



(Grant Agreement 278921)

*“Demonstration Project for Power Supply to
Telecom Stations through FC technology”*

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Ericsson Telecomunicazioni*

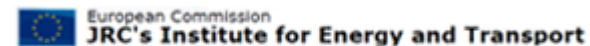
Project Summary

- **Starting Date:** 01/01/2012
- **Duration:** 36 months
- **Budget:** € 10,591,649
- **Funding:** € 4,221,270
- **Partners:** 6 partners
- **Countries:** Belgium, Denmark, Italy, Switzerland
- 2 full size systems will be tested in R&D centers for benchmarking.
- 18 real RBS station power generation systems will be installed in selected sites field trials.

Partners



GREENHYDROGEN.DK



Dipartimento di Ingegneria Industriale
Università degli Studi di Roma "Tor Vergata"



Customers Involvement



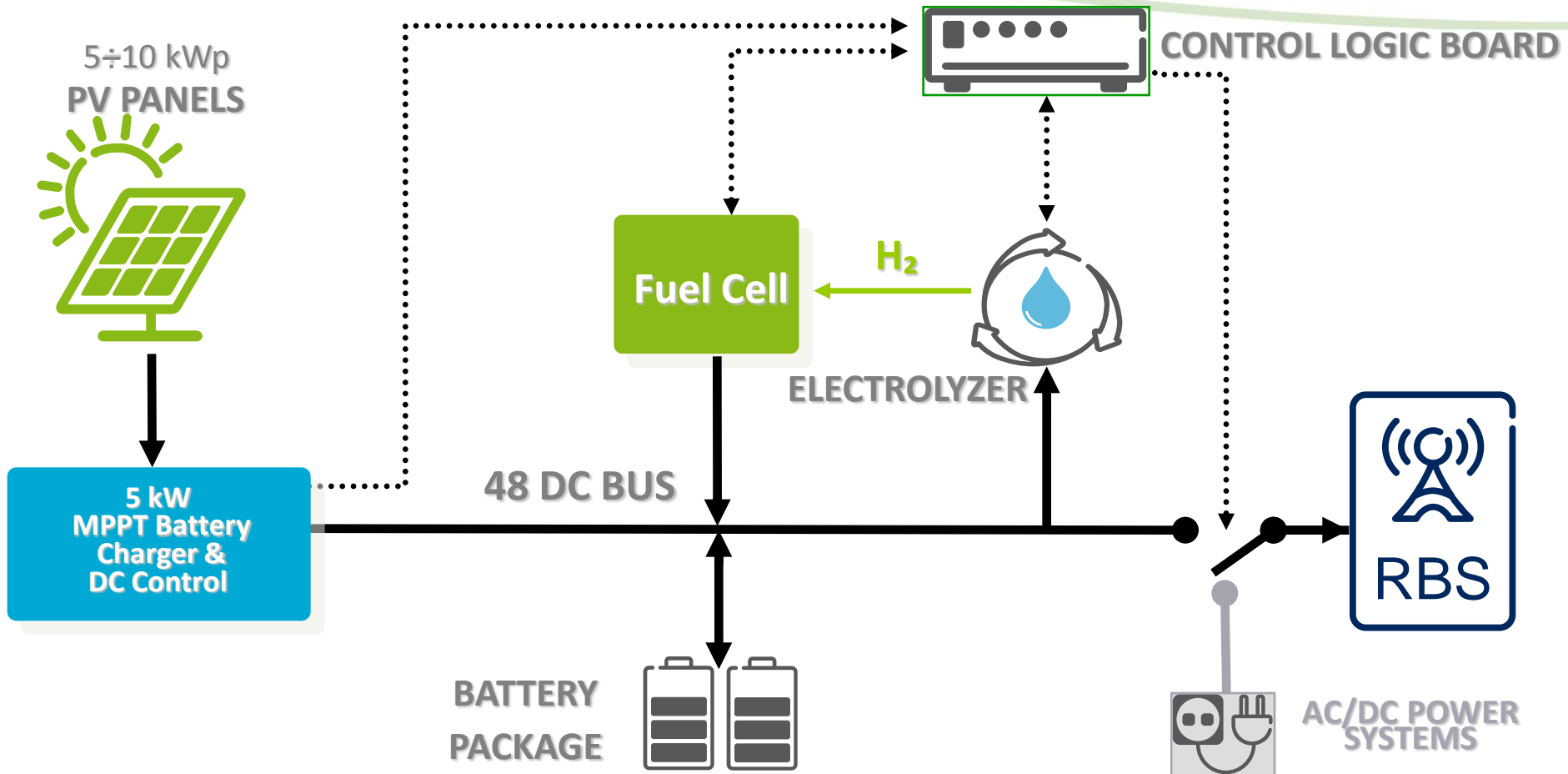
Project Objectives

- Demonstrate the advantages of hydrogen and fuel cells with the supporting hydrogen refuelling infrastructure for delivering the expected power supply service, compared to the solutions used today:
 - *Off-grid sites power generation is often limited by energy availability for remote site. Whereas the integrate use of PV with batteries may allow for prolonged operations. FC based solution may both increase the hours of unattended operation due to the higher efficiency and to the storage potential of H2 or Methanol.*
- Demonstrate a significant number of sites and shall be based on sufficient maturity levels of fuel cell systems & hydrogen supply solutions:
 - *The 20 sites minimum target foreseen for the FCpoweredRBS Project test phase represents a very significant large scale demonstration which will allow a complete assessment of the technology to this specific application and to this very interesting early market. The systems and solutions used in this project have track records documenting high maturity levels.*

Project Targets

- Full integration of the FC energy production system with a renewable energy production:
 - *Increased energy efficiency under stand alone configuration*
 - *Durability*
 - *24/7 operation with four digit availability*
- Benchmarking of different technical configurations for fuel cells integrated with renewable sources:
 - *European FC and H₂ production technologies (Dantherm, MES, GreenHydrogen) together with a US product (IdaTech) are benchmarked with a specific application with a wide potential*

Solution: System Overview

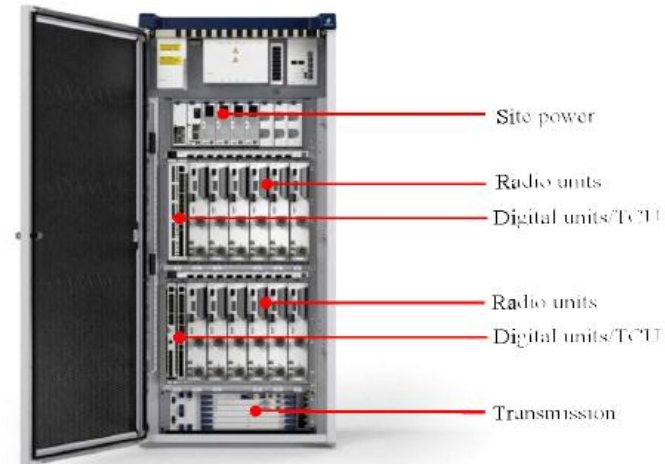
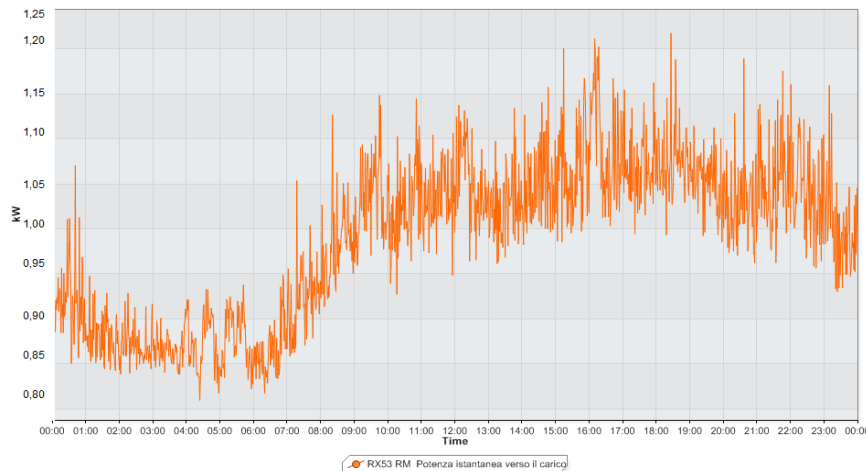


Solution: System Components 1/4

Load

Ericsson RBS 6201

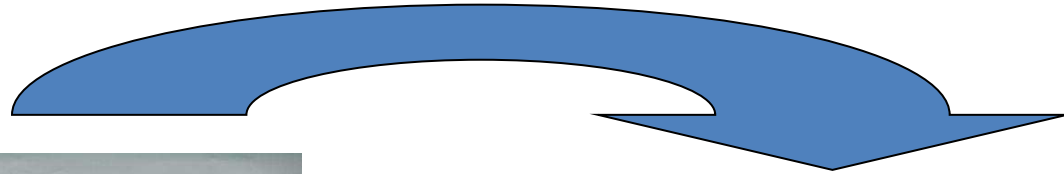
- Typical Radio Configuration 3x2 WCDMA
- N° 3 Radio Unit, N°1 Digital Unit
- Typical power consumption 1000W
- Nominal voltage Vdc -48
- Operating voltage range -40.0 to -58.5 Vdc
- Operating environment Temperature +5° to +50°C
- Operating environment Relative Humidity 5 – 85%



- **Variation Load (kw) versus Traffic Load (daily)**

Solution: System Components 2/4

MES Solution



MES DEA 1.1 FC Module X 2 (in parallel)

Nominal Total Power: around 2 kW

Voltage Range: 27V – 42V

Electrical Efficiency (LHV): 45% @full load.



Pressurized Water H₂ Nitidor Electrolyzer

H₂ Production: 0.2 Nm³/h

H₂ Pressure: 30 bar

H₂ Purity: 99.95%

Power Consumption: 1.5 kW @ full load.

Solution: System Components 3/4

Dantherm & Green Hydrogen Solution

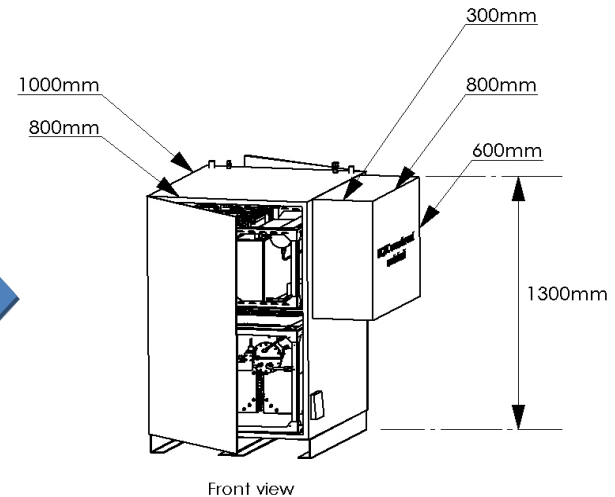


Dantherm Battery eXtender

Nominal Total Power: around 1.7 kW

Voltage Range: 45V – 57V

Electrical Efficiency (LHV): 45% @full load.



Pressurized Water Green Hydrogen Electrolyzer

H₂ Production: 0.2 Nm³/h @ 20%load

H₂ Pressure: 30 bar

H₂ Purity: 99.95%

Power Consumption: 0.906 kW @ 20%load

(Full load: 1.0 Nm³/h of H₂ with 5.3 kW)

Solution: System Components 4/4



5 kW MPPT Battery Charge & DC Control

- Max PV Power 5 kW
- MPPT Start Up Voltage 130 V
- Optimum MPPT Voltage Range 100 - 180 V
- Efficiency > 95%
- Max PV Current 42 A @115 full load
- Max Output Power 5 kW @42Vdc full load

Control Logic Board

- Remote Control System
- Sensor and Telemetry System
- Logic Control



Installation of the Systems



- 2 full size systems in UniRoma2 and JRC
- Widest latitude range covered (in Italy)
- Several TelCo Operators involved

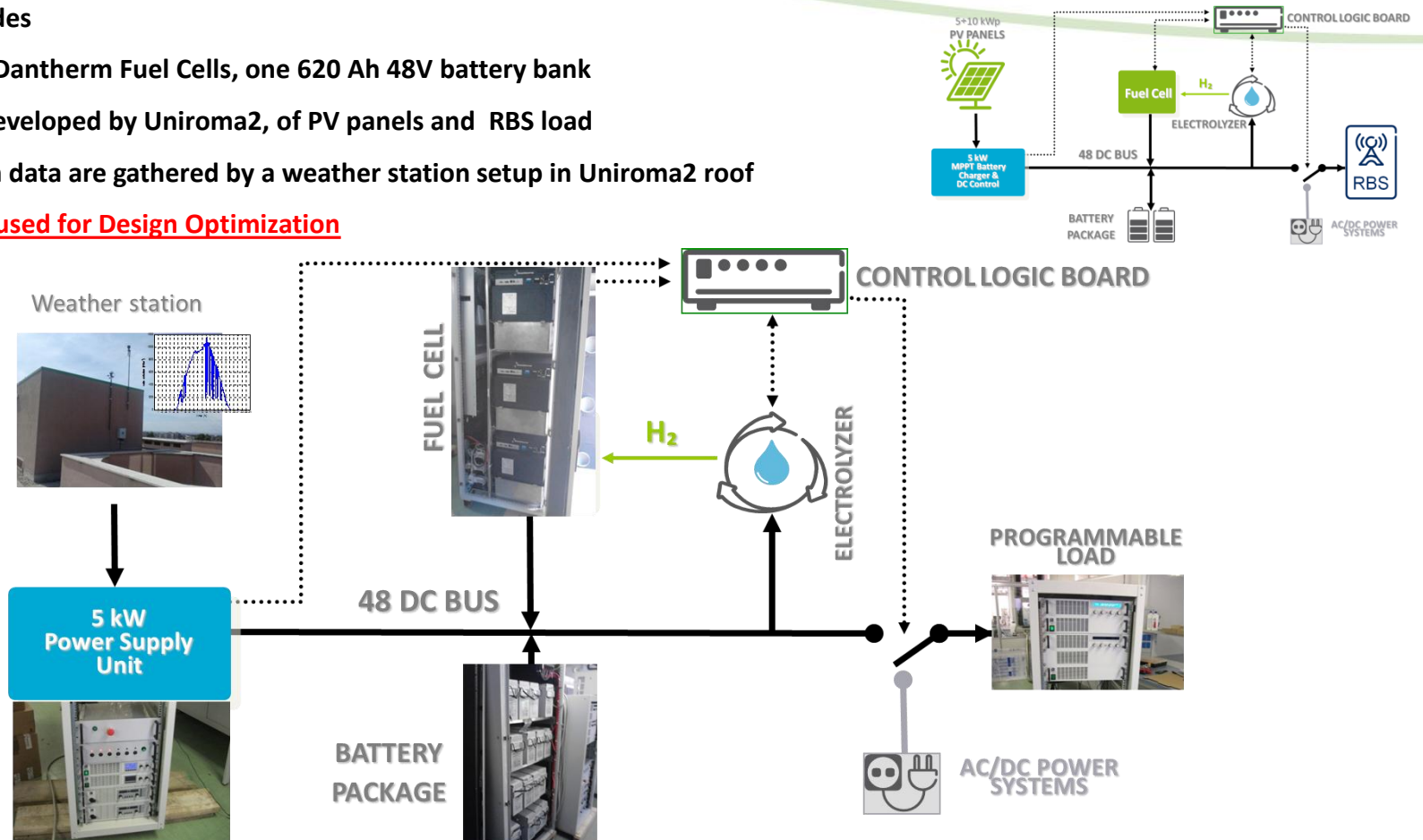
#	Id	Location	Coordinates Lat - Lon	End-user	Type	Sizes [mt]	Configuration	PV Rated	Site Survey
1	PN037	Maniago (PD) SS251	46°9'23,854" - 12°41'41,033"	WIND	GSM	10x10	A: Hydrogen	5 kW	05/07/2012
2	UD063	S.Giorgio di Nogaro (UD)	45°49'26,1" - 13°12'24,5"	WIND	UMTS	10x10	A: Hydrogen	5 kW	06/07/2012
3	UD075	Pavia di Udine (UD)	45°59'22,1" - 13°17'34,5"	WIND	UMTS	10x15	A: Hydrogen	5 kW	06/07/2012
4	VI026	Montebello V.no (VI)	45°27'20,8" - 11°23'30,1"	WIND	GSM	10x10	A: Hydrogen	5 kW	23/07/2012
5	VR034	Oppeano (Verona)	45°19'48,7" - 11°04'42,1"	WIND	UMTS	10x15	A: Hydrogen	5 kW	30/07/2012
6	BA5999	Giovinazzo Località 7 Torri	41,142083 - 16,614478	H3G	UMTS	10x10	C	10 kW	16/07/2012
7	BA5157	Bari Casermette	41,09024 - 16,877018	H3G	UMTS	8x8	A: Hydrogen	5 kW	24/07/2012
8	LE5249	Lecce Stadio	40,3629113 - 18,210247	H3G	UMTS	9x9	A: Hydrogen	5 kW	22/08/2012
9	LE2733	Brindisi Cappuccini	40,128017 - 18,288556	H3G	UMTS	10x8	A: Hydrogen	5 kW	13/09/2012
10	BR5232	Maglie Est	40,634998 - 17,925073	H3G	UMTS	10x8	A: Hydrogen	5 kW	25/09/2012
11	CZT241	Belcastro	39°01'10,6" - 16°47'07,1"	TELECOM	GSM	10x10	A: HydroPlus	5 kW	09/07/2012
12	LA1M	Sonnino	41°24'48" - 13°15'09"	TELECOM	GSM	5x8	A: HydroPlus	5 kW	10/07/2012
13	LTT01C	Latina Gorgolicano	41 26 28 66 - 00 25 34 20 E	TELECOM	UMTS	5x8	A: HydroPlus	5 kW	07/09/2012
14	RMT157	Ostia Sud	41 43 06.43 - 00 08 37,53 W	TELECOM	UMTS	10x10	A: HydroPlus	5 kW	11/09/2012
15	RMT230	Monterotondo	42 02 35.38 - 00 10 16,26 E	TELECOM	UMTS	10x10	A: Hydrogen	5 kW	17/09/2012
16	RMT541	Bagni di Tivoli	41 57 08.69 - 00 15 50.39 E	TELECOM	UMTS	10x10	A: Hydrogen	5 kW	18/09/2012
17	RMT676	RM Settebagni	42 00 26.50 - 00 03 41.90 E	TELECOM	UMTS	10x15	A: Hydrogen	5 kW	27/09/2012
18	RMT813	Fiano	42 10 25.77 - 00 07 44.44 E	TELECOM	UMTS	10x15	A: Hydrogen	5 kW	28/09/2012

Normative and Permitting Procedures

- **Geometric Capacity hydrogen tanks $\leq 0.75 \text{ m}^3$**
No Fire Prevention Certificate. (DPR 151/2001)
- **Adoption Hydrogen Safety (DLgs 81/2008)**
 - *Frequency and duration of the flammable gas presence*
 - *Protective measures are applied*
 - *Suitable positioning pipe and cylinder's hydrogen*
- **Obtain the necessary Authorizations (DPR 380/2001)**
 - *Legal Permissions from TelCo operators for sites usage*
 - *Standard Civil work authorization*
 - *Sites without landscape constrains.*

Project Achievements: Research Center installation

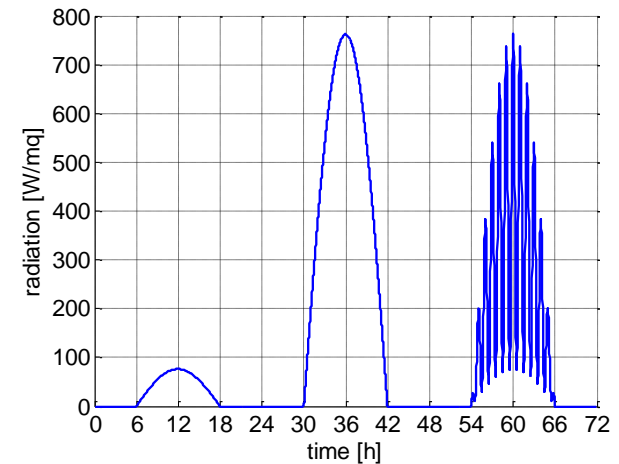
- A prototypal system has been installed in Uniroma2 labs
- The system includes
 - Three 1.7 kW Dantherm Fuel Cells, one 620 Ah 48V battery bank
 - A simulator, developed by Uniroma2, of PV panels and RBS load
 - Solar radiation data are gathered by a weather station setup in Uniroma2 roof
 - The System is used for Design Optimization



Project Achievements

Test procedure design

- A test protocol is under development to benchmark the FC system vs. standard Diesel GenSet solutions for RBS systems. Targets are
 - comparison of the different systems in terms of TCOs
 - Comparison of FC powered systems with Diesel engine powered systems with same battery storage
 - A test cycle is being defined to test systems, by having 3 representative radiation days, so that efficiency and fuel consumption will eventually be representative of the system behavior over the year
 - Real world radiation data will be used



- **Application Area: Early Markets**
- Project will bring EU companies operating in a very interesting application (Telecom) with significant commercial potential worldwide.
- The DEMO nature of the project supported by the RTD effort will represent a significant contribution to overcome market entry barriers in Europe.
- The technology will be compared with standard solution highlighting its environmental, energy efficiency as well as economic impacts.
- Public awareness and acceptance of the technology will be promoted.
- Market penetration made possible by this project will help achieve FCH-JU targets of installed systems by 2015.

- The aim, concept, and the choice of the technological solution will match perfectly with the scope and objectives of the call in the
 - “Application Area Early Markets” (SP1-JTI-FCH.4)
- and the topic on
 - “Demonstration of industrial application readiness of fuel cell generators for power supply to off-grid stations, including the hydrogen supply solution” (SP1-JTIFCH. 2010.4.2).
- The objective of this action was to demonstrate the industrial application readiness and market appeal of hydrogen and fuel cells for powering stand alone off-grid stations.
- Although a potential early-market is under development worldwide this objective seems to be not pursued by the 2012 AIP which instead is focused on Back-Up or UPS applications. If the process will succeed the potential market will add up to the expected ones

Cross/Cutting Issues

- Training:
 - Training is an important outcome of the project as a significant number of field operators will be trained to operate with hydrogen and fuel cells
- Safety:
 - Safety procedure will be available, developed in a very demanding environment as the Telecom market

TLC Operators present view

- Driver: reducing CO2 emissions using FC instead of diesel generators
- Internal discussions on going for solution for Off-grid sites
- High interest on Hydroplus (logistic issues)



- Interest on this trial
- Lack of investment on Energy



- Managed Services contract in place on Off Grid sites not FC's... yet
- High Interest on this trial

Future Perspectives

- The project is targeting prototype solutions to be used on existing Radio sites
- Commercial retrofit solution has an interesting payback period vs diesel generator (about 3 years) and half annual OPEX starting from the fourth year.
- This solution may be also engineered within a new Radio site model to address new field installation (greenfield or swap), mostly in emerging markets.
- Customers are also interested in Hydroplus (methanol) and Natural Gas / LPG solutions to overcome hydrogen logistic issues.

Thank you for your attention!

Project Web Site: www.fcpoweredrbs.eu

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Project Manager **FC Powered RBS**