity from the grid to simplify the analysis
- The peak electricity in California in September 2008 was 0.11$/kWh for Industrial applications. While the off peak price is on average 0.07$/kWh
- The off peak electricity price has been considered as 0.04$/kWh (70% of the standard off peak), this price can be achieved only through a customized energy contract signed in accordance with the govern to sustain hydrogen diffusion
- 98% of hydrogen production reliability has been considered for the Farm
- 5 days every year are dedicated to station and buses maintenance (production stopped)
- Refueling station life time of 20 years
- The maintenance cost a year has been estimated in 2% of the initial Investment
- Idrogen2 does not sell all the components of a Domestic Electrolyzer for a Farm but only the core components: the single unit price considers the core components cost, an Idrogen2's intellectual royalty and assembly assistance
- An additional cost for the storage and distribution system is considered
- The entire quantity of hydrogen produced every day is totally consumed by the bus fleet.
- Only the refueling station's economical sustainability is considered, not the bus fleet one.

- The specification of the bus are reported below:

Bus company	*Atlantic Hydrogen Corp.
Bus model	New Flyer H40LFR
Fuel cell power	150kW
Hydrogen Storage	50 kg
Operating range	325 miles

Table 11: Bus specifications

* There have already been a first contact with this US company for a project of 5 Farms for refueling stations in Canada

The analysis aims to estimate the production cost of 1kg oh hydrogen and the cost structure. The hydrogen selling price has been estimated to allow hydrogen buses to compete with standard diesel ones. A new generation diesel bus has a fuel efficiency of 8 miles for US gallon and 1 mile cost of 0.59$, as consequence, the target for the hydrogen bus has been fixed at 0.54$/mile.

Table 12 shows the results:

	Value	Unit
Electrolyzer Modules	100	#
Single Unit Price	14.500	$
Additional cost	80.000	$
Mantainance cost	30.600	$
Total Investment	1.530.000	$
Station Operating Life	20	Years
Hydrogen dayly capacity	441	kg/day

	Value	Unit
Number of buses served	8	#
Ammortization cost	0,48	€/kg
Mantainance cost	0,19	€/kg
Water cost	0,01	€/kg
Electricity cost	1,82	€/kg
Total hydrogen production cost	2,5	€/kg
Hydrogen price at the pump	3,4	€/kg

Table 12: Final results

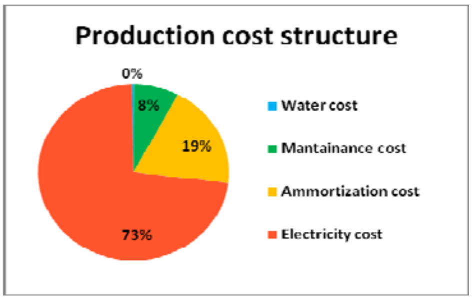

Figure 7: Production cost structure

A selling price at the pump of 3,4€/kg of hydrogen, 36% of margin on production cost, generates 219.299€ of revenue for the refueling station and a payback time of the initial investment of 7 years. The real limitation of hydrogen buses is the maintenance cost of on average 1-1.5$/miles instead of 0,15$/miles of the diesel ones.

Porter's 5 forces analysis

An useful instrument to analyze the market where Idrogen2 operates is the Porter's 5 forces analysis, in particular it's a tool that allows to determine the competitive intensity and therefore attractiveness of a market and it allows to individuate the possible opportunities to catch and the threats to prevent. The Figure 8 illustrates the structure and the relationship between the five different forces, and then it analyzes each force in detail, underlining the competitiveness of Idrogen2.

Figure 8: Porter'5 forces analysis

The intensity of competitive rivalry

The companies that operate in this business are not numerous, but in any case the competitiveness is characterized by the following structural variables:

- **Number of competitors**: actually there aren't many companies that operate in this business, so the potential market is very high and Idrogen2 has the capacity to capture the most portion of business.
- **Diversity of product**: Idrogen2 commercializes a product with an innovative, safety and reliable technology. It's the only company that commercialize product with ATEX, PED CE certificates with a competitive price.
- **Fixed cost allocation**: the only fixed cost is the human cost, because the business in based principally on the know-how of people.
- **Rate of industry growth:** the rate of growth of this business is very high, as the forecast of Idrogen2 demonstrate.
- **Exit barriers:** there aren't barriers in this business, the only core competence that Idrogen2 need are the skills, the know-how, not particular machines or plant.

This analysis details a business that in few years should grew a lot and the Idrogen2 is the unique company that now is already competitive, it has the capacity to became a leader of this business, according to the growth of it.

A research of the electrolyzer market has individuate the situation illustrated in Table 13, where it's match the different company operating in this business.

Company	Know-how level	Technology	Market	Idrogen2 advantages
Statoil Hydro	Over 20 years of experience, very high skills	Big alkaline electrolyzers with output atmospheric pressure and output capacity between 10 and 485 Nm3/h of hydrogen	Northern Europe, Asia and South America	Difference of target and geographical market, higher pressure
ITM Power	Low experience both for business both for technology	PEM technology	England	They aren't ready for the production
Teledyne Energy System	Good skills level	Alkaline electrolyzers with capacity between 1 and 200 Nm3/h, and their output pressure is only 6,9bar	USA	Higher output pressure, higher efficiency
Texol	Very high skills level	Alkaline electrolyzer with 6Nm3/h capacity, and PEM technology	Scotland	Higher output pressure, higher efficiency
Hydrogenics	Low experience both for business both for technology	Alkaline electrolyzer and PEM technology	USA and Canada	Difference of interests in the market (they produces only for automotive in USA)
AccaGen	Good skills	Alkaline electrolyzers with 1 to 100 Nm3/h capacity and quite low efficiency (4,4-6,3 kWh/Nm3), 10bar output	Switzerland	Higher output pressure, higher efficiency
Other Italian producers	Really low quality	Alkaline electrolyzers with 1 to 10 Nm3/h capacity and low efficiency (5-8 kWh/Nm3), 15bar output max	Italy	Really higher quality and lower prices
Idrogen2	Top know-how	Alkaline electrolyzers with 1 to 5 Nm3/h capacity and the higher efficiency (3,9 kWh/Nm3), 35 bar output presure	Europe	

Table 13: Competitors analysis

All the competitors are also industrial gas plants producer, Idrogen2 instead dedicates all the efforts to Electrolyzers production.

The threat of the entry of new competitors

There's a possibility that other company could enter in this business, thank to the absence of the enter barriers, to the less financial requirement, but to became competitive as Idrogen2 should be necessary at least two years for the following reasons:

- The price of Idrogen2's products (15 k€) is the best that could be made with the actual technologies.
- The partnership with ICI Caldaie guarantees a distribution into the Italian market, ICI caldaie is the leader company in his business.
- The quality and the high performance of products.
- The know-how of Idrogen2's management that represents the core competence of the company.

Idrogen2 has organised its business in order to became as soon as possible the market leader, thanks to its competitiveness and to its technologies.

The threat of substitute products

In this case there aren't possibilities of substitute products, because the only way to produce and stock hydrogen for small consumers is the Idrogen2's technology, the other one are too much expensive and produce to much quantity of Hydrogen with the transport problem.

The bargaining power of suppliers

In this business the power of suppliers is practically absence, because the core competence are the know-how and the skills of the people, the components of the Idrogen2 technology are common to find. The company has made a research in order to find the best suppliers, for becoming competitive on the market.

The bargaining power of customers

This is a new business for every customer, so the bargaining power is relative to the adaptation of the Idrogen2 technology, but it's the normal way of the market. Another aspect is that the potential market is really vast, and the bigger market is the lower power of customers is.

Management Team

The company was founded by the owner and CEO Giacomo Coppo, who graduated "cum laude" in Physics at the State University of Milan, with specialization matter physics. He has a deep expertise in material research and development accomplished during several years working in the microelectronics, optoelectronics and telecommunication industry. From 2002 he works in the field of electrochemistry having participated to start up of a Swiss company dedicated to designing and manufacturing of electrolyser as the CTO and production manager of the company. In 2006 he has been founder and manager of the electrolyser business unit Italian small enterprise. He is at present owner and CEO of IdroGen2, together with his associate Lorenzo Tardini, where he has put all his cumulated knowledge in hydrogen and electrochemistry field.

He has published several international papers in the field of optics and optoelectronics, he is co-inventor of a patent in the field of laser for optical communication industry and he is owner and inventor of a patent for intelligent heat in building management using on-site hydrogen production.

MSc in Mechanical Engineering was Research Assistant at the Department of Management, Economics & Industrial Engineering, Politecnico di Milano, Italy. He has consulting experience in a variety of operations improvement projects in the field of eco-efficiency and technology transfer for SMEs, recycling technologies and product recovery network analysis. During the period 2005-2006, he worked in ECODOM (a white goods producers consortium focused on recycling of waste from electrical and electronical appliances - WEEE) like Operation manager, building the weee reverse logistic and treatment activity in all Italy (managing supplier for a turnover of 40 million euros for year).

He is co-author of a book named "Recupero e trattamento dei RAEE: sfide per un nuovo settore industriale", and of 21 national and international scientific publications.

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.

Financial revenue

Idrogen2's business is functional not only for the idea, but also the economic number that this idea creates because without them it's difficult to survive into the market.

Starting to the 2008 economics performance, it must be realised a forecast and a future balance sheet in order to understand how the company could grow up and how it could be placed on the market.

The company could operate in this business, thanks to its capital structure, as the following graph shows, the next year a new partner will work for the Idrogen2 with an emission of 1500 k€. in this way the company can operate and work on the prototype and on the technology that in 2011 will became the main business of the company.

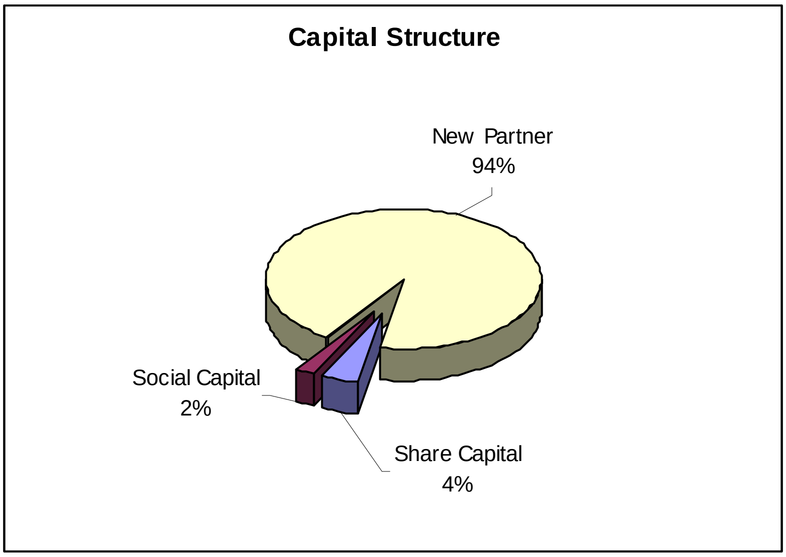

Figure 8: Capital Structure of Idrogen2

The share Capital is about 37%, 2 k€, then the Share Capital is about 70 k€; Idrogen2 with this structure could operate in this business and the planned result could be realized.

The sales forecast

The forecast for the next three year are crucial for the company, because there's the launch of the product with the new technology realized by Idrogen2.

The Table 14 explains the forecast estimated by the company, thinking a medium (not the best case and not the worst case) scenario. It's only for the next three years because the laws and the rules about energy and CO^2 emission change very frequently, so a forecast over the fourth year is a no sense.

Sales	2009	2010	2011	2012
Industrial Electrolyzer	10	5	3	0
H2&CH4 Units	1	24	81	323
Electrolyser Farm Units*	0	1	3	3
Total Units	**11**	**29**	**603**	**775**

Table 14: Idrogen2's sales forcast

*Each Farm consists on 100 simple electrolyzer units

The Industrial Electrolyzer Farm is the current business of the company that allow it to survive on the market and to have time to realize the prototype of the H2&CH4 Unit that will constitute the business future. Besides the Industrial Electrolyzer Farm guarantees the employment of three blue collars that begin to improve their skill and to become more efficient.

The customer that buys the Industrial Electrolyzer Farm is the same that assure the business Electrolyser Units from 2011, together with an American company that need the product to make a hydrogen project in USA. So these two big customers constitute the way to attack the international market and to create a good image of the Idrogen2 Company into the world.

On the other side the H2&CH4 Units are the way to get into the Italian market, thanks to a partnership with a leader company in the production and the commercialization of boilers, in fact this company integrates the Idrogen2's technology in his product and sells them. In this way the company obtains a double advantage: the first is a certain partnership that guarantees high level of revenue and the second thing is the indirect marketing made by this company.

In conjunction with this customer there's a different marketing actions made by Idrogen2 to get into the market and in order to became in a little time a competitive reality in the market.

The Budget Plan

With this sales forecast and with the skill acquired this past year, Idrogen2 has estimated the budget plan for the next four years. In the following table is reported the future economic account.

The next year is crucial, because it's the year where it could be build the prototype of H2&CH4 Units with the re-engineering of the technology; in fact the net income of 2009 is negative, but it isn't a big problem since next year a new partner enter in the company, giving the money to realize the excellent performance planned by Idroge2.

The 2010 has a little value because the company has planned a marketing campaign in conjunction with ICI Caldaie that should allow to penetrate the market and to allow to realize the sales forecast. From 2011 the company should start to make standard growing net income.

	2009	2010	2011	2012	2013
Turnover	***673.575***	***2.848.625***	***5.451.225***	***9.169.625***	***14.591.500***
H2SUSBUILD	333.575	147.125	10.725	10.725	0
Electrolyser	180.000	160.000	160.000	0	0
H2&CH4 units	160.000	1.320.000	1.616.000	5.494.400	8.484.000
Electrolyser Farm	0	1.221.500	3.664.500	3.664.500	6.107.500

Production Cost	***173.000***	***1.041.000***	***2.774.000***	***5.413.720***	***8.215.560***
Raw Materials	156.000	1.024.000	2.756.000	5.378.400	8156000
Consumptions	17.000	17.000	18.000	35320	59560
Gross Gain	***500.575***	***1.807.625***	***2.677.225***	***3.755.905***	***6.375.940***
Fixed Cost	***631.894***	***1.422.153***	***1.040.517***	***1.114.122***	***1.237.214***
Staff	305.280	599.320	630.640	747.064	825.072
Administration Cost	90.736	86.055	82.121	32.310	29.885
Rent	58.878	61.778	119.756	146.648	173.758
General expenses	36.000	44.000	66.000	46.100	66.500
Marketing Cost	132.000	622.000	132.000	132.000	132.000
Training	9.000	9.000	10.000	10.000	10.000
EBITDA	***-131.319***	***385.472***	***1.636.708***	***2.641.783***	***5.138.726***
Material Amortizations	11.600	23.200	26.400	29.600	34.800
Fixed Amortizations	66.715	96.140	102.140	108.140	114.140
Net Gain	***-209.634***	***266.132***	***1.508.168***	***2.504.043***	***4.989.786***
Burden from Balance sheet	***0***	***0***	***45.245***	***75.121***	***149.694***
Interest	0	0	45.245	75.121	149.694
Burden	0	0	0	0	0
EBIT	***-209.634***	***266.132***	***1.553.413***	***2.579.164***	***5.139.479***
Finance burden	***-26.943***	***-113.945***	***-218.049***	***-366.785***	***-583.660***
Earning	***-236.577***	***152.187***	***1.335.364***	***2.212.379***	***4.555.819***
Straordinary income	***0***	***0***	***0***	***0***	***0***
Income before tax	***-236.577***	***152.187***	***1.335.364***	***2.212.379***	***4.555.819***
Tax	***0***	***107.929***	***546.209***	***859.095***	***1.728.975***

IRAP (3,90%)	0	29.309	78.439	118.348	215.693
IRES (33%)	0	78.620	467.770	740.747	1.513.282
Net Income	***-236.577***	***44.258***	***789.155***	***1.353.284***	***2.826.844***

Table 15: Economic analysis

The core competences, as it has been said, are the know-how and the kills of people working for the company, so the cost of training and of recruitment are the most expenses of Idrogen2.

Performance index

For a complete analysis it's necessary not only to do the forecast and the future Economic Accounting, but also some significant performance index.

The Table 16 shows the cash flow and the relative Net Present Value for the next four years, calculated using a discount rate of 15%.

	2009	**2010**	**2011**	**2012**
CASH FLOW	-512.894	190.347	1.593.708	2.598.783
NPV	6.351.024			
Profitability Index	5,82			

Table 16: Economic Indexes

NPV indicates how much value a project gives to the company, the Idrogen2's value is really bigger than zero, so the business is really profitable. This is the demonstration that the company uses in a good way its resources, so the linked risk is not excessive, but it's sustainable.

Another index usefully to analyze the Idrogen2 is the Profitability Index, because it allows to clearly identify the amount of value created per unit of investment. The condition to accept the project is that the PI index is more then one, in this case the value is higher then one.

The short analysis demonstrates how the feasibility of the Idrogen2's idea, and its capacity to penetrate the market and to generate value added.

One other important performance index is the Return of Investment that shows the ratio of money gained or lost (realized or unrealized) on an investment relative to the amount of money invested.

Idrogen2 for operating in this business doesn't have the need to make debts, but it use internal economic resources, so it isn't useful for this analysis to calculate the Operating Leverage.

Social Return on Investment Analysis

Although Idrogen2 is a for-profit enterprise, the company has an underlying social mission:

> ***Commercialization of on-site hydrogen generation technology that promotes social, environmental, and economic self-reliance for building heating and electricity and transportation sector worldwide***

The two primary social and environmental impacts of Idrogen2's Domestic Electrolyzer and Electrolyzer Farm are listed below:

1. **Reduction in the release of CO_2 and NOx into the atmosphere** – Hydromethane obtained through the hydrogen of Domestic Electrolyzers, burned in boilers for building heat, reduces the usage of methane thus reducing emissions of the combustion. Each Electrolyzer Farm installed to supply hydrogen for refueling stations strongly contributes to reduce public transportation emission increasing air quality in cities as well as the clean electricity produced by RES and stored into hydrogen. The Idrogen2 SROI calculates the social cost of the CO2 avoided by the two products, estimated through sales projections.
2. **Increase in families energy bill savings through the use of Idrogen2's products** – every residential building that purchases and uses the Idrogen2 Domestic Electrolyzer to burn hydromethane will have saving on their energy bills. The unit pays back its initial cost after seven years, after this period the product generates revenue for each occupant improving their life level.

Each of the benefits listed above are described in detail in the following sections.

The chart of Figure 9 below shows the path that investments in Idreogen2 follows to achieve the social and environmental impacts:

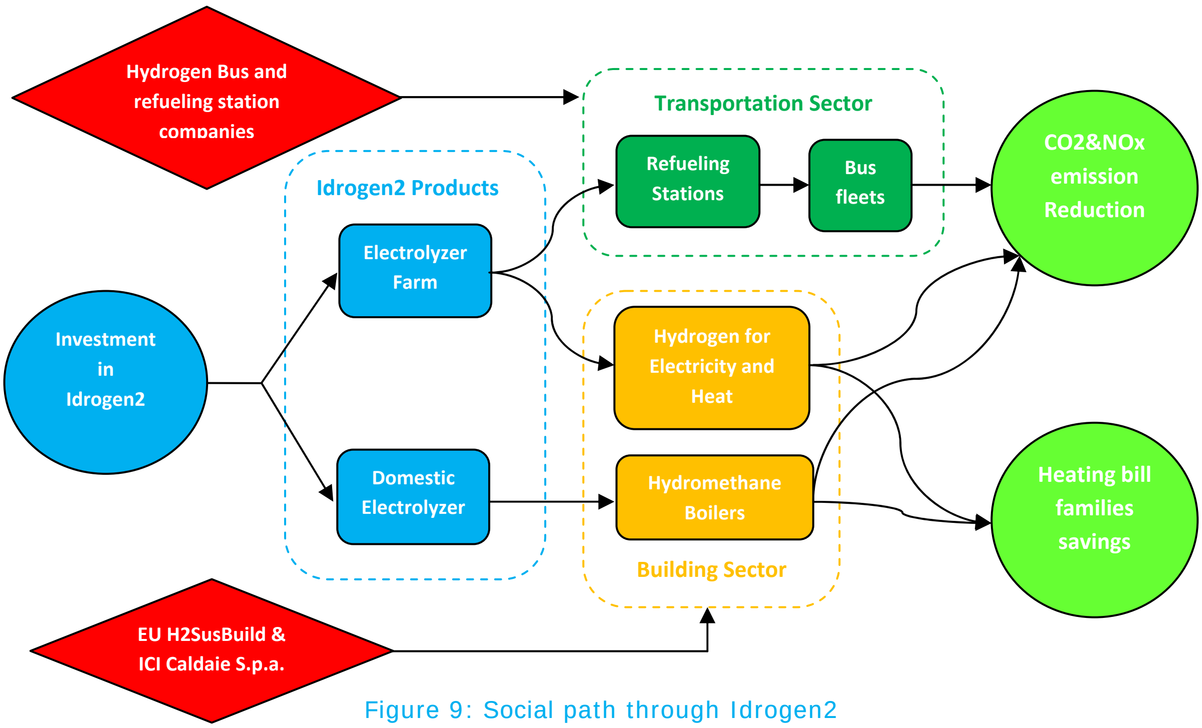

Figure 9: Social path through Idrogen2

Reduction in the release of CO2 and NOx into the atmosphere

This analysis is divided in two sections: the first is dedicated to the Domestic Electrolyzer impact on emission reduction, while the second considers the Electrolyzer Farm. For the first product the emission avoided are estimated on the domestic boiler business case presented before, while for the Farm has been considered, together with the Hydrogen Station, the social impact of electricity produced by hydrogen generated from RES.

As SROI indicator, is considered the equivalent CO_2 avoided by the application of each product. The emission considered are the CO_2 and NOx generated by building boilers and by a standard bus fleet. To relate the different green house gas which contribute to the global warming, is conventionally used the value 1 as Global Warming Potential (GWP) of the CO_2, while a value of 310 for the NOx. In fact NOx has an effect on global warming 310 times more powerful than CO_2.

The total CO_2 avoided is the sum of the real CO_2 and the equivalent to the NOx avoided. The SROI monetizes the emission savings with the carbon tax price of 10€/kg, the total cost of the emission is the social savings obtained investing in Idrogen2 products.

Hydromethane Boiler impact

A building boiler of the size of Domestic Electrolyzer's application produces on average 0,2kg of CO_2 for each thermal kWh produced: a 100kW unit produces at least 43 tons of CO_2 a year. The natural gas saved by the Idrogen2's unit results in an on-site saving of CO_2 of 18 tons per year.

In Europe, in 2007, the grid electricity generates on average 0,4 kg of CO_2 for each kWh consumed. As consequence, the hydrogen generation causes emission by the grid electricity production, it means that the total CO2 savings decrease to 4 tons per year (that is still positive).

Electrolyzer Farm impact

First is considered the social impact of an hydrogen buses fleet compared to the standard fleet. Table 17 reports the value of emissions for last generation diesel and natural gas urban buses.

Diesel	CO_2	160,9	g/mile
	NOx	8,4	g/mile

CNG	CO_2	64,4	g/mile
	NOx	4,1	g/mile

Table 17: Bus emission

Refering to the business case presented in the hydrogen station section, an electrolyzer farm of 100 units, working 10 hours a day during the electric off peak time, can refuel every day a fleet of 8 hydrogen bus. Each bus travels for 325 miles a day, all the operating range, and is completely refueled every day. In the emission balance are considered also the CO_2 and NOx produced by the electricity consumed from the grid (2007 U.S. values: 0,56 kg-CO_2/kWh and 0,00125 kg-NOx/kWh)

Considering the GWPs of CO_2 and NOx the total equivalent CO_2 avoided by the whole fleet in one year is reported below in Table 18.

Base Case Diesel		
CO_2 from electric grid	11,2	tons
NOx from electric grid	2,8	tons
CO_2 avoided	150,6	tons
Nox avoided	7,8	tons
CO_2 equivalent NOx	2.423	tons
Total CO_2 directly avoided	2.559	tons
Social saving a year	25.590	€

Base case NG		
CO_2 from electric grid	11,2	tons
NOx from electric grid	2,8	tons
CO_2 avoided	60	tons
Nox avoided	3,8	tons
CO_2 equivalent NOx	1.190	tons
Total CO_2 directly avoided	1.236	tons
Social saving a year	12.360	€

Table 18: Social Impact

Due to the larger diffusion of diesel urban bus the SROI indicator is based on the diesel base case.

The indicator considers also the application of the Farm in electricity generation from RES. Idrogen2's product allows a controlled production of electric power from RES which is totally clean from emission. The social value of the emission from electricity generation avoided through the Electrolyzer Farm is considered in the final social return balance.

The Table 19 shows the total social impact of the Domestic Electrolyzer and Electrolyzer Farm sales plan.

	2009	2010	2011	2012	2013	2014
Bus stations	0	0	1	1	1	1
RES stations	0	1	2	2	4	4
CH4&H2 units	4	24	81	323	436,05	588,6675
Total investement	€ 60.000	€ 1.465.584	€ 4.531.752	€ 8.161.752	€ 12.068.670	€ 14.357.933
Total CO2 saved [tons]	74	752.789	2.261.389	3.774.465	6.794.175	9.816.708
Total social savings	€ 740	€ 7.527.890	€ 22.613.885	€ 37.744.650	€ 67.941.749	€ 98.167.082

Table 18: SROI

The CO2 savings calculation considers the impact of each new unit sold together with the units sold the previous years. The social monetization of the total savings is expressed as the ratio of the Emission Savings and the Investment in Idrogen2's technology. The SROI obtained is 5,76€ for each euro invested on a time horizon of 6 years.

Increase in families energy bill savings

A heating power of 35kW is suitable for large buildings, residential and commercial. A Domestic Electrolyzer coupled with a hydromethane boiler can serve a residential building of on average 40 apartments. Considering only the Idrogen2's unit, the initial investment is 15k€ that means 375€ for each family living in the building. The annual family savings is 53.7€ and the payback time of the investment is 7 years.

As second SROI indicator, has been considered the return on the initial investment on a time horizon of 10 years:

$$\text{Total energy bill savings} \Big/ (\text{Investement} + \text{mantainance cost}) = 1.43$$

An investment of 1€ in Idrogen2's technology has a social return after 10 years of 1.43€.

Non-Quantifiable Social Benefits

Trust in Hydrogen by population

One of the main barrier to hydrogen penetration is that population is not aware of the potentialities of hydrogen in energetic applications. Idrogen2 is able to bring the hydrogen in every building and in every city as new source of energy and money savings, improving the trust of people in this new energy solution. This trust could give additional pressure for the diffusion of green vehicles and green buildings.

Hydrogen research and development

Idrogen2 has found a way for starting the creation of a real hydrogen market: everyone can produce the hydrogen he needs wherever he needs. This newborn market will push venture capitalist to invest in research and development, bringing the hydrogen more and more convenient as a real solution for the environment.

Municipal attention on sustainable energy solutions

Every municipality can seriously contribute to reduce the green house gas emissions improving air and life quality of the inhabitants: Idrogen2 is an example of that. There still a lot to do to find clean energy solutions, Idrogen2 shows a direction for that.