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

Contents

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 deliverables in Horizon 2020 projects (from call 2014 onwards).

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

2. Data collection

Reference period

Data collection is to be performed on an annual basis, and 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 refueling station research
- Hydrogen refueling 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 refueling stations, electrolysers or industrial-scale CHP's, 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 refueling station research**: one research object per project
- **Hydrogen refueling station demonstration**: one research object per station
- **Fuel cells – research at stack level or lower**: one research object per project
- **Fuel cells – research at system level**: one research object per system
- **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
- **Fule 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

Electrolyser – research at stack level or lower

Descriptive

- Technology
- Number of cells in each stack
- Stack nominal capacity
- Nominal hydrogen weight capacity
- Stack lifetime, rated
- Hydrogen purity
- Operating pressure
- Operating temperature
- Input voltage
- Stack electrical efficiency (rated - HHV - DC current) - average for all stacks
- Active cell area
- Catalyst at the cathode
- Catalyst at the anode
- Capital cost of the stack (per kW)
- Capital cost of the stack (per kW) @ mass production (estimate)

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 (observed - HHV - DC current)
- Energy consumption for hydrogen production
- Current density
- Power density
- Cell voltage
- Degradation rate in µV/h/cell
- Efficiency degradation per 1000 h
- Catalyst loading - Anode (in mg/cm2)
- Catalyst loading - Cathode (in mg/cm2)
- Catalyst loading - Anode - in g/(kg H2/day)
- Catalyst loading - Cathode - in g/(kg H2/day)

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
- System lifetime, rated
- Stack lifetime, rated
- Operating pressure
- Operating temperature
- Power converter
- Input voltage
- Power usage of auxiliary equipment - in standby
- Power usage of auxiliary equipment - nominal capacity
- Catalyst at the anode
- Catalyst at the cathode
- Active cell area
- Hydrogen purity
- System electrical efficiency (rated - HHV - AC current)
- Stack electrical efficiency (rated - HHV - DC current) - average for all stacks
- Capital cost of the system (per kW)
- Capital cost of the system (per ton/day)
- Capital cost of the system (per ton/day) @ mass production (estimate)
- Cost - balance of plant (BoP)

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
- Part-load operation - minimum - observed
- Maximum overload operation
- Quantity of hydrogen produced
- Electricity consumed
- System availability
- Stack availability
- System electrical efficiency (observed - HHV - AC current)
- Stack electrical efficiency (observed - HHV - DC current)
- System energy consumption for hydrogen production
- Energy consumption for hydrogen compression
- Energy consumption for hydrogen production
- Operating profile
- Current density
- Power density
- Cell voltage
- Degradation rate in µV/h/cell
- Efficiency degradation per 1000 h
- Catalyst loading - Anode (in mg/cm2)
- Catalyst loading - Cathode (in mg/cm2)
- Catalyst loading - Anode - in g/(kg H2/day)
- Catalyst loading - Cathode - in g/(kg H2/day)

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
- Footprint
- Volume
- Electricity origin
- System lifetime, rated
- Stack lifetime, rated
- Hydrogen purity
- Power converter
- Operating pressure
- Operating temperature
- Input voltage
- Power usage of auxiliary equipment - in standby
- Power usage of auxiliary equipment - nominal capacity
- Stack electrical efficiency (rated, HHV, DC current)
- System electrical efficiency (rated - HHV - AC current)

CAPEX - electrolyser capital cost

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
- Part-load operation - minimum - observed
- 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
- Degradation rate in µV/h
- Degradation rate in %/kh
- Stack electrical efficiency (observed - HHV - DC current)
- System electrical efficiency (observed - HHV - AC current)
- Energy consumption for hydrogen production
- Energy consumption for hydrogen compression
- Number of safety incidents - total
- 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 - if applicable
- Catalyst(s)
- Hydrogen purification method
- Nominal hydrogen weight capacity
- Nominal hydrogen volume capacity

Operational

- Start date for reporting
- End date for reporting
- Technology readiness level (TRL) @start of timeframe
- Technology readiness level (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
- Part-load operation - Minimum
- Quantity of hydrogen produced
- Conversion efficiency @ start of timeframe
- Efficiency degradation
- Number of times the catalyst was replaced
- Purity of the produced hydrogen before purification
- Purity of the produced hydrogen after purification
- Number of safety incidents - total
- Cost of the hydrogen produced - estimate

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
- System lifetime, rated
- Hydrogen purity
- Conversion efficiency @ start of operations
- Technology readiness level (TRL) @start of operations
- Capital cost of the system (per ton/day)
- Capital cost of the system (per ton/day) @ mass production (estimate)

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
- Part-load operation - minimum - observed
- Quantity of hydrogen produced
- Availability
- Conversion efficiency @ start of timeframe
- Conversion efficiency @ end of timeframe
- Efficiency degradation rate
- Purity of the produced hydrogen before purification
- Purity of the produced hydrogen after purification
- Energy consumption for hydrogen production
- Energy consumption for hydrogen compression
- Number of safety incidents - total
- Technology readiness level (TRL) @end of timeframe
- Cost of the hydrogen produced
- OPEX - Operational and maintenance costs

Co-electrolyser – research at stack or lower

Descriptive

- Technology
- Number of cells in each stack
- Stack nominal power capacity
- Stack lifetime, rated
- Operating pressure
- Operating temperature
- Input voltage
- Stack electrical efficiency (rated - HHV - DC current)
- Active cell area
- Catalyst at the cathode
- Catalyst at the anode
- Capital cost of the stack (per kW)
- Capital cost of the stack (per kW) @ mass production (estimate)
- Methanation process
- Methanation catalyst
- Design temperature for the methanation step
- Design pressure for the methanation step
- Design overall process efficiency

Operational

- Start date for reporting
- End date for reporting
- CO2 source
- Hours of operation
- Hours of operation - cumulative
- Fuel cell: quantity of hydrogen produced
- Fuel cell: quantity of CO produced
- Fuel cell: Electricity consumed
- Stack availability
- Stack electrical efficiency (observed - HHV - DC current)
- Stack: current density
- Stack: density
- Stack: cell voltage
- Stack: degradation rate in µV/h/cell
- Stack: efficiency degradation per 1000 h
- Methanation yield
- Methanation temperature, experimental
- Methanation pressure, experimental
- Amount of methane produced
- Overall efficiency

Hydrogen refueling 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 within the project
- Refuelling protocol
- Hydrogen supply
- On-site hydrogen production method (if applicable)
- Onsite hydrogen production rate
- Source of renewable feed for hydrogen dispensed
- Fraction of renewable feed for hydrogen production
- Storage capacity
- State of the hydrogen in the storage tank
- Pressure of the on-site storage tank - rated
- Noise - compressor
- State of the hydrogen at dispensing
- Dispensing pressure
- CAPEX for the component(s)
- CAPEX for the component(s) - estimated at mass production
- CAPEX for the HRS
- CAPEX for the HRS - estimated at mass production

Operational

- Start date for reporting
- End date for reporting
- Technology readiness level (TRL) - station
- Vehicles refuelled
- Days of operation
- Hours of operation
- Hours of operation - cumulative
- Amount of hydrogen dispensed
- Number of hydrogen refuellings
- Availability - within this data collection exercise
- Mean time between failures (MTBF)
- Metering accuracy
- System energy consumption for hydrogen compression
- Technology readiness level (TRL) - components
- Cost of hydrogen
- Number of safety incidents - total

Hydrogen refueling 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
- On-site hydrogen production method (if applicable)
- Onsite hydrogen production rate
- Source of renewable feed for hydrogen dispensed
- Fraction of renewable feed for hydrogen production
- CAPEX for the HRS

Operational

- Start date for reporting
- End date for reporting
- Vehicles refuelled
- Days of operation
- Hours of operation
- Distance from the hydrogen production site
- Amount of hydrogen dispensed
- Number of hydrogen refuellings
- Metering accuracy
- Availability - within this data collection exercise
- Availability - since start of operations
- Mean time between failures (MTBF)
- Overall downtime
- Downtime due to scheduled maintenace and 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 - total
- OPEX - Operational and maintenance costs
- Cost of hydrogen
- Price of hydrogen dispensed

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
- Stack electrical efficiency (LHV) - rated
- Stack total efficiency (LHV) - rated
- Capital cost of the stack (per kW)
- Capital cost of the stack (per kW) @ mass production (estimate)

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 µV/h
- Degradation rate in %/kh
- PGM catalyst loading - Anode (in mg/cm2)
- PGM catalyst loading - Anode (in g/kW)
- PGM catalyst loading - Cathode (in mg/cm2)
- 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 fuel cell system include a fuel reformer?
- Number of stacks per system
- Number of cells per stack
- Capacity of the system - rated
- System durability - rated
- Stack durability - rated
- Purity required for the fuel
- Catalyst at the cathode
- Catalyst at the anode
- Active cell area
- System electrical efficiency (LHV) - rated
- System total efficiency (LHV) - rated
- Stack electrical efficiency (LHV) - rated
- Stack total efficiency (LHV) - rated
- Capital cost of the system (per kW)
- Capital cost of the system (per kW) @ mass production (estimate)
- Capital cost of the stack (per kW)
- Cost - balance of plant (BoP)

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 µV/h
- PGM catalyst loading - Anode (in mg/cm2)
- PGM catalyst loading - Anode (in g/kW)
- PGM catalyst loading - Cathode (in mg/cm2)
- PGM catalyst loading - Cathode (in g/kW)
- Cost of electricity generated - levelised (LCOE)

Fuel cell car demonstration

Descriptive

- Country
- Town or region
- Deployment date
- Vehicle manufacturer
- Vehicle model
- Car 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
- Consumption, tank to wheel
- Durability
- Minimum ambient temperature
- Maximum ambient temperature
- Fuel cell system cost
- Estimated fuel cell system cost at mass production
- Vehicle cost
- Estimated vehicle cost at mass production
- 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 in the project
- Distance driven - cumulative overall
- Number of hydrogen refuelling events
- Amount of hydrogen fed
- Availability
- Mean distance between failures (MDBF)
- Downtime
- Downtime due to scheduled maintenance/upgrades
- Downtime of vehicles due to stack issues
- Downtime of vehicles due to peripheric mechanical components
- Downtime of vehicles due to electrical components
- Downtime of vehicles due to the on-board hydrogen storage tank
- Downtime of vehicles due to the high voltage battery
- Number of safety incidents - total
- Near misses
- OPEX - Operational and maintenance costs

Fuel cell /plug-in car demonstration

Descriptive

- Country
- Town or region
- Deployment date
- Manufacturer
- Model
- Car 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
- Passenger capacity
- Hydrogen storage capacity
- Hydrogen tank pressure rating
- Battery capacity
- Durability
- Minimum ambient temperature
- Maximum ambient temperature
- Fuel cell system cost
- Estimated fuel cell system cost at mass production
- Vehicle cost
- Estimated vehicle cost at mass production

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 in the project
- Distance driven - cumulative overall
- Number of hydrogen refuelling events
- Amount of hydrogen fed
- Number of electric recharges
- Amount of electricity fed
- Availability
- Mean distance between failures (MDBF)
- Downtime
- Downtime due to scheduled maintenance/upgrades
- Downtime of vehicles due to stack issues
- Downtime of vehicles due to peripheric mechanical components
- Downtime of vehicles due to electrical components
- Downtime of vehicles due to the on-board hydrogen storage tank
- Downtime of vehicles due to the high voltage battery
- Number of safety incidents - total
- Near misses
- Operational and maintenance costs

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
- Consumption, tank to wheel (SORT 1)
- Consumption, tank to wheel (SORT 2)
- Bus durability
- Fuel cell system durability
- Minimum ambient temperature
- Maximum ambient temperature
- Vehicle price
- Bus cost
- Estimated bus cost at mass production
- Fuel cell system cost
- Estimated fuel cell system cost at mass production

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 in the project
- Distance driven - cumulative overall
- Mean distance between failures (MDBF)
- Stack lifetime (at end of life)
- Number of stacks reaching end-of life
- Total distance driven with the same stack(s) until stack end of life
- Amount of hydrogen fed
- Number of hydrogen refuelling events
- Availability
- Downtime
- Downtime due to scheduled maintenance/upgrades
- Downtime of vehicles due to stack issues
- Downtime of vehicles due to peripheric mechanical components
- Downtime of vehicles due to electrical components
- Downtime of vehicles due to the on-board hydrogen storage tank
- Downtime of vehicles due to the high voltage battery
- Number of safety incidents - total
- Near misses
- OPEX - Operational and maintenance costs

Fuel cell material handling vehicle demonstration

Descriptive

- Country
- Town
- Deployment date
- Manufacturer
- Production year
- Model
- Type
- Forklift Class
- Load capacity
- Power
- Fuel cell system weight
- Weight
- Height
- Length
- Width
- Hydrogen storage capacity
- Hydrogen tank pressure rating
- State of the hydrogen in storage
- Electrical efficiency
- Durability
- System durability
- Minimum ambient temperature
- Maximum ambient temperature
- Vehicle cost
- Estimated vehicle cost at mass production
- Vehicle price
- Fuel cell system cost
- Estimated fuel cell system cost at mass production
- Fuel cell system price
- CAPEX for the storage tank

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
- Amount of hydrogen fed
- Number of hydrogen refuelling events
- Availability
- Mean time between failures (MTBF)
- Downtime
- Downtime due to scheduled maintenance/upgrades
- Downtime of vehicles due to electrical components
- Downtime of vehicles due to the high voltage battery
- Downtime of vehicles due to the on-board hydrogen storage tank
- Downtime of vehicles due to peripheric mechanical components
- Downtime of vehicles due to stack issues
- Number of safety incidents - total
- Number of incidents with both INJURY and HYDROGEN RELEASE
- Number of incidents with INJURY but no hydrogen release
- Number of incidents with HYDROGEN RELEASE but no injury
- Number of incidents with neither injury or hydrogen release
- Near misses
- OPEX - Operational and maintenance costs

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
- System electrical efficiency (LHV), rated
- System total efficiency (LHV), rated
- Stack electrical efficiency (LHV), rated
- Stack total efficiency (LHV), rated
- CAPEX - APU system capital cost
- Estimated APU cost (CAPEX) at 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 since start of operations
- Average duration of 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
- SOx emissions
- NOx emissions
- Number of safety incidents
- OPEX - Operational and maintenance costs

Onboard storage for compressed gaseous hydrogen

Descriptive

- State of the hydrogen in the 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 - rated
- Nominal working pressure - rated
-
- Minimum temperature - rated
- Maximum temperature – rated
- CAPEX - Storage tank
- Estimated CAPEX - Storage tank at mass production

Operational

- Start date for reporting
- End date for reporting
- Proven durability of the storage tank
- Estimated lifetime of the storage tank
- Number of charging/discharging cycles achieved
- 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?
- Capacity of the system - electrical output, rated
- Description
- System durability, rated
- Stack durability, rated
- System electrical efficiency (LHV), rated
- System thermal efficiency (LHV), rated
- CO2 emissions per electricity output - rated
- SOx emissions per electricity output - rated
- NOx emissions per electricity output - rated
- Noise - rated
- Capital cost of the system
- Capital cost of the system @ mass production (estimate)

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 - total
- OPEX - Operational and maintenance costs
- Cost of electricity generated - levelised (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 power capacity
- Reference process: Active cell area
- Reference process: Electrical efficiency
- Reference process: Durability
- Reference process: Efficiency degradation rate
- Reference process: Production rate in units/h
- Reference process: Production rate in units/yr
- Reference process: Scrap rate
- Reference process: Quality acceptance criterion
- Reference process: Offline quality testing duration
- Reference process: Number of staff per number of units produced
- Reference process: Number of staff per MW power produced
- Reference process: Production line footprint
- Reference process: Energy consumption per unit produced
- Reference process: Energy consumption per MW power produced
- Reference process: Operational costs per unit produced
- Reference process: Operational costs per MW produced
- Reference process: CAPEX
- Reference process: Estimated CAPEX @ mass production

Operational

- Start date for reporting
- End date for reporting
- Description
- Project process: Stack weight
- Project process: Stack volume
- Project process: Stack nominal power capacity
- Project process: Active cell area
- Project process: Electrical efficiency
- Project process: Durability
- Project process: Efficiency degradation rate
- Project process: Production rate in units/h
- Project process: Production rate in units/yr
- Project process: Scrap rate
- Project process: Quality acceptance criterion
- Project process: Offline quality testing duration
- Project process: Number of staff per number of units produced
- Project process: Number of staff per MW power produced
- Project process: Production line footprint
- Project process: Energy consumption per unit produced
- Project process: Energy consumption per MW power produced
- Project process: Operational costs per unit produced

Diagnostics – electrolysis

Descriptive

- Diagnostic/control tool description
- Property measured by the diagnostic/control tool
- Information derived from the diagnostic/control tools measurement
- Does the diagnostic/control tool measure the degradation?
- Power usage of the diagnostic/control tool
- Is (or will) the diagnostic/control tool be associated to prognostics for the estimation of residual lifetime?
- Capital cost of the diagnostic/control tool
- Electrolyser manufacturer
- Electrolyser technology
- Production rate of hydrogen - rated - daily weight
- Electrolyser nominal power
- Stack manufacturer
- Stack capacity - rated
- Stack durability - rated
- System durability - rated
- Capital cost of the electrolyser system

Operational

- Start date for reporting
- End date for reporting
- Hours of operation - total (stack)
- Hours of operation - total (electrolyser system)
- Hours of operation - total (diagnostic/control tool)
- Electrical efficiency of the system at start
- Electrical efficiency of the system at end
- Improvement of the degradation rate - estimate
- Improvement of mean time between failures (MTBF)
- Availability improvement
- Durability of the system - predicted
- Durability of the stack(s) - predicted
- Improvement of the system lifetime - estimate
- Improvement of the stack lifetime - estimate
- Number of faults detected
- Number of failures detected
- Detection rate of the diagnosis/control tool - total
- Detection rate - H2 in O2 stream or viceversa
- Detection rate - breaks and/or leakages
- Detection rate - to delamination
- Detection rate - other issues
- Diagnosis/monitoring system availability
- Operational costs for diagnosis/control, per Kg H2
- Operational costs reduction estimate due to diagnostics/control system - per Kg H2

Diagnostics - fuel cells

Descriptive

- Diagnostic/control tool description
- Property measured by the diagnostic/control tool
- Information derived from the diagnostic/control tools measurement
- Does the diagnostic/control tool measure the degradation?
- Power usage of the diagnostic/control tool
- Is (or will) the diagnostic/control tool be associated to prognostics for the estimation of residual lifetime?
- Capital cost of the diagnostic/control tool
- 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
- Hours of operation - total (fuel cell stack)
- Hours of operation - total (fuel cell system)
- Hours of operation - total (diagnostic/control tool)
- Electrical efficiency of the system at start
- Electrical efficiency of the system at end
- Improvement of the degradation rate - estimate
- Improvement of mean time between failures (MTBF)
- Availability improvement
- Durability of the system - predicted
- Durability of the stack(s) - predicted
- Improvement of the system lifetime - estimate
- Improvement of the stack lifetime - estimate
- Number of faults detected
- Number of failures detected
- Detection rate of the diagnosis/control tool - 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 system availability
- Operational costs for diagnosis/control, per Kg H2
- Operational costs reduction estimate due to diagnostics/control system - per kWh produced

Pre-Normative Research

Descriptive

- Gap in knowledge addressed
- Project objective
- FCH JU pillar
- Approach
- Target regulation, code or standard
- Targeted organisation
- Targeted technical/working group
- Other RCS addressing the issue tackled by the project
- Foreseen means of improvement/revision of standard
- Collaborations outside EU28

Operational

- Start date for reporting
- End date for reporting
- Newly detected relevant RCS activities
- Progress vs knowledge gap
- Standardisation bodies: is consortium involved first-hand?
- Standard developing organisation(s) contacted to date
- 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 at scientific seminars/conferences
- Nr of posters at scientific seminars/conferences
- Have the project results been integrated (to date) in any regulation, codes or standards?
- By what year would you expect that the project result become integrated in any regulation, code or standard?

Education

Descriptive

- Training course: name and brief description
- Training topic(s)
- Training target group(s)
- Training type
- Training material
- Language(s) of the training
- Training attendance type
- Training duration
- Does the training include a passing test/exam?
- Does the training confer 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 (if applicable) in reference period
- Nr of diplomas/certificates issued (if applicable) in totla in the project