

Fuel cells and Hydrogen Joint Undertaking (FCH JU) - TRUST data collection

Contents

- 1. Introduction 2
- 2. Data collection 2
 - Reference period 2
 - Templates..... 3
 - Data providers..... 4
 - Input method 4
 - Confidentiality..... 4
 - Data aggregation..... 4
- 3. Data utilisation 5
 - Data validation (authorisation)..... 5
 - Data rejection 5
 - Data exploitation..... 5
 - Data disclosure..... 5
- Annex 1: Aggregation level for the items concerned by the various parameter templates..... 6
- Annex 2: Parameter templates 7
 - Electrolyser – research at stack level or lower 7
 - Electrolyser – research at system level..... 8
 - Electrolyser demonstration 10
 - Hydrogen production research..... 11
 - Hydrogen production demonstration..... 12
 - Co-electrolyser – research at stack or lower 13
 - Hydrogen refuelling station research 14
 - Hydrogen refuelling station demonstration 15
 - Fuel cells – research at stack level or lower..... 16
 - Fuel cells – research at system level..... 17
 - Fuel cell car demonstration 18
 - Fuel cell /plug-in car demonstration..... 19
 - Fuel cell bus demonstration..... 20
 - Fuel cell material handling vehicle demonstration..... 21
 - Auxiliary power unit demonstration..... 22
 - Onboard storage for compressed gaseous hydrogen..... 23



Stationary, μ -CHP	24
Stationary, non μ -CHP.....	25
Fuel cell stack manufacturing	26
Diagnostics – electrolysis.....	27
Diagnostics - fuel cells.....	28
Pre-Normative Research.....	29
Education	30

1. Introduction

The FCH JU finances research and innovation projects aiming at ultimately bringing fuel cells and hydrogen technologies to market readiness level. To this end, it publishes calls for proposals, manages proposal evaluations and finally monitors project implementation.

In view of assessing the effectiveness of its research programme and the needs for further technological developments (to be translated into new calls for proposals), the FCH JU has been mandated to collect data on the concerned technologies in a systematic and uniform way.

This need was identified early after the set-up of the FCH JU and follows the explicit request of the FCH JU governing board, reflecting the will of all 3 members of the FCH JU: the European Commission, Hydrogen Europe, representing the industrial stakeholders and N.ERGHY, representing the research community.

The data collection is intended to yield comparable data from various projects by unambiguously setting the relevant

- parameters
- units
- validity date (annual granularity)

Data collection is to be performed, as from 2017, through the TRUST (Technology Reporting Using Structured Templates) collection platform.

Projects have a contractual obligation to comply with the submission of the requested data according to article II.10 of FP7 grant agreements (from calls 2008 to 2013) and to dedicated project deliverables¹ for Horizon 2020 projects (from call 2014 onwards).

The expected outcome is a coherent and comprehensive vision of the fuel cells and hydrogen sector which is critical for its further development and visibility and for fostering political and financial support

2. Data collection

Data collection input period

The data collection system is intended to be open for data input by the projects for at least 1 month each year, typically in the March-June period. For 2017, the foreseen input timeframe should be from mid-April to mid-May.

¹ Typically labelled “Annual data reporting” deliverables

Reference period

Data collection should concern project data referring to the calendar year (reference year) preceding the collection exercise, i.e. for the 2017 data collection exercise, data should be reported concerning the period from 01/01/2016 to 31/12/2016 (the reference year is 2016).

For projects (a) started or (b) ended in the year preceding the data collection exercise, the reference period for which data are expected is:

- a) Project start date to 31/12 of the previous year
- b) 01/01 of the previous year to project end date

Templates

Data are to be collected through template questionnaires tailored to the various technologies and their readiness level, to be answered annually by the funded projects: each project is to be divided into one or more “research object” defining a specific reporting item within the project scope. Each of these research objects will be associated to a specific template questionnaire.

The existing template questionnaires are listed below:

- Electrolyser – research at stack level or lower
- Electrolyser – research at system level
- Electrolyser demonstration
- Hydrogen production research
- Hydrogen production demonstration
- Co-electrolyser – research at stack or lower
- Hydrogen refuelling station research
- Hydrogen refuelling station demonstration
- Fuel cells – research at stack level or lower
- Fuel cells – research at system level
- Fuel cell car demonstration
- Fuel cell /plug-in car demonstration
- Fuel cell bus demonstration
- Fuel cell material handling vehicle demonstration
- Auxiliary power unit demonstration
- Onboard storage for compressed gaseous hydrogen
- Stationary, μ -CHP
- Stationary, non μ -CHP
- Fuel cell stack manufacturing
- Diagnostics – electrolysis
- Diagnostics - fuel cells
- Pre-Normative Research
- Education

The template questionnaire within the research object is divided into descriptive and operational parameters.

Descriptive parameters define the item addressed in the questionnaire and allow to set the scene for which actual results are reported as **operational** parameters. In principle, descriptive parameters do not change during the project lifetime, while operational parameters evolve and will be different from one annual data collection exercise to the next according to progress in the reference period.

The parameters have been defined in view of allowing a comprehensive overview of the technology status and include the Key Performance Indicators (KPIs) defined in the FCH JU Multi-Annual Work Plan (MAWP).

The parameters requested in each template are listed in Annex 2.

Each project is expected to provide, to the best of its capabilities, a value for every parameter requested. For each parameter, there is also the possibility (optional) to add a comment if it is relevant to give additional information.

The filled questionnaire can only be submitted if, for every single parameter, a value or a comment is provided. This offers the possibility of leaving a parameter unanswered in the case that there is an impossibility to provide a value, for instance because the parameter is not relevant to the project or has not yet been obtained. In such cases, the reason should be given in the comment field.

In general, it will not be acceptable that parameters that are either MAWP KPIs or specified in the “expected impact” section of the call for proposals to which the project has successfully applied are marked as irrelevant to the project itself.

Data providers

The person with access to the online system is hereby referred to as “data provider”.

If needed, several data providers can be assigned to a same research object .

Please note that the data providers are assigned specifically for each research object, so different research objects from the same project may have different data providers.

As default, the project coordinator will be assigned as data provider. Changes or additions in data provider can be requested to fchju_trust@fch.europa.eu

Input method

The data will be collected online, through a secured connection, in a programme called TRUST.

For each research object, the data provider has the possibility (optional) to enter a generic comment, e.g. specifying information relevant to the whole set of data concerned, in addition to the values and comments for the individual parameter.

Confidentiality

Each individual parameter in the template questionnaires can be defined by the data provider as either public or confidential.

Public data will be treated as such and the FCH JU will consider that it can disclose them accordingly.

Confidential data will be treated with extreme care, avoiding that any related information is made public in any form that could lead to the identification of its origin. Confidential data will be visible exclusively by the FCH JU Programme Office.

More information on data treatment is provided in the section 3.

Data aggregation

Research objects in TRUST refer either to single items or a group of equivalent items. This is defined individually for each project according to its nature, its description of work and the type of questionnaire concerned. For instance, reporting is expected individually for single hydrogen refuelling stations, electrolysers or large-scale CHP units, while aggregated data would be

sufficient for a fleet of same vehicles or small CHP units deployed in a given region. An intended “rule of thumb” on aggregation levels expected according to the template questionnaires is provided in Annex 1.

3. Data utilisation

As already mentioned above, data provided in TRUST will be collected and treated by the FCH JU Programme Office only.

No raw data will be disclosed publicly unless they are provided as “public”.

Data validation (authorisation)

In a first phase after data submission, the data will be validated by the relevant Project Officers which will authorise or reject the entire form. In this step, the values will be verified in terms of whether they are realistic, whether there is no clerical mistake (order of magnitude, units,...) and whether the “confidential” label (if applicable) is justified. The Project Officer will also verify (and accept/reject) the justifications given for not providing certain parameters.

Data rejection

In the case that a research object form is rejected, the data provider will be informed (through an email notification) with an explanation of the reasons for rejection. The data provider will be thus asked to revise the value / comment and resubmit the form.

Cost claims related to tasks that would lead to forms that have been rejected may be suspended until an agreement is found between the FCH JU and the project consortium.

Data exploitation

The FCH JU Programme Office will analyse the data obtained to form a view on technology status.

In comparison with public values obtained through continued technology watch and international state of the art values, it also aims at assessing the positioning of FCH JU projects in the global picture.

In time, through comparison of data obtained for different periods, the achievements of the FCH JU will also be traced in terms of technology progress yielded through the projects financed.

Data disclosure

The FCH JU Programme Office is often assisting its members in defining the state of the art or providing information on project progress.

As is custom already with deliverables and reports, only public data will be disclosed in this context, unless aggregation of several comparable data is possible to provide anonymised and unrecognisable output.

Annex 1: Aggregation level for the items concerned by the various parameter templates

The information given below is indicative. The aggregation is always done individually according to the exact nature of the project and its description of work

- **Electrolyser – research at stack level or lower:** one research object per project
- **Electrolyser – research at system level:** one research object per system
- **Electrolyser demonstration:** one research object per unit
- **Hydrogen production research:** one research object per project
- **Hydrogen production demonstration:** one research object per unit
- **Co-electrolyser stack or lower:** one research object per project
- **Hydrogen refuelling station research:** one research object per project
- **Hydrogen refuelling station demonstration:** one research object per station
- **Fuel cells – research at stack level or lower:** one research object per project or per stack technology
- **Fuel cells – research at system level:** one research object per system or per system technology
- **Fuel cell car demonstration:** one research objects for aggregated data per vehicle model/location (typically this involves several vehicles within a single research object)
- **Fuel cell /plug-in car demonstration:** one research objects for aggregated data per vehicle model/location (typically this involves several vehicles within a single research object)
- **Fuel cell bus demonstration:** one research objects for aggregated data per vehicle model/location (typically this involves several vehicles within a single research object)
- **Fuel cell material handling vehicle demonstration:** one research objects for aggregated data per vehicle model/location (typically this involves several vehicles within a single research object)
- **Auxiliary power unit demonstration:** one research object per unit
- **Onboard storage for compressed gaseous hydrogen:** one research object per unit
- **Stationary, μ -CHP:** one research objects for aggregated data per CHP unit model/location
- **Stationary, non μ -CHP:** one research object per unit
- **Fuel cell stack manufacturing:** one research object per project
- **Diagnostics – electrolysis:** one research object per project
- **Diagnostics - fuel cells:** one research object per project
- **Pre-Normative Research:** one research object per project
- **Education:** one research object per training course

Annex 2: Parameter templates

The exact parameters, as well as to their exact name and order may vary.

Electrolyser – research at stack level or lower

Descriptive

- Technology
- Number of cells in each stack
- Stack nominal capacity
- Nominal hydrogen weight capacity
- Rated stack lifetime
- Hydrogen purity
- Operating pressure
- Operating temperature
- Input voltage
- Rated stack electrical efficiency (HHV, DC current)
- Active cell area
- Catalyst at the cathode
- Catalyst at the anode
- Stack CAPEX (per kW)
- Est. stack CAPEX (per kW) @ mass production

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Hours of operation - cumulative
- Operating time per day
- Transient response time
- Quantity of hydrogen produced
- Electricity consumed
- Stack availability
- Stack electrical efficiency (HHV, DC current)
- Stack energy consumption for H2 production
- Current density
- Power density
- Cell voltage
- Voltage degradation rate in $\mu\text{V}/\text{h}/\text{cell}$
- Efficiency degradation per 1000 h
- Anode catalyst loading per cell area
- Cathode catalyst loading per cell area
- Anode catalyst loading per H2 capacity
- Cathode catalyst loading per H2 capacity

Electrolyser – research at system level

Descriptive

- System manufacturer
- Stack manufacturer
- Technology
- Number of stack arrays
- Number of stacks in each stack array
- Number of cells in each stack
- Nominal hydrogen weight capacity
- Nominal hydrogen volume capacity
- System nominal capacity
- System minimum power
- Maximum overload capacity
- Stack nominal capacity
- Rated system lifetime
- Rated stack lifetime
- Operating pressure
- Operating temperature
- Power converter
- Input voltage
- Power usage of auxiliary equipment - in standby
- Power usage of auxiliary equipment at nominal capacity
- Catalyst at the anode
- Catalyst at the cathode
- Active cell area
- Hydrogen purity
- Rated system electrical efficiency (HHV, AC current)
- Rated stack electrical efficiency (HHV, DC current)
- System CAPEX per kW
- System CAPEX per ton/day
- Est. System CAPEX per ton/day @ mass production
- BoP CAPEX

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Hours of operation - cumulative
- Days of operation
- Transient response time
- Time from standby to nominal capacity
- Time from standby to nominal power
- Time for cold start to nominal capacity
- Time for cold start to nominal power
- Minimum part-load operation observed
- Maximum overload operation
- Quantity of hydrogen produced
- Electricity consumed
- System availability
- Stack availability
- System electrical efficiency (HHV, AC current)
- Stack electrical efficiency (HHV, DC current)
- System energy consumption for H2 compression
- System energy consumption for H2 production
- Stack energy consumption for H2 production
- Operating profile
- Current density
- Power density
- Cell voltage
- Voltage degradation rate in $\mu\text{V}/\text{h}/\text{cell}$
- Efficiency degradation per 1000 h
- Anode catalyst loading per cell area
- Cathode catalyst loading per cell area
- Anode catalyst loading per H2 capacity
- Cathode catalyst loading per H2 capacity

Electrolyser demonstration

Descriptive

- Country
- Town
- Postcode
- Deployment date
- Electrolyser manufacturer
- Stack manufacturer
- Technology
- Nominal hydrogen weight capacity
- Nominal hydrogen volume capacity
- Nominal power
- Maximum overload capacity
- System minimum power
- Stack nominal capacity
- Electrolyser Footprint
- Electrolyser Volume
- Electricity origin
- Rated system lifetime
- Rated stack lifetime
- Hydrogen purity
- Power converter
- Operating pressure
- Operating temperature
- Input voltage
- Power usage of auxiliary equipment - in standby
- Power usage of auxiliary equipment at nominal capacity
- Rated stack electrical efficiency (HHV, DC current)
- Rated system electrical efficiency (HHV, AC current)
- CAPEX - electrolyser

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Hours of operation - cumulative
- Days of operation
- Days of operation - cumulative
- Transient response time
- Time from standby to nominal capacity
- Time from standby to nominal power
- Time for cold start to nominal capacity
- Time for cold start to nominal power
- Minimum part-load operation
- Maximum overload operation
- Fraction of renewable energy input
- Maximum % power for 98% efficiency
- Quantity of hydrogen produced
- Electricity consumed
- Duration of planned maintenance
- Availability
- Efficiency degradation per 1000 h
- Voltage degradation rate in $\mu\text{V/h}$
- Voltage degradation rate in $\%/kh$
- Stack electrical efficiency (HHV, DC current)
- System electrical efficiency (HHV, AC current)
- Energy consumption for H₂ production
- Energy consumption for H₂ compression
- Number of safety incidents
- Price/cost of electricity
- OPEX - Operational and maintenance costs
- Cost of the hydrogen produced

Hydrogen production research

Descriptive

- Hydrogen production method
- Process description
- Hydrogen feedstock
- Main energy source
- Secondary energy input/parasitic losses
- Catalyst(s)
- Hydrogen purification method
- Nominal hydrogen weight capacity

Operational

- Start date for reporting
- End date for reporting
- TRL @ start of timeframe
- TRL @ end of timeframe
- Hours of operation
- Hours of operation - cumulative
- Catalyst durability, observed
- Time from standby to nominal capacity
- Time for cold start to nominal capacity
- Operating pressure
- Operating temperature
- Min. part-load operation, observed
- Quantity of hydrogen produced
- Conversion efficiency @ start of timeframe
- Efficiency degradation rate
- Number of catalyst replacements
- H2 purity before purification
- Purity of the produced hydrogen after purification
- Number of safety incidents
- Est. cost of the hydrogen produced

Hydrogen production demonstration

Descriptive

- Country
- Town
- Postcode
- Hydrogen production method
- Description of the production unit
- Manufacturer
- Target application
- Hydrogen feedstock
- Main energy source
- Secondary energy input/parasitic losses
- Operating pressure
- Operating temperature
- Deployment date
- Catalyst(s)
- Hydrogen purification method
- Footprint
- Volume
- Nominal hydrogen weight capacity
- Nominal hydrogen volume capacity
- Rated system lifetime
- Hydrogen purity
- Conversion efficiency @ start of operations
- TRL @start of operations
- System CAPEX per ton/day
- Est. System CAPEX per ton/day @ mass production

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Hours of operation - cumulative
- Days of operation
- Days of operation - cumulative
- Operating time per day
- Time from standby to nominal capacity
- Time for cold start to nominal capacity
- Min. part-load operation, observed
- Quantity of hydrogen produced
- Availability
- Conversion efficiency @ start of timeframe
- Conversion efficiency @ end of timeframe
- Efficiency degradation rate
- H2 purity before purification
- H2 purity after purification
- Energy consumption for H2 production
- Energy consumption for H2 compression
- Number of safety incidents
- TRL @ end of timeframe
- Cost of the hydrogen produced
- OPEX - Operational and maintenance costs

Co-electrolyser – research at stack or lower

Under finalisation

Hydrogen refuelling station research

Descriptive

- Hourly capacity
- Daily capacity
- Number of cars per hour
- Number of cars per day
- Number of buses per hour
- Number of buses per day
- Component(s) addressed
- Refuelling protocol
- Hydrogen supply logistics
- On-site H2 production method
- Onsite H2 production rate
- Renewable feed
- Fraction of renewable feed
- Storage capacity
- State of H2 in storage tank
- Nominal pressure of the on-site storage tank
- Noise - compressor
- State of the hydrogen at dispensing
- Dispensing pressure
- CAPEX for the component(s)
- CAPEX for the component(s), est. @ mass prod.
- CAPEX for the HRS
- Est. HRS CAPEX @ mass production

Operational

- Start date for reporting
- End date for reporting
- Station TRL
- Vehicles refuelled
- Days of operation
- Hours of operation
- Hours of operation - cumulative
- Amount of hydrogen dispensed
- Number of H2 refuellings
- Availability - in period
- Mean time between failures (MTBF)
- Metering accuracy
- System energy consumption for H2 compression
- TRL - components
- Cost of hydrogen
- Number of safety incidents

Hydrogen refuelling station demonstration

Descriptive

- Country
- Town
- Postcode
- Location type
- Station setting
- Type of access
- HRS manufacturer
- Operator
- Deployment date
- Number of dispensers
- Number of nozzles
- Storage capacity
- Dispensing pressure
- Hourly capacity
- Daily capacity
- Refuelling protocol
- Number of cars per hour
- Number of cars per day
- Number of buses per hour
- Number of buses per day
- Hydrogen supply logistics
- On-site H2 production method
- Onsite H2 production rate
- Renewable feed
- Fraction of renewable feed
- CAPEX for the HRS

Operational

- Start date for reporting
- End date for reporting
- Vehicles refuelled
- Days of operation
- Hours of operation
- Distance from the H2 production
- Amount of H2 dispensed
- Number of H2 refuellings
- Metering accuracy
- Availability - in period
- Availability - since start
- Mean time between failures (MTBF)
- Downtime, overall
- Downtime for scheduled maintenance/upgrades
- Downtime due to the compressor/pump
- Downtime due to the hydrogen storage facility
- Downtime due to the refuelling dispensers
- Downtime due to electrical components
- Downtime due to software issues
- Downtime due to the hydrogen supply
- Downtime due to other reasons
- Number of safety incidents
- OPEX
- Cost of hydrogen
- Price of hydrogen

Fuel cells – research at stack level or lower

Descriptive

- Stack manufacturer
- Fuel cell technology
- Fuel
- Number of cells per stack
- Capacity of the stack - rated
- Stack durability - rated
- Purity required for the fuel
- Catalyst at the cathode
- Catalyst at the anode
- Active cell area
- Rated stack electrical efficiency (LHV)
- Rated stack total efficiency (LHV)
- Stack CAPEX (per kW)
- Est. stack CAPEX (per kW) @ mass production

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Hours of operation - cumulative
- Operating time per day
- Transient response time
- Time for cold start to rated power (from +20°C)
- Time for cold start to rated power (from -20°C)
- Operating pressure
- Operating temperature
- Minimum ambient temperature
- Maximum ambient temperature
- Stack availability
- Fuel utilisation rate
- Electricity produced - Total
- Stack electrical efficiency (LHV) - observed
- Stack total efficiency (LHV) - observed
- Current density
- Power density
- Cell voltage
- Degradation rate in $\mu\text{V}/\text{h}$
- Degradation rate in $\%/ \text{kh}$
- PGM catalyst loading - Anode (in mg/cm^2)
- PGM catalyst loading - Anode (in g/kW)
- PGM catalyst loading - Cathode (in mg/cm^2)
- PGM catalyst loading - Cathode (in g/kW)

Fuel cells – research at system level

Descriptive

- System manufacturer
- Stack manufacturer
- Fuel cell technology
- BoP component of interest
- Fuel
- Does the FC system include a reformer?
- Number of stacks per system
- Number of cells per stack
- Rated capacity of the FC system
- Rated FC system durability
- Rated stack durability
- Purity required for the fuel
- Catalyst at the cathode
- Catalyst at the anode
- Active cell area
- Rated system electrical efficiency (LHV)
- Rated system total efficiency (LHV)
- Rated stack electrical efficiency (LHV)
- Rated stack total efficiency (LHV)
- FC system CAPEX
- Est FC system CAPEX @ mass production
- Stack CAPEX (per kW)
- BoP CAPEX

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Hours of operation - cumulative
- Operating time per day
- Transient response time
- Time for cold start to rated power (from -20°C)
- Time for cold start to rated power (from +20°C)
- Operating pressure
- Operating temperature
- Minimum ambient temperature
- Maximum ambient temperature
- System availability
- Stack availability
- Fuel utilisation rate
- Electricity produced - Total
- Useful heat output
- System electrical efficiency (LHV) - observed
- System total efficiency (LHV) - observed
- Stack electrical efficiency (LHV) - observed
- Stack total efficiency (LHV) - observed
- Current density
- Power density
- Cell voltage
- Degradation rate in %/kh
- Degradation rate in $\mu\text{V}/\text{h}$
- PGM catalyst loading - Anode (in mg/cm^2)
- PGM catalyst loading - Anode (in g/kW)
- PGM catalyst loading - Cathode (in mg/cm^2)
- PGM catalyst loading - Cathode (in g/kW)
- LCOE

Fuel cell car demonstration

Descriptive

- Country
- Town or region
- Deployment date
- Vehicle manufacturer
- Vehicle model
- Vehicle segment
- Production year
- Drivetrain power
- Drivetrain weight
- Range (NEDC)
- Maximum speed
- Acceleration time 0-50 km/h
- Acceleration time 0-100 km/h
- Weight
- Height
- Length
- Width
- Number of seats
- Hydrogen storage capacity
- Hydrogen tank pressure rating
- Tank to wheel consumption
- Durability
- Minimum ambient temperature
- Maximum ambient temperature
- Fuel cell system cost
- Est. FC system cost @ mass prod.
- Vehicle cost
- Est. vehicle cost @ mass prod.
- Vehicle price

Operational

- Start date for reporting
- End date for reporting
- Number of vehicles
- Number of vehicles taken out of service
- Hours of operation
- Hours of operation - cumulative
- Distance driven
- Distance driven, cumulative (project)
- Distance driven, cumulative (overall)
- Number of H2 refuellings
- Amount of hydrogen fed
- Availability
- MDBF
- Downtime, overall
- Downtime for scheduled maintenance/upgrades
- Downtime due to stack issues
- Downtime due to peripheral mechanical components
- Downtime due to electrical components
- Downtime due to the on-board hydrogen storage tank
- Downtime due to the high voltage battery
- Number of safety incidents
- OPEX

Fuel cell /plug-in car demonstration

Descriptive

- Country
- Town or region
- Deployment date
- Manufacturer
- Model
- Vehicle segment
- Production year
- Drivetrain power
- Drivetrain weight
- Range
- Hydrogen range
- Maximum speed
- Acceleration time 0-50 km/h
- Acceleration time 0-100 km/h
- Weight
- Height
- Length
- Width
- Number of seats
- Hydrogen storage capacity
- Hydrogen tank pressure rating
- Battery capacity
- Durability
- Minimum ambient temperature
- Maximum ambient temperature
- Fuel cell system cost
- Est. FC system cost @ mass prod.
- Vehicle cost
- Est. vehicle cost @ mass prod.
- Vehicle price

Operational

- Start date for reporting
- End date for reporting
- Number of vehicles
- Number of vehicles taken out of service
- Hours of operation
- Hours of operation - cumulative
- Distance driven
- Distance driven, cumulative (project)
- Distance driven, cumulative (overall)
- Number of H2 refuellings
- Amount of hydrogen fed
- Number of electric recharges
- Amount of electricity fed
- Availability
- MDBF
- Downtime, overall
- Downtime for scheduled maintenance/upgrades
- Downtime due to stack issues
- Downtime due to peripheral mechanical components
- Downtime due to electrical components
- Downtime due to the on-board hydrogen storage tank
- Downtime due to the high voltage battery
- Number of safety incidents
- OPEX

Fuel cell bus demonstration

Descriptive

- Country
- Town or region
- Deployment date
- Bus manufacturer
- Bus model
- Production year
- Bus operator
- Drivetrain power
- Number of stacks
- Drivetrain weight
- Maximum speed
- Acceleration time 0-50 km/h
- Range (SORT 1)
- Range (SORT 2)
- Weight
- Height
- Length
- Width
- Number of seated passengers
- Number of standing passengers
- Hydrogen storage capacity
- Hydrogen tank pressure rating
- TTW consumption SORT 1
- TTW consumption SORT 2
- Bus durability
- Fuel cell system durability
- Minimum ambient temperature
- Maximum ambient temperature
- Vehicle price
- Bus cost
- Est. bus cost @ mass prod.
- Fuel cell system cost
- Est. FC system cost @ mass prod.

Operational

- Start date for reporting
- End date for reporting
- Number of buses
- Number of buses taken out of service
- Hours of operation
- Hours of operation - cumulative
- Distance driven
- Distance driven, cumulative (project)
- Distance driven, cumulative (overall)
- MDBF
- Stack lifetime (at end of life)
- Number of stacks reaching EoL
- Distance driven with same stack until EoL
- Amount of hydrogen fed
- Number of H2 refuellings
- Availability
- Downtime, overall
- Downtime for scheduled maintenance/upgrades
- Downtime due to stack issues
- Downtime due to peripheric mechanical components
- Downtime due to electrical components
- Downtime due to the on-board hydrogen storage tank
- Downtime due to the high voltage battery
- Number of safety incidents
- OPEX

Fuel cell material handling vehicle demonstration

<u>Descriptive</u>	<u>Operational</u>
– Country	– Start date for reporting
– Town	– End date for reporting
– Deployment date	– Number of vehicles
– Manufacturer	– Number of vehicles taken out of service
– Production year	– Hours of operation
– Model	– Hours of operation - cumulative
– MHV Type	– Amount of H2 fed
– Forklift Class	– Number of H2 refuellings
– Load capacity	– Availability
– Vehicle Power	– MTBF
– FC system weight	– Downtime, overall
– Vehicle Weight	– Downtime for scheduled maintenance/upgrades
– Vehicle height	– Downtime due to electrical components
– Vehicle length	– Downtime due to the high voltage battery
– Vehicle width	– Downtime due to the on-board hydrogen storage tank
– H2 storage capacity	– Downtime due to peripheric mechanical components
– H2 tank pressure rating	– Downtime due to stack issues
– State of the H2 in tank	– Number of safety incidents
– Electrical efficiency, rated	– Incidents with both INJURY and H2 RELEASE
– Vehicle durability, rated	– Incidents with INJURY but no H2 release
– System durability, rated	– Incidents with H2 RELEASE but no injury
– Minimum ambient temperature	– Incidents with neither injury or H2 release
– Maximum ambient temperature	– OPEX
– Vehicle cost	
– Est. vehicle cost @ mass prod.	
– Vehicle price	
– Fuel cell system cost	
– Est. FC system cost @ mass prod.	
– Fuel cell system price	
– CAPEX - storage tank	

Auxiliary power unit demonstration

Descriptive

- Country
- APU Vehicle
- APU deployment date
- APU unit manufacturer
- APU stack manufacturer
- Fuel cell technology
- APU fuel
- APU system power
- Stack power
- APU Weight
- APU Volume
- APU Noise
- APU operating pressure
- APU operating temperature
- Minimum ambient temperature
- Maximum ambient temperature
- APU system durability
- Stack durability
- Rated system electrical efficiency (LHV)
- Rated system total efficiency (LHV)
- Rated stack electrical efficiency (LHV)
- Rated stack total efficiency (LHV)
- APU CAPEX
- Est. APU CAPEX @ mass production
- Time for break-even, current CAPEX
- Time for break-even, projected CAPEX

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Hours of operation - cumulative
- Average duration of each operation
- Time for cold start (-20°C)
- Time for cold start (+20°C)
- Amount of fuel fed to the APU
- System electrical efficiency (LHV), observed
- System total efficiency (LHV), observed
- Stack electrical efficiency (LHV), observed
- Stack total efficiency (LHV), observed
- Total electricity produced
- Useful heat output
- APU availability
- Mean time between failures (MTBF)
- CO₂ emissions
- SO_x emissions
- NO_x emissions
- Number of safety incidents
- OPEX

Onboard storage tank for compressed gaseous hydrogen

Descriptive

- State of H₂ in storage tank
- Tank type
- Storage tank material
- Internal lining material
- Internal tank volume
- Hydrogen storage capacity
- External tank volume
- Tank weight
- Deployment date
- Minimum working pressure
- Nominal working pressure
- Minimum temperature - rated
- Maximum temperature - rated
- CAPEX - Storage tank
- Est. storage tank CAPEX @ mass production

Operational

- Start date for reporting
- End date for reporting
- Proven durability of the storage tank
- Est. lifetime of storage tank
- Number of cycles
- Type of cycle applied
- Peak hydrogen charging rate

Stationary, μ -CHP

Under finalisation

Stationary, non μ -CHP

Descriptive

- Country
- Town or region
- Postcode
- Deployment date
- Manufacturer
- Model
- Stack manufacturer
- Technology
- Stationary application
- Fuel
- Does the fuel cell system include a fuel reformer?
- Rated system electrical capacity
- Description
- Rated system durability
- Rated stack durability
- Rated system electrical efficiency (LHV)
- Rated system electrical efficiency (LHV)
- Rated CO₂ emissions per electricity output
- Rated SO_x emissions per electricity output
- Rated NO_x emissions per electricity output
- Noise - rated
- System CAPEX
- Est. system CAPEX (per kW) @ mass production

Operational

- Start date for reporting
- End date for reporting
- Hours of operation
- Days of operation
- Hours of operation - cumulative
- System ramp-up time
- Energy input from fuel
- Electricity produced
- Useful heat output
- Availability
- Number of safety incidents
- OPEX - Operational and maintenance costs
- LCOE

Fuel cell stack manufacturing

Descriptive

- Reference process: description
- Fuel cell technology
- Target application
- Reference process: Stack weight
- Reference process: Stack volume
- Reference process: Stack nominal capacity
- Reference process: Active cell area
- Reference process: Electrical efficiency
- Reference process: Durability
- Reference process: degradation rate
- Reference process: Prod. rate (stacks/h)
- Reference process: prod. rate (stacks/yr)
- Reference process: specifications criteria
- Reference process: Percent in-specification
- Reference process: quality testing duration
- Reference process: production scrap rate
- Reference process: Nr staff per stack
- Reference process: Nr staff per MW
- Reference process: footprint
- Reference process: energy per stack
- Reference process: energy per MW
- Reference process: OPEX per stack
- Reference process: CAPEX

Operational

- Start date for reporting
- End date for reporting
- Project process: description
- Project process: Stack weight
- Project process: Stack volume
- Project process: Stack nominal capacity
- Project process: Active cell area
- Project process: Electrical efficiency
- Project process: Durability
- Project process: degradation rate
- Project process: Prod. Rate (stacks/h)
- Project process: Prod. Rate (stacks/yr)
- Project process: specifications criteria
- Project process: Percent in-specification
- Project process: Quality testing duration
- Project process: production scrap rate
- Project process: nr staff per stack
- Project process: nr staff per MW
- Project process: footprint
- Project process: Energy per stack
- Project process: Energy per MW
- Project process: OPEX per stack
- Project process: CAPEX

Diagnosics – electrolysis

Descriptive

- Diagnostic/control tool description
- Property measured by the tool
- Information derived
- Does the tool measure the degradation?
- Power usage of the tool
- Association to prognostics for residual lifetime?
- Tool CAPEX
- Electrolyser (system) manufacturer
- Electrolyser system technology
- H2 production rate, nominal - daily weight
- Electrolyser nominal power
- System durability - rated
- Stack manufacturer
- Stack capacity - rated
- Stack durability - rated
- Capital cost of the electrolyser system

Operational

- Start date for reporting
- End date for reporting
- Stack hours of operation
- System hours of operation
- Tool hours of operation
- System electrical efficiency at start
- System electrical efficiency at end
- Est. improvement of degradation rate
- Improvement of mean time between failures (MTBF)
- Availability improvement
- Predicted system durability
- Predicted stack durability
- Est. improvement of system lifetime
- Est. improvement of stack lifetime
- Number of faults detected
- Number of failures detected
- Detection rate - total
- Detection rate - H2 in O2 stream or viceversa
- Detection rate - breaks/leakages
- Detection rate - delamination
- Detection rate - other issues
- Diagnosis/monitoring tool availability
- Tool operational costs per kg H2
- Est. electrolyser system OPEX reduction per kWh

Diagnostics - fuel cells

Descriptive

- Diagnostic/control tool description
- Property measured by the tool
- Information derived
- Does the tool measure the degradation?
- Power usage of the tool
- Association to prognostics for residual lifetime?
- Tool CAPEX
- Fuel cell system manufacturer
- Fuel cell system technology
- Fuel cell application
- Fuel
- Fuel cell system capacity
- Fuel cell system durability - rated
- Stack manufacturer
- Stack capacity - rated
- Stack durability - rated
- Capital cost of the fuel cell system

Operational

- Start date for reporting
- End date for reporting
- Stack hours of operation
- System hours of operation
- Tool hours of operation
- System electrical efficiency at start
- System electrical efficiency at end
- Est. improvement of degradation rate
- MTBF improvement
- Availability improvement
- Predicted System durability
- Predicted Stack durability
- Est. improvement of system lifetime
- Est. improvement of stack lifetime
- Number of faults detected
- Number of failures detected
- Detection rate - total
- Detection rate - fuel starvation
- Detection rate - air starvation
- Detection rate - flooding and dehydration
- Detection rate - changes in fuel composition
- Detection rate - sulphur poisoning
- Detection rate - breaks and/or leakages
- Detection rate - to delamination
- Detection rate - other issues
- Diagnosis/monitoring tool availability
- Tool operational costs per kWh
- Est. FC system operational costs reduction per kWh

Pre-Normative Research

Descriptive

- Gap in knowledge addressed
- Project objective
- FCH JU pillar
- Approach
- Target RCS
- Target organisation
- Target tech/working group
- Other RCS addressing the issue tackled by the project
- Foreseen means
- Collaborations outside EU28

Operational

- Start date for reporting
- End date for reporting
- Newly detected relevant RCS activities
- Progress vs knowledge gap
- Is consortium involved first-hand in standardisation bodies?
- Standard developing organisation(s) contacted
- Number of meetings with standard developing organisations
- Number of workshops with standard developing organisations
- Number of reports sent to standard developing organisations
- Regulatory bodies contacted to date
- Number of meetings with regulatory organisations
- Number of workshops with regulatory organisations
- Number of reports sent to regulatory organisations
- Number of peer reviewed publications
- Number of patents
- Number of oral presentations @ scientific seminars/conferences
- Nr of posters at scientific seminars/conferences
- Have the project results been integrated in any RCSs?
- When (year) do you expect project results to be integrated in any RCS?

Education

Descriptive

- Training course: name & brief description
- Training topic(s)
- Training target group(s)
- Training type
- Training material
- Training language(s)
- Training attendance method
- Training duration
- Is there a passing test/exam?
- Awarding of a diploma/certification
- Training website

Operational

- Start date for reporting
- End date for reporting
- Number of people trained in reference period
- Total number of people trained in project
- Training location(s) in reference period
- Training location(s) in the project
- Trainees per country in the reference period
- Trainees per country in the project
- Nr of diplomas/certificates issued in reference period
- Nr of diplomas/certificates issued in the project