Ref. Ares(2018)2849062 - 31/05/2018

Grant Agreement No.: 779606

Project acronym: EVERYWH2ERE

Project title: Making Hydrogen affordable to sustainably operate Everywhere in European cities

Call (part) identifier: H2020-JTI-FCH-2017-1

Thematic Priority: FHC-02-10-2017, Transportable FC gensets for temporary power supply in urban applications

Starting date of project: 1st February, 2018

Duration: 60 months

Project URL: www.everywh2ere.eu

WP1 – "FC Gensets Specifications"
D1.2 – "EVERYWH2ERE Demonstration tracking tool and KPIs Panel"

Due date of deliverable
31st May 2018

Actual submission date
31st May 2018

Deliverable version
1.0

Organisation name of lead contractor for this deliverable: RINA Consulting

Dissemination Level		
CO	Confidential	
PU	Public	**X**

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Executive Summary

"D1.2 EVERYWH2ERE Demonstration tracking tool and KPIs Panel" has the aim of providing a simple tool (Excel sheet) to be accessible to all the partners (i.e. stored on EVERYWH2ERE project repository on NEXTCLOUD) to track where the eight gensets (4x25 kW + 4x100 kW) will be installed during the second half of the project (Demonstration Campaign) also monitoring some relevant performances.

These performances, strongly related to project objectives and impacts, will be monitored in terms of KPIs, so a specific KPI panel will be here by presented.

EVERYWH2ERE KPI panel includes both KPIs of the project (to evaluate the achievement of foreseen objectives and impact) and gensets performances KPIs (to evaluate the effective behaviour of the generators).

A monitoring platform has been developed by RINA-C to facilitate the collection and post-processing of demonstration data and it will be described in this report.

This tracking tool will be constantly updated during the project lifetime (also potentially including new categories/KPIs to be monitored) and it will be included as annex of D1.6, D2.2, D8.3, D4.4, D4.5, D4.6, D4.7, D4.8, D4.9, D8.4 to track project updates and status.

This tool has the objective of tracking the status of the installation and deployment of the genset and it will work as a mean of verification and reporting of the achievement of the project KPIs.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Table of Contents

List of Figures

Abbreviations and acronyms

PEM	Proton Exchange Membrane: a type of fuel cell
BOP	Balance of Plant: all electrical components excluding the fuel cell stack
CAPEX	Capital Expenditure
OPEX	Opertive Expenditure.
FC	Fuel Cell
PBP	Payback Period.
GHG	Greenhouse Gases
KPI	Key Performance Indicator
EOH	Equivalent Operating Hours

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

1. Introduction

This report was prepared within the framework of Work Package 1: FC Gensets Specifications, coordinated by RINA-C. According to its role of project coordinator and WP1 leader and due to deliverable's cruciality to track project outcomes and status, has been realized under the responsibility of RINA Consulting, which could also benefit of previous research expertise in the definition of H2020 project relevant KPI Panel and monitoring architecture (R2CITIES, PLANHEAT, REUSEHEAT etc.).

The choice of the KPIs and the intention of realizing a monitoring platform directly interconnected to data collected "on the gensets" (to be defined also thanks to SHSA and GENP support if via a GSM connection or via SD card that stores relevant data) has been discussed at first during Genova KOM, where RINA-C proposed a first set of KPIs.

The selection of relevant KPIs has been indeed performed collaboratively by all project partners to ensure the definition of a proper and complete evaluation framework.

This collaborative approach has been already started during the Kick-Off Meeting where a dedicated interactive session dedicated to KPIs took place. In this session a round-table brainstorming gave as results a preliminary list of project KPIs.

Then, the preliminary list has been integrated with KPIs already introduced in the proposal phase and circulated by email to all the partners for getting comments and then approval.

Afterwards, via email exchange and bilateral talks (with demonstration responsibles - to better understand which data could be available "on the field" - and technology providers – to clarify which performances will be effectively monitored by EVERYWH2ERE gensets), KPIs have been better further refined towards their final definition under WP4 leader supervision (ENVI). KPIs have been so finally defined as presented in the following chapters.

Similar approach has been pursued for what it concerns the identification of "non-technical" KPIs related to social, economic, dissemination objectives thanks to the support of VTT, FHA, LINDE, ICLEI and D1.

This document presents the result of all those collaborative activities and specifically Chapter 2 is dedicated to the description of each of the identified KPIs. Each indicator is presented in terms of ID, Unit of measurement, monitoring methodology and monitoring frequency.

Chapter 3 presents how the demonstration tracking tool is structured and how it will be used during EVERYWH2ERE demonstration campaign and project reporting.

Chapter 4 introduces the monitoring platform that RINA-C is going to promote in the project to facilitate data post-processing and the continuous (and if possible "real-time") monitoring of EVERWYH2ERE demonstration campaign.

Finally Chapter 5 reports next steps and conclusions.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

2. EVERYWH2ERE KPIs Panel

The preliminary identification of relevant project KPIs have been carried out during a dedicated interactive session organized by RINA Consulting in the framework of the project Kick-Off Meeting.

Then, the preliminary list has been integrated with KPIs already introduced in the proposal phase and circulated by email to all the partners for getting their approval.

First of all project KPIs panel (Tab.2.1) has been divided in 4 main clusters: Gensets' performances (G), Environmental performances/aspects (ENV), Economic performances/aspects (ECO), Dissemination and Stakeholders (DS)

The consortium identified then specific KPIs per each cluster according to available monitored data, also referring, if present, to specific project targets declared in the distribution of action or already declaring quantifiable suitable and achievable targets.

GENSETS		**ENVIRONMENTAL**	
G1	STACK EFFICIENCY	ENV1	GHG AND EMISSION SAVINGS IF COMPARED WITH FOSSIL FUEL BASED GENSETS
G2	STACK DEGRADATION		
G3	STACK DURABILITY		
G4	MINIMUM STARTING TEMPERATURE IN SUB-ZERO CONDITIONS	ENV2	GHG AND EMISSION SAVINGS IF COMPARED WITH GRID SUPPLY
G5	FC PEAK CURRENT		
G6	FC PEAK VOLTAGE		
G7	VOLUME	ENV3	GHG AND EMISSION OF THE H2 LOGISTIC SUPPLY
G8	WEIGHT		
G9	POWER PRODUCTION		
G10	AUXILIARY SERVICES SELF CONSUMPTION	ENV4	NOISE
G11	AUXILIARY BATTERY SELF CONSUMPTION		
G12	TOTAL ENERGY SUPPLIED BY THE EVERYWH2ERE GENSETS IN DEMONSTRATION ACTIVITIES: temporary events		
G13	TOTAL ENERGY SUPPLIED BY THE EVERYWH2ERE GENSETS IN DEMONSTRATION ACTIVITIES: music festival	ENV5	CURRENT ELECTRIC ENERGY USED IN EVENTS/CONSTRUCTION SITE TO SUPPLY POWER
G14	TOTAL ENERGY SUPPLIED BY THE EVERYWH2ERE GENSETS IN DEMONSTRATION ACTIVITIES: construction sites		

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

G15	GAS CONSUMPTION		
G16	NUMBER OF FAULTS	ENV6	CURRENT FUEL ENERGY ASSOCIATED (kg * LHV) USED IN EVENTS/CONSTRUCTION SITE TO SUPPLY POWER
G17	NUMBER OF START/STOPS		
G18	RAMP TIME		
ECONOMIC		**DISSEMINATION AND STAKEHOLDERS**	
ECO1	CAPEX	DS1	CITIES INVOLVED
ECO2	REDUCED MANUFACTURING COSTS AND TIMING	DS2	FESTIVALS AND EVENTS HOSTING EVERYWH2ERE GENSETS
ECO3	CONTRACTUAL COSTS FOR RENTAL IF COMPARED TO DIESEL OR FOSSIL GENSETS	DS3	FESTIVALS AND EVENTS HOSTING EVERYWH2ERE H2CORNER
ECO4	OPEX FOR MAINTENANCE AND HYDROGEN SUPPLY	DS4	PROJECT WEBSITE VISITS
ECO5	PBP FOR A CONSTRUCTION COMPANY PURCHASING A GENSET AND USING IT IN ITS CONSTRUCTIONS SITES	DS5	STAKEHOLDERS EVENTS ATTENDED
ECO6	PBP FOR A RENTAL COMPANY OFFERING RENTAL SERVICES	DS6	NUMBER OF SOCIAL MEDIA INTERACTIONS (followers on Twitter and FB)
ECO7	INSTALLATION TIME		

Table 2.1- KPIs in relation to project's impacts listed in the DoA

In the following sections, a punctual description of each KPI of different KPIs section previously introduced is presented analysing why they were chosen, the identified measurement unit, measurement frequency, proposed measurement responsible and the methods to measure (direct/indirect), monitor and collect data about these KPIs during the duration of the process in order to constantly monitor the progress/impact of the project.

Some methodologies for indirect calculation of relevant performance parameters has been proposed according to previous consortium research and industrial expertise.

KPI to be monitored during/after each demonstration campaign will be collected together in a template to be updated after/during each demonstration campaign event and to be stored on the NextCloud project Repository together with EVERYWH2ERE Demonstration Tracking tool.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

2.1 Gensets' performances KPIs

- **G1: STACK EFFICIENCY**

Stack efficiency is one of the most relevant parameter for the evaluation of EVERYWH2ERE gensets' performances, nevertheless its calculation its not so easy due to the fact that it's strictly related to gas consumption. For for an overall performance estimation it is possible to rely integral calculations such as:

- average fuel efficiency = total Kg of H2 consumend / total kWh to the load
- average BOP efficiency = 1 - (total kWh from the aux / total kWh to the load)

ID	G1
Description	Stack Efficiency
Unit of Measurement	%
Target (if declared)	50%
Responsible of the Monitoring	Calculation from data monitored by the gensets (GENP-SHSA)
Methods to Monitor	Indirect
Monitoring frequency	Real time – post processing of data after demonstration campaign

- **G2: STACK DEGRADATION**

In order to ensure reliability of EVERYWH2ERE gensets performances, stack degradation has to be monitored. In order to do so voltage at nominal conditions will be evaluated after 100 equivalent operating hours (EOH). The challenging part will be to find a period that remains stable around the reference current for long enough that we can be confident that system is in steady state. PCS normally runs their reference points for up to 30mins to be sure that everything has stabilized (the cathode humidity level takes the longest to equalize) and then compare performances after 100 EOH. Another opportunity could be or to set a current for the evaluation of the performances or a fixed powe level (i.e. 80 kW and 20 kW) to evaluate the effective performances of the FC system.
According to this KPI methodology will be further investigate in the framework of WP4 during lab validation activities, nevertheless it is confirmed its relevancy, so this KPI has been here presented.

ID	G2
Description	-
Unit of Measurement	% (decrease of voltage after 100 hrs equivalent of functioning)
Responsible of the Monitoring	Calculation from data monitored by the gensets (GENP-SHSA)

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Methods to Monitor	Indirect
Monitoring frequency	Real time – post processing of data after demonstration campaign

- **G3: STACK DURABILITY**

The lifetime of the system is limited by the first failing component that will force the service interruption of the FC genset. The PCS stack and the balance of plant components will be chosen based on the data analysis of previous systems and component durability testing in order to achieve the targeted lifetime of 20000 EOH.

ID	G3
Description	Stack durability
Unit of Measurement	Hrs
Target (if declared)	20000
Responsible of the Monitoring	Calculation from data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct (correction of EOH for start/stop)
Monitoring frequency	Real time – post processing of data after demonstration campaign

- **G4: MINIMUM STARTING TEMPERATURE IN SUB-ZERO CONDITIONS**

Fuel Cell System freeze tolerance is indeed a key aspect to increase FC gensets affordability: in a fuel cell water is produced which might accumulate and damage the system during freezing conditions. One possibility is to keep the system warm, but then an external power source is required reducing efficiency and robustness. The new BOP design from PCS and the new ejector from VTT will solve both issues guaranteeing unassisted operation will increase from 0°C to -20°C for the 25 kW genset.

ID	G4
Description	Minimum Starting Temperature in Sub Zero conditions
Unit of Measurement	°C
Target (if declared)	- 20°C for 25 kW genset
Responsible of the Monitoring	Data monitored by the gensets via local environment temperature sensoring (GENP-SHSA and demo responsible)
Methods to Monitor	Direct

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Monitoring frequency	Real time during demonstration and lab validation campaign

- **G5: FC PEAK CURRENT**

Current is produced by the FC stack: its value has to be constantly monitored in real time in order to avoid faults. A control will be set on peak current to avoid misfunctioning and failures.

ID	G5
Description	Peak Current
Unit of Measurement	A
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct
Monitoring frequency	Real time during demonstration and lab validation campaign

- **G6: PEAK VOLTAGE**

Voltage produced in the FC stack between anode and cathode has to be constantly monitored in real time in order to avoid faults and over tension. A control will be set on peak voltage to avoid misfunctioning and failures.

ID	G6
Description	Peak Voltage
Unit of Measurement	V
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct
Monitoring frequency	Real time during demonstration and lab validation campaign

- **G7: VOLUME**

At the end of the integration and commissioning phase the whole volume of the genset (both of 25 kW and 100 kW) is a key parameter that proves the easiness of handling, transport and install the gensets everywhere. Furthermore genset volume is a relevant parameter also according to some permitting issues.

ID	G7
Description	Volume

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Unit of Measurement	m^3
Responsible of the Monitoring	Data measured by the gensets integrators once they will be ready
Methods to Monitor	Direct
Monitoring frequency	At the final commissioning of the gensets

- **G8: WEIGHT**

As stated for KPI G7, at the end of the integration and commissioning phase the weight of the genset (both of 25 kW and 100 kW) is a key parameter that proves the easiness of handling, transport and install the gensets everywhere. Furthermore genset weght is a relevant parameter also according to some regulations related to logistic and transportation issues.

ID	G8
Description	Weight
Unit of Measurement	Kg
Responsible of the Monitoring	Data measured by the gensets integrators once they will be ready
Methods to Monitor	Direct
Monitoring frequency	At the final commissioning of the gensets

- **G9: POWER PRODUCTION**

EVERYWH2ERE gensets has to guarantee a nominal power of 25 kW and 100 kW respectively. Power production is a key parameter to be constantly monitored to guarantee affordability and continuous operation of FC gensets.

ID	G9
Description	Power Production
Unit of Measurement	kW
Target (if declared)	25 kW and 100 kW
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct via Gross Power Monitoring sensor

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Monitoring frequency	Real time during demonstration and lab validation campaign

- **G10: AUXILIARY SERVICES SELF CONSUMPTION**

The overall power production is a result of the stack effective power minus energy losses related to the balance of plant components. The BOP component losses will be decreased as much as possible relying on affordable components, innovative design of the BOP (i.e. the ejector solution) and optimized operation strategy.

ID	G10
Description	Auxiliary services self consumption
Unit of Measurement	kW or kWh (to be verified)
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct or Indirect (To be verified) – If indirect: Gross Power Metering – Power Metering "at the plug"
Monitoring frequency	Real time during demonstration and lab validation campaign

- **G11: AUXILIARY BATTERY SELF CONSUMPTION**

As stated for G10, also auxiliary buffer battery (to be integrated in the gensets to guarantee a smooth functioning of the FC system) self consumption has to be considered to better monitor where losses are occurring in the FC gensets.

ID	G11
Description	Auxiliary battery self consumption
Unit of Measurement	kWh
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct or Indirect (To be verified)
Monitoring frequency	Real time during demonstration and lab validation campaign

- **G12: TOTAL ENERGY SUPPLIED BY THE EVERYWH2ERE GENSETS IN DEMONSTRATION ACTIVITIES *(Temporary events)***
- **G13: TOTAL ENERGY SUPPLIED BY THE EVERYWH2ERE GENSETS IN DEMONSTRATION ACTIVITIES *(Music Festivals)***
- **G14: TOTAL ENERGY SUPPLIED BY THE EVERYWH2ERE GENSETS IN DEMONSTRATION ACTIVITIES *(Construction Sites)***

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

One of the main goal of EVERYWH2ERE project is to realize a robust demonstration campaign, providing energy to temporary events, music festivals and construction sites. It will be important to monitor energy production in each of this category (together with the global hours of operation) in order to benchmark these and understand which could be the most relevant entry market for EVEVRYWH2ERE gensets for what it concerns energy production.

ID	G12
Description	Total energy supplied by the EVERYWH2ERE gensets in demonstration activities (Temporary events)
Unit of Measurement	kWh
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct via energy production metering at the plug
Monitoring frequency	Real time during demonstration and lab validation campaign

ID	G13
Description	Total energy supplied by the EVERYWH2ERE gensets in demonstration activities (Music Festivals)
Unit of Measurement	kWh
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct via energy production metering at the plug
Monitoring frequency	Real time during demonstration and lab validation campaign

ID	G14
Description	Total energy supplied by the EVERYWH2ERE gensets in demonstration activities (Construction Sites)
Unit of Measurement	kWh
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct via energy production metering at the plug
Monitoring frequency	Real time during demonstration and lab validation campaign

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

- **G15: GAS CONSUMPTION**

Gas consumed by the FC gensets is a relevant key parameter to be monitored to evaluate the efficiency of the system and also an useful value to evaluate logistic re-fuelling issues. Nevertheless measuring hydrogen entering in the FC stack could not be so easy, so it has been decided to monitor this value in terms of volume of gas supplied to each genset during their demonstration phase.

There is an alternative and totally cost free method to indirectly measure the H2 flow: simply by measuring the stack current and multiply by some fundamental and manufacturing constants and for a more precise estimation add a fixed quantity per each purge. These values are strongly related to manufacturers' experience so it will be then decided (in WP2-WP3) which method could be more relevant and reliable to monitor gas consumption.

ID	G15
Description	Gas Consumption
Unit of Measurement	kg of hydrogen
Responsible of the Monitoring	Demo responsible/gas supplier
Methods to Monitor	Indirect (via the number of re-filling) as direct monitoring could be difficult
Monitoring frequency	Post processing after each demonstration and lab validation campaign

- **G16: NUMBER OF FAULTS**

In order to monitor EVERYWH2ERE gensets during demonstration campaign, it will be important to constantly monitor the number of faults and misfunctioning potentially occurring (both relevant – that cause the temporary interruption of the production service – and non relevant ones – over current/over voltage) in order to evaluate the reliability of the gensets.

ID	G16
Description	Number of faults
Unit of Measurement	-
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Indirect (values extrapolated from monitored power production profile)
Monitoring frequency	Post processing after each demonstration and lab validation campaign

- **G17: NUMBER OF START/STOPS**

Strongly connected to G16 and in order to monitor EOH of the gensets (strictly connected to their degradation and lifetime), the affordability and continuous operation of the

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

EVERYWH2ERE gensets, number of start/stops of the gensets have to be monitored during all demonstration events.

ID	G17
Description	Number of start/stops
Unit of Measurement	-
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Indirect (values extrapolated from monitored power production profile)
Monitoring frequency	Post processing after each demonstration and lab validation campaign

- **G18: RAMP TIME**

EVERYWH2ERE gensets aim to be "plug-and-play solutions". Ramp time after the turning on of the gensets has to be properly monitored during each demonstration event in order to prove gensets' reliability.

ID	G18
Description	Ramp Time
Unit of Measurement	s
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Indirect (values extrapolated from monitored power production profile from the turn on to nominal power)
Monitoring frequency	Post processing after each demonstration and lab validation campaign

2.2 Environmental KPIs

- **ENV1: GHG AND EMISSION SAVINGS IF COMPARED WITH FOSSIL FUEL BASED GENSETS**

EVERYWH2ERE gensets are zero emissions. One relevant environmental KPI is to calculate their beneficial environmental impact in terms of emission if compared with current state of the art transportable generators based on diesel engine.

ID	ENV1
Description	GHG and emission savings if compared with fossil fuel based gensets
Unit of Measurement	$kgCO_{2,eq}$

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Indirect (values extrapolated from monitored power production profile from the turn on to nominal power, leveraging power production and gas metering – if present)
Monitoring frequency	Post processing after each demonstration and lab validation campaign

- **ENV2: GHG AND EMISSION SAVINGS IF COMPARED WITH GRID SUPPLY**

Similarly to ENV1, EVERYWH2ERE gensets beneficial environmental impact in terms of emission saving has to be calculated in respect of the other most common solution to provide power to construction sites, music festivals, temporary events: the direct connection with local electric grid. In order to do this calculation, National Electricity Emission Factors will be taken into account (from EUROSTAT Database) to calculate GHG and emission savings if compared with direct grid supply.

ID	ENV2
Description	GHG and emission savings if compared with grid supply
Unit of Measurement	$kgCO_{2,eq}$
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Indirect (values extrapolated from monitored power production profile from the turn on to nominal power, leveraging power production and gas metering – if present)
Monitoring frequency	Post processing after each demonstration and lab validation campaign

- **ENV3: GHG AND EMISSION OF THE H_2 LOGISTIC SUPPLY**

Even if EVERYWH2ERE gensets are zero emission, logistic supply of hydrogen to demonstration location has an environmental impact that has to be properly monitored and calculated also via databases and validated calculation methods coming from WP5 outcomes and correlating the distance between the hydrogen supply point and the location where the EVERYWH2ERE gensets will be hosted.

ID	ENV3
Description	GHG and emission of the H_2 logistic supply
Unit of Measurement	$kgCO_{2,eq}$
Responsible of the Monitoring	VTT – RINA-C

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Methods to Monitor	Indirect (values calculated with correlations)
Monitoring frequency	Post processing after each demonstration and lab validation campaign

- **ENV4: NOISE**

EVERYWH2ERE gensets are zero noise, a beneficial aspect particularly for urban applications. One relevant environmental KPI is to effectively monitor generation noise via microphones installed in the gensets container.

ID	ENV4
Description	Noise
Unit of Measurement	dB
Responsible of the Monitoring	Data monitored by the gensets (GENP-SHSA and demo responsible)
Methods to Monitor	Direct (microphone internal to the gensets
Monitoring frequency	Real time monitoring during each demonstration and lab validation campaign

- **ENV5: CURRENT ELECTRIC ENERGY USED IN EVENTS/CONSTRUCTION SITE TO SUPPLY POWER**

In order to benchmark EVERYWH2ERE gensets' production, to evaluate their beneficial impacts on local distribution grid and also to understand (in case of parallel functioning) how much energy needed by the end user is effectively produced by the gensets, it is important to monitor, in case of direct grid supply of electricity, how much energy is directly provided by the local grid to the end user.

ID	ENV5
Description	Current electric energy used in events/construction site to supply power
Unit of Measurement	kWh
Responsible of the Monitoring	Demo Responsible
Methods to Monitor	Direct or indirect (via Energy bills/interview)
Monitoring frequency	Post processing data after each demonstration and lab validation campaign

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

- **ENV6: CURRENT FUEL ENERGY ASSOCIATED (kg * LHV) USED IN EVENTS/CONSTRUCTION SITE TO SUPPLY POWER**

Strictly related to ENV5 (and according to similar purposes), it is important to evaluate primary energy related to fossil fuel based gensets acting in parallel to EVERYWH2ERE gensets in demonstration phases.

ID	ENV6
Description	Current fuel energy associated (kg * LHV – primary energy) used in events/construction site to supply power
Unit of Measurement	kWh, $_{EP}$
Responsible of the Monitoring	VTT – RINA-C – Demo Responsible
Methods to Monitor	Indirect
Monitoring frequency	Post processing data after each demonstration and lab validation campaign

2.3 Economic KPIs

- **ECO1: CAPEX**

Capital cost of EVERYWH2ERE gensets has to be tracked at the end of the integration and commissioning phase, in order to respect cost objectives declared in the Grant Agreement and to propose an economically viable solution. A preliminary assessment of EVERYWH2ERE gensets costs has been presented in D1.3.

ID	ECO1
Description	CAPEX
Unit of Measurement	€/kW
Target (if declared)	5500 €/kW
Responsible of the Monitoring	Genset Integrator – RINA-C
Methods to Monitor	Indirect (costs of realization)
Monitoring frequency	Once the gensets are ready

- **ECO2: REDUCED MANUFACTURING COSTS AND TIMING**

Leveraging on robust and already tested components, the consortium committed itself to realize an integrated gensets that aim to reduce manufacturing costs and timing. Therefore this

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

parameter has to be properly monitored and quantified by the genset integrators and all subcomponents' suppliers.

ID	ECO2
Description	REDUCED MANUFACTURING COSTS AND TIMING
Unit of Measurement	%
Target (if declared)	-20%
Responsible of the Monitoring	Genset Integrator – RINA-C
Methods to Monitor	Indirect (costs and time of realization)
Monitoring frequency	Once the gensets are ready

- **ECO3: CONTRACTUAL COSTS FOR RENTAL IF COMPARED TO DIESEL OR FOSSIL GENSETS**

One of the main objective of EVERYWH2ERE project is to demonstrate an economically attractive solution, that should have a comparable cost for final end-users. Leveraging WP5 and WP6 outcomes and potential contracts applied in the demonstration phase, it will be important to monitor this parameter during both demonstration and business model analysis.

ID	ECO3
Description	Contractual costs for rental if compared to diesel or fossil gensets
Unit of Measurement	€
Target (if declared)	+/- 10% maximum discrepancy
Responsible of the Monitoring	Demosite Responsible – RINA-C
Methods to Monitor	Indirect
Monitoring frequency	Once the gensets are mobilized and contracts signed

- **ECO4: OPEX FOR MAINTENANCE AND HYDROGEN SUPPLY**

EVERYWH2ERE gensets have to guarantee continuous operation, facility of operation/installation and an increased efficiency (G1). At this purpose it will be important to monitor operative costs of the gensets also to benchmark them (both for fuel supply and maintenance) with current state of the art diesel based gensets.

ID	ECO4

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Description	OPEX for maintenance and hydrogen supply
Unit of Measurement	€
Target (if declared)	Reduced Maintenance & H_2 costs thanks to higher reliability and efficiency (OPEX - 10%)
Responsible of the Monitoring	Demosite Responsible – RINA-C – Gensets manufacturer
Methods to Monitor	Indirect
Monitoring frequency	Evaluation after each demonstration and lab validation campaign

- **ECO5: PBP FOR A CONSTRUCTION COMPANY USING IT IN ITS CONSTRUCTIONS SITES**

Looking at potential end users of EVERYWH2ERE Gensets and leveraging WP6 and demonstration campaign results, it will be important, in order to study entry market for a prompt marketability of project gensets, to evaluate the potential profitability of an investment to be performed by a construction company who would like to add to its gensets fleet a FC based solution.

ID	ECO5
Description	PBP for a construction company using it in its constructions sites
Unit of Measurement	yrs
Responsible of the Monitoring	ACC – RINA-C – Gensets manufacturer
Methods to Monitor	Indirect
Monitoring frequency	At the end of the project leveraging the full demonstration campaign

- **ECO6: PBP FOR A RENTAL COMPANY OFFERING RENTAL SERVICES**

Similarly to ECO5, looking at potential end users of EVERYWH2ERE Gensets and leveraging WP6 and demonstration campaign results, it will be important, in order to study entry market for a prompt marketability of project gensets, to evaluate the potential profitability of an investment to be performed by a genset rental company/energy utility who would like to add to its gensets fleet a FC based solution.

ID	ECO 6
Description	PBP for a rental company offering rental services

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Unit of Measurement	yrs
Responsible of the Monitoring	RINA-C
Methods to Monitor	Indirect
Monitoring frequency	At the end of the project leveraging the full demonstration campaign

- **ECO7: INSTALLATION TIME**

EVERYWH2ERE gensets have to be easy to transport, easy to install and plug-and-play. During each demonstration phase/event it will be important to properly monitor installation time at demonstration location.

ID	ECO 7
Description	Installation time
Unit of Measurement	hours
Target (if declared)	6 hours
Responsible of the Monitoring	Demosite Responsible - RINA-C
Methods to Monitor	Direct
Monitoring frequency	Evaluation after each demonstration and lab validation campaign

2.4 Dissemination and Stakeholders KPIs

- **DS1: CITIES INVOLVED**

EVERYWH2ERE project aims to strongly involve cities in its progress and demonstration activities, recognizing their role of potential living laboratories for hydrogen and fuel cell technologies. In this sense a dedicated stakeholder group will be setup also thanks to ICLEI's support, in order to collect guidelines, wishes and needs to facilitate the integration of EVERYWH2ERE gensets in urban environment.

ID	DS 1
Description	Cities Involved
Unit of Measurement	-
Target (if declared)	20

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Responsible of the Monitoring	ICLEI
Methods to Monitor	Direct
Monitoring frequency	Each year of the project

- **DS2: FESTIVALS AND EVENTS HOSTING EVERYWH2ERE GENSETS**

One of the most relevant stakeholders targeted by EVERYWH2ERE are music festivals which will be involved in project demonstration campaign also thanks to D1's relevant support. Dedicated dissemination action will be organized during the first period of the project to identify music festivals and temporary events able to host EVERYWH2ERE gensets and to identify their wishe/needs also to study dedicated business models and contractual arrangements.

ID	DS 2
Description	Festivals and events hosting EVERYWH2ERE gensets
Unit of Measurement	-
Target (if declared)	min 3, max 6 events per demonstration year (25 kW) (2021-2022) / min 3, max 6 events per demonstration year (100 kW) (2021-2022)
Responsible of the Monitoring	RINA-C, ENVI as WP4 Leader
Methods to Monitor	Direct
Monitoring frequency	Each year of the project

- **DS3: FESTIVALS AND EVENTS HOSTING EVERYWH2ERE H_2CORNER**

In the framework of WP7, one of the most relevant dissemination and communication activities will be the promotion of EVERYWH2ERE project and FC and hydrogen technologies in music festivals. This action will be performed with the support of D1, FHA and all partners also to facilitate the increase of social awareness about hydrogen technologies.

ID	DS 3
Description	Festivals and events hosting EVERYWH2ERE H_2Corner
Unit of Measurement	-
Target (if declared)	3 H_2Corner setups per year (2021-2022)
Responsible of the Monitoring	RINA-C, D1, FHA as WP7 Leader

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

Methods to Monitor	Direct
Monitoring frequency	Each year of the project

- **DS4: PROJECT WEBSITE VISITS**

Project website is the main tool of dissemination and communication that the consortium setup to promote project outcomes and news. It is important to track website visits in order to have a perception of the interest of general audience to EVERYWH2ERE themes. As presented in D7.1, RINA-C already setup an automatic method to statistically monitor website visits that will be reported to the consortium each 6 months during project General Assemblies.

ID	DS 4
Description	Project Website Visits
Unit of Measurement	-
Responsible of the Monitoring	RINA-C, FHA as WP7 Leader
Methods to Monitor	Direct
Monitoring frequency	Each 6 months of the project

- **DS5: STAKEHOLDERS EVENTS ATTENDED**

Another important mean of promotion of project outcomes is the attendance to relevant events where to disseminate EVERYWH2ERE project and encourage the hosting of project demonstration.

ID	DS 5
Description	Stakeholders events attended
Unit of Measurement	-
Target (if declared)	Min.3
Responsible of the Monitoring	RINA-C, FHA as WP7 Leader
Methods to Monitor	Direct
Monitoring frequency	Each year of the project

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

- **DS6: NUMBER OF SOCIAL MEDIA INTERACTIONS**

Similarly to DS4, it is important to constantly track the interaction that project consortium has with general audience via its social media.

ID	DS 6
Description	Number of Social Media interactions
Unit of Measurement	-
Responsible of the Monitoring	RINA-C, FHA as WP7 Leader
Methods to Monitor	Direct
Monitoring frequency	Each 6 months of the project

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

2.5 Relevance of identified KPIs and project objectives and impact assessment

It is important to identify which project KPIs monitor the achievement of the objectives and impacts listed within the Grant Agreement. Here in Tab.2.2, a summary of the identified KPIs in relation to project objectives and impacts in the GA is presented.

EVERYWH2ERE Objectives to be achieved declared in the DoA	**Project KPIs**
MO1: Capitalize EU expertise in automotive and other industrial sector towards FC genset realization	ECO1, ECO2, ECO4, G1, G2, G3
MO2: Demonstrate FC gensets reliability - Demonstrate adequate CAPEX and OPEX	G1, G2, G3, G4, G5, G6, G9, G10, G11, G12, G13, G14, G15, G16, G17, G18
MO3: Show the logistic and environmental sustainability of the use of FC gensets	G7, G8, ENV1, ENV2, ENV3, ENV4, ENV5, ENV6, ECO7
MO4: Promote innovative Business Models	ECO3, ECO5, ECO6
MO5: Involve cities in the promotion of the use of FC genset - Disseminate the project's results to increase social awareness of H2 potential	DS1, DS2, DS3, DS4, DS5, DS6
EVERYWH2ERE Expected Impact in the DoA	**Project KPIs**
Demonstrate the safe transport and operation of fuel cell systems, portable/transportable fuel storage and refuelling logistics	G1, G3, G4, G7,G8, G16, G17, G18, ECO4, ECO7
Demonstrate the economic viability of each application/ business case selected in the project through real-world TCO analysis	ECO1, ECO2, ECO3, ECO4, ECO5, ECO6
Demonstrate reduced noise and pollutant emissions related to providing temporary power supply in urban applications as well as faster authorisation process for FC gensets (as compared to diesel generators or grid connections) with respect to regulations concerning installations in , specifically noise and pollution, urban areas	ECO7, ENVI1, ENV2, ENV3, ENV4, ENV5, ENV6
KPIs to be demonstrated include system CAPEX of 3,500 -6,500€/ kW, availability over 97% and lifetime over 20,000 hours. Higher visibility of stationary FC and hydrogen technology in the public consciousness through high profile urban demonstrations	G9, DS1, DS2, ECO1,
commercial pathway for replacement of diesel gensets with economically feasible, easy-to-install (truck-in and plug-in) power supply in urban areas. A theoretical analysis on viability of FCs as a disruptive 'diesel genset replacement' technology post 2020 is highly recommended. This should	ECO2, ECO3, ECO4, ECO5, ECO6, ENV3, G2,G3,G4,G5,G6

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

take into account data collected during the project and a credible analysis of the market situation at project end. This should include but not be limited to H2 cost reductions, improvements in FC lifetime, system and stack component cost reductions, development of alternate fuel/ fuel storage technology, economy-of-scale effect on the supply chain through synergies with large scale FC transport deployments.	
Primary energy savings and GHG emission savings triggered by the proposed actions (compared to best available solution existing today:diesel based ICE and connection to the grid)	ENV1, ENV2, ENV3, ENV5, ENV6

Table 2.2- KPIs in relation to project's impacts listed in the DoA

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

3. EVERYWH2ERE Demonstration Tracking Tool

In order to monitor the effectiveness of the EVERYWH2ERE Demonstration campaign and to track gensets' presence and performances all around EU, a Demonstration Tracking Tool (DTT) has been realized (Fig.3.1).

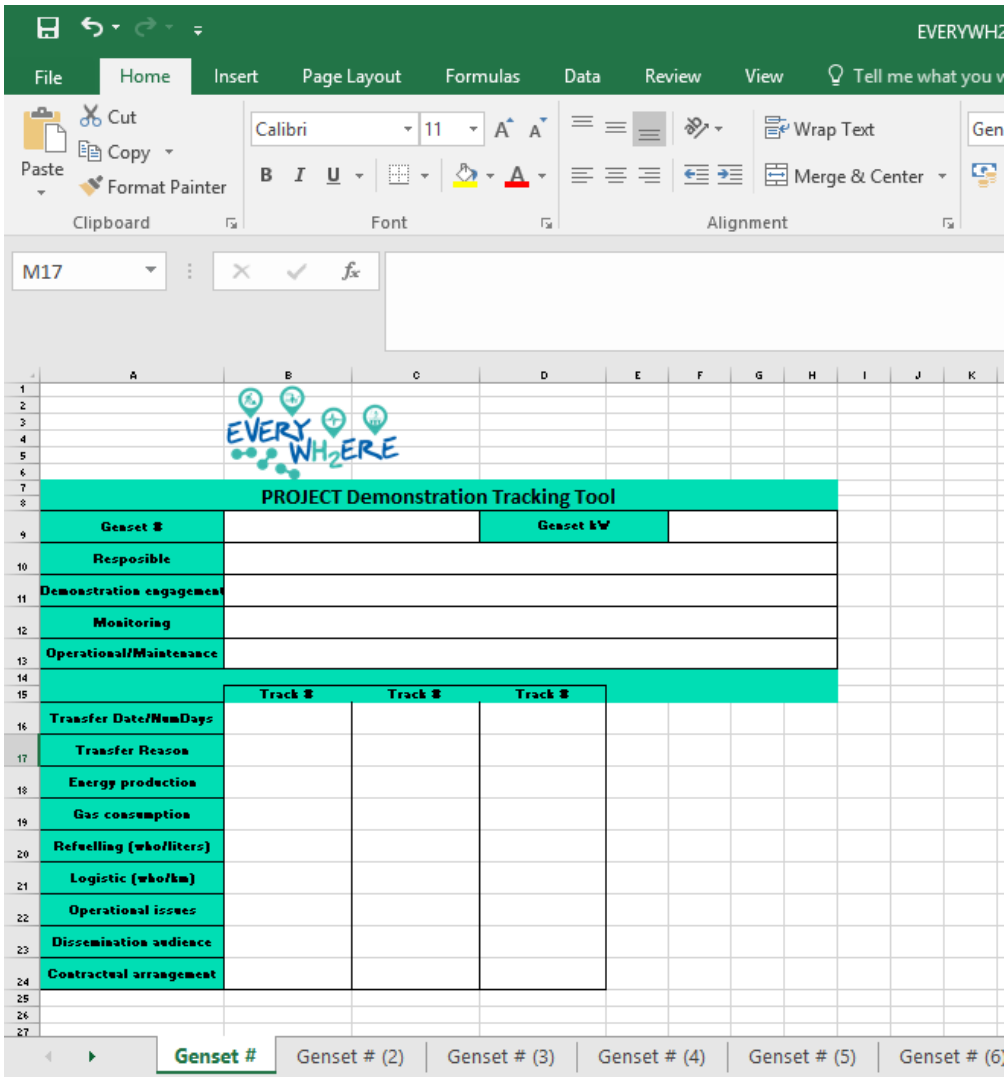

Fig.3-1 – EVERYWH2ERE Demonstration Tracking Tool

EVERYWH2ERE DTT is an Excel file composed by 8 Sheets, one per each EVERYWH2ERE gensets to be realized in the project.

Each Excel Sheet is composed by two parts: the first one where the genset is identified via some specific information (i.e. Size, Partner Responsible, Demonstration purpose (i.e. Construction sites, music festivals etc.), Responsible of O&M and monitoring) and the second part where data related to each demonstration event/campaign is tracked collecting relevant data related to each specific event and local energy production (date, number of days, energy production, gas consumption, operation issues/events/faults potentially occurred etc.). Furthermore logistic data related to hydrogen supply are collected (km of distance from the hydrogen supply point, responsible of the supply) as well as dissemination (type of audience) and contractual arrangement issues.

The EVERYWH2ERE DTT will be constantly updated by the responsible of each genset under the supervision of ENVI (WP4 leader) and of RINA-C as coordinator.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

4. EVERYWH2ERE Monitoring platform

One of the objectives of the project is to monitoring the genset from both the demonstration and functionality aspects. Given the importance of these measured data, a deployment plan will be put in place early so as guarantee that necessary sensors will be installed in an early stage of the project.

The monitoring platform is structure in different layers that can be identified as:

- **Infrastructure layer**, that are represented by the sensor installed on the gensets
- **Access layer**, the part responsible of the communication between the sensors and the platform
- **Data layer**, the one responsible of metrics storage.
- **Application layer**, the layer that allows to analyse the collected data by Graphical User Interfaces (GUIs).

These layers are, therefore, composed by a message broker (Access layer) which aim is to collect the metrics from the genset sensors (Infrastructure layer). The metric collector telegraf can implement several plugins in order to communicate with the most common message services, so it will directly be connected with broker to gather the data and send them to the time series databse, InfluxDB (Data layer). Grafana will be connected to InfluxDB in order to query the database and to visualize and analyse the received data on an user-friendly dashboard (Application layer).

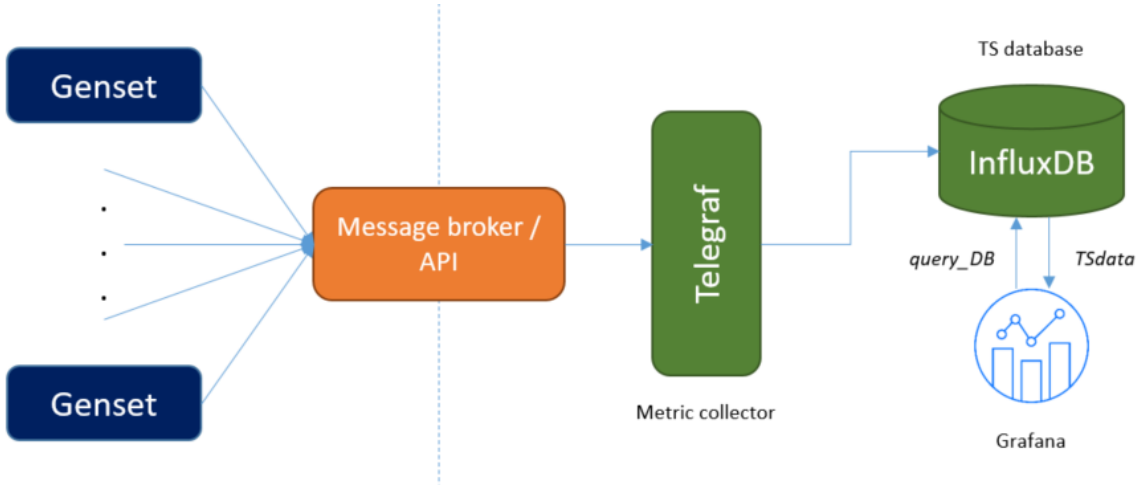

Figure 4-1- Monitoring platform architecture

4.1 The infrastructure layer

The sensors that are going to be installed are necessary to evaluate the FC perfomances in term of power production, hydrogen consumption, local environment condition, stack degradation.

4.2 Access Layer

This layer involves communication protocol between the sensors and the metrics collector. Message brokers are the elements that handle the message service (validation, routing) between senders and receivers. There are many message brokers available and for the EVERYWH2ERE project has been proposed to use RabbitMQ or, as an alternative, RESTful API.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

RabbitMQ[1] is the most widely deployed open source message broker. It's an open-source messaging system based on the Advanced Message Queuing Protocol (AMQP) protocol. Besides, it runs on all major operating systems and supports a large number programming languages and plugins. In RabbitMQ, message are received by brokers via an exchange (which address the messages in queues) and then sent to the registered consumers. In detail, a producer sends a message to a specific exchange (and not a queue), which in turn will decide whether it should redirect, duplicate or discard the message[2]. The queue delivers the message only to the consumer that subscribed to it.

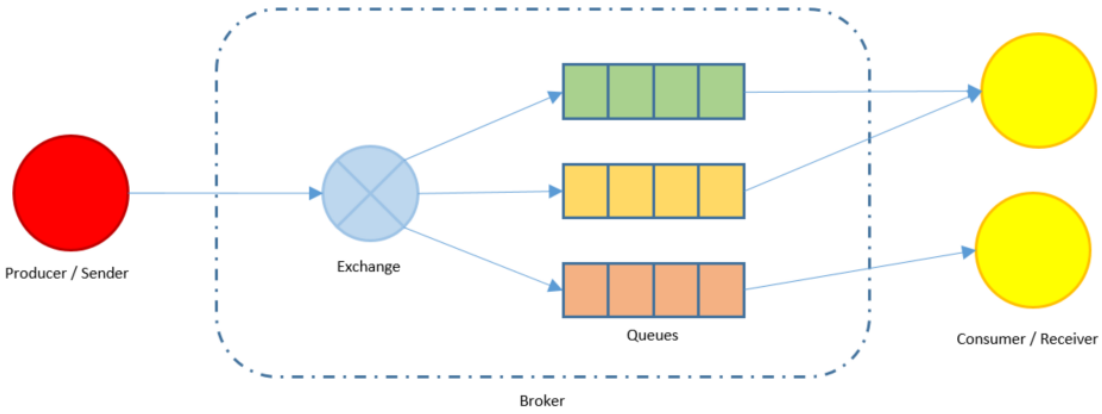

Figure 4-2 - RabbitMQ Architecture example

RESTful API architecture takes advantage of HTTP protocol to send data from a client to a server (when used for Web APIs)s. It can handle multiple types of calls, return different data formats (i.e. SML, JSON etc) and even change structurally with the correct implementation of hypermedia[3].

4.3 Data Layer

Once the data are sent to the message broker, they are collected and stored in a time series database. Time series data are data that are indexed in time order (the time is primary key) and they are used in scenarios in which temporal measurements is required (i.e. operation monitoring, Internet of Things…).

The data layer is partially based on the open source platform called TICK stack[4]. Provided by InfluxData, it's a modern time-series platform designed to handle metrics and events. This stack is composed by four projects: Telegraf, InfluxDB, Chronograf and Kapacitor. Each element has

[1] https://www.rabbitmq.com/

[2] http://kth.diva-portal.org/smash/get/diva2:813137/FULLTEXT01.pdf

[3] https://www.mulesoft.com/resources/api/what-is-rest-api-design

[4] https://www.influxdata.com/time-series-platform/

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

been development to have a particular function in the whole TICK stack architecture, but they are complementary to each other.

For the project purpose, the component that will be implement are the metrics collector Telegraf and the time series database InfluxDB.

InfluxDB is an open-source NoSQL databased that has been optimized for fast and heavy read/write operations. Furthermore, it offers a SQL-like language for interacting with data. InfluxDB can handle millions of data point per second and it permits to to downsample and expiring old data. **Telegraf** is a metric collector that takes in put a wide arrays of data and push them in output. It is plugin-driven so it can support a wide range of end-points.

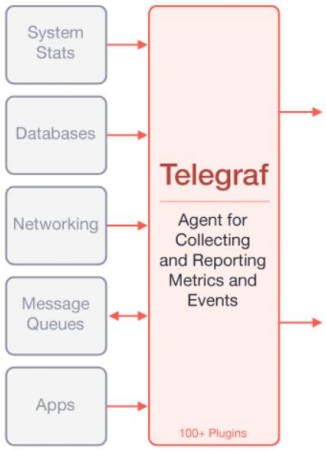

Figure 4-3. Telegraf I/O

4.4 Application Layer

The collected data can be analysed and monitored through GUI interfaces such as panels, graphs, table, dashboard provided by the Grafana platform. In fact, the flexibility of the TICK stack modules, allows to integrate external projects or plugins to the platform as Grafana. It's a web-based open-source application developed for monitoring and time series analysis. It can be integrated with different type of time series database and it permits to create graphs and to set an alert system through the use of several customizable plugins.

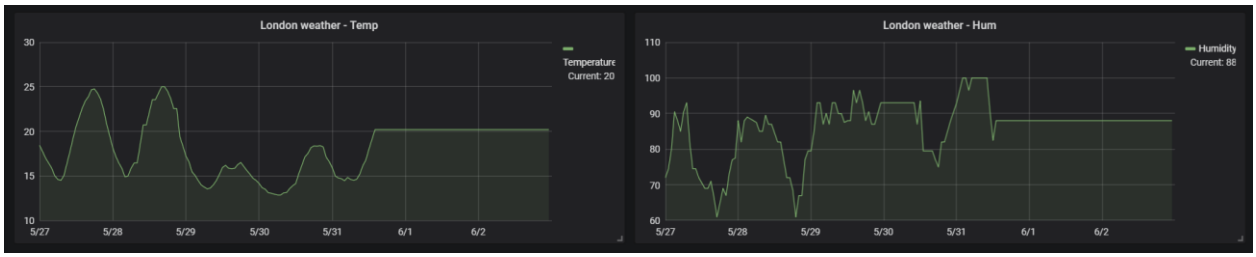

Figure 4-4 - Grafana dashboard example

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research

5. Conclusions and Future Plans

In the present deliverable a panel of KPIs to be used for constant monitoring the progress status and impact of the project is presented. Such a panel has been defined in order to monitor how the project addresses the expected objectives and impacts both during and earlier than project demonstration phase. Looking at numbers and targets declared in the Grant Agreement, KPIs have been defined at different level such as the performances of the gensets, environmental and economic aspects as well as dissemination and stakeholders' engagement.

All these KPIs will be monitored according to the methods, the responsibilities and the scheduling identified by the Consortium for each of them. Furthermore RINA Consulting will finalize a dedicated monitoring platform to easily post-process monitored data and potentially automatically tracking gensets performances.

A dedicated Excel tracking sheet has been set up for KPIs constant monitoring and it will be properly updated to be used during the project also to drive progress reporting in already identified relevant deliverables for progress reporting tracking (WP8).

The results of this monitoring process will be progressively presented and discussed (also potentially foreseeing the introduction of new KPIs) during the Consortium General Assembly meetings along project life.

In parallel a demonstration tracking tool (Excel) has been realized to follow EVERYWH2ERE demonstration campaign also tracking the global number of hours of functioning, location of demonstrations, different type of events/demosites where gensets will be used.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 779606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research