Horizon 2020 Work Programme for Research & Innovation 2018-2020

H2020 Transport info day – 7 October 2019

Automated Road Transport (ART) and Batteries (BAT) Calls

#H2020Transport
Horizon 2020 Work Programme for Research & Innovation 2018-2020

Efficient and safe connected and automated heavy-duty vehicles in real logistics operations

Large-scale cross-border demonstration of connected and highly automated driving functions for passenger cars

Tom Alkim
Future Urban & Mobility Systems, UNIT D2
European Commission – DG RTD

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#H2020Transport
H2020 calls on “Automated Road Transport”

- **Budget:** € 300 Mio (2014-2020)
- **Focus**
  - Large-scale demos of automated driving systems for passenger cars, trucks and urban transport
  - Safety and end user acceptance
  - Road infrastructure to support automation
  - Traffic management solutions
  - Connectivity for automation
  - Testing and validation procedures
  - Assessment of impacts, benefits and costs of CAD systems
  - Support for cooperation and networking activities
  - Human centered design of AV

5 Calls for proposals

- 2016
- 2017
- 2018
- 2019
- 2020
Human centered design for the new driver role in highly automated vehicles

Developing and testing shared, connected and cooperative automated vehicle fleets in urban areas for the mobility of all

Efficient and safe connected and automated heavy commercial vehicles in real logistics operations

Large-scale, cross-border demonstration of highly automated driving functions for passenger cars

Topic DT-ART-05-2020 (RIA)
Efficient and safe connected and automated heavy commercial vehicles in real logistics operations

**Scope**

- Develop, design, test and validate enhanced connected and automated vehicle technologies for heavy commercial vehicles
- Test and demonstrate innovative, efficient and safe connected and automated heavy commercial vehicles for real logistics operations on hub-to-hub corridors, on open roads in mixed traffic or in confined areas
- Enhanced interaction between automated heavy commercial vehicles and their users and other vulnerable road users
- Innovative services for automated freight logistics of individual transport units

**Estimated EC contribution per proposal**

- EUR 15-20 million
Potential

• Connected and automated driving systems for heavy commercial vehicles have great potential to bring a disruptive change to the trucking industry, fleet operators and the whole logistics sector.

• They can improve safety and efficiency of freight transport and make vehicle operations more comfortable.

• Fuel efficiency gains can be achieved through automated truck operations, such as platooning.

• Positive impacts can be expected when highly automated systems will be used in logistics operations going from hub to hub including both operations in mixed traffic and in confined areas.
Specific Challenges to be addressed

before connected, cooperative and automated driving technologies for heavy commercial vehicles can be widely deployed:

• vehicle technologies
• driver/user interaction/collaboration
• vehicle-to-vehicle and vehicle-to-infrastructure communication
• operational challenges in confined areas (ports, logistics terminals, consolidation centers, truck parkings, etc.)
• operational challenges in mixed traffic on public roads
Topic DT-ART-06-2020 (RIA)
Large-scale, cross-border demonstration of connected and highly automated driving functions for passenger cars

Scope

• Demonstrate highly automated driving technologies and systems for passenger cars (SAE level 4) for different use cases in particularly challenging and complex environments that are expected to be introduced into the market after 2020

• Test innovative connectivity technologies

• Conduct cross-border demonstrations to ensure that new services and systems are compatible and interoperable at European level

• Develop and test solutions for smooth communication and interaction between automated vehicles and their users and other (vulnerable) road users

Estimated EC contribution per proposal

• EUR 15-30 million
Specific challenges

Significant progress has been made in developing technologies for connected and automated driving in Europe and many large-scale demonstration projects are already ongoing.

Several challenges remain, in particular for highly automated vehicles, before we will see them on the roads:

- HAVs must achieve very high levels of availability and effectiveness of their functions.
- Performance of HAVs has to be better compared to the performance of human drivers.
- Seamless cross-border functionality has to be guaranteed.
- User and customer expectations and acceptance, market potentials and risks need to be better understood.
Thank you!

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H2020 Transport info day – 07 October 2019

Next-generation and realisation of battery packs for BEV and PHEV

Johan Blondelle
European Commission – DG RTD

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Cross-cutting activities: Building a Low-Carbon, Climate Resilient Future: **Next-Generation Batteries**

- COP21 climate objectives
- EU2020 and EU2050 climate targets
- EU Batteries Alliance

**Cross-cutting call on batteries**

H2020-LC-BAT-2019-2020

- Materials
- Transport
- Energy

[European Commission logo]
# Topic overview

## Building a Low-Carbon, Climate Resilient Future: Next-Generation Batteries

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC-BAT-8-2020</td>
<td>Next-generation batteries for stationary energy storage</td>
</tr>
<tr>
<td>LC-BAT-9-2020</td>
<td>Hybridisation of battery systems for stationary energy storage</td>
</tr>
<tr>
<td><strong>LC-BAT-10-2020</strong></td>
<td><strong>Next generation and realisation of battery packs for BEV and PHEV</strong></td>
</tr>
<tr>
<td>LC-BAT-11-2020</td>
<td>Reducing the cost of large batteries for waterborne transport</td>
</tr>
</tbody>
</table>

### A large-scale research initiative on Future Battery Technologies

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC-BAT-12-2020</td>
<td>Novel methodologies for autonomous discovery of advanced battery chemistries</td>
</tr>
<tr>
<td>LC-BAT-13-2020</td>
<td>Sensing functionalities for smart battery cell chemistries</td>
</tr>
<tr>
<td>LC-BAT-14-2020</td>
<td>Self-healing functionalities for long lasting battery cell chemistries</td>
</tr>
<tr>
<td>LC-BAT-15-2020</td>
<td>Coordinate and support the large scale research initiative on Future</td>
</tr>
</tbody>
</table>
Next generation and realisation of battery packs for BEV and PHEV

Challenge: To accelerate the mass market take-up of BEV and PHEV - passenger cars

Scope: Design of advanced battery packs and systems; solutions and processes for the sustainable dismantling and recycling; Flexible advanced battery management system with advanced functionalities of battery management systems to enable control of modules and packs and their remote maintenance; compatible with high-power ultra-fast charging; performance-related test procedures; Concept validation and safety test procedures

Expected impact: improved performance and knowledge of the EV through reducing system weight, reducing charging time, extended battery life; improved circularity.

Estimated EC contribution per proposal: EUR 8 - 10 million
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Reducing the cost of large batteries for waterborne transport

Peter Crawley
European Commission – DG RTD
LC-BAT-11:
Reducing the cost of large batteries for waterborne transport

Challenge:
• Large battery packs are increasingly used to improve efficiency and to eliminate emissions from waterborne transport.
• The cost of waterborne transport batteries is up to ten times higher than an equivalent automotive battery.
• High cost is an important barrier to increasing the deployment of both hybrid and fully battery electric shipping.
• Unlike other transport modes, space, weight and consequently battery power density for waterborne transport is usually secondary to the systems total life cycle cost.
• Causes of higher cost include; production processes, safety certification, fire suppression, lower economies of scale and higher assembly costs.
• Challenge to substantially reduce the cost of large waterborne transport battery systems and cells.
Address all bullets:

- Research and develop large (applicable to minimum 1MWh systems) waterborne transport battery system and/or battery cells that are substantially cheaper on a total cost basis.
- Trials and testing to prove technology and manufacturing processes.
- Address production efficiency & requirements for type approval from relevant authorities, including risk based safety assessment.
- Develop a marine battery certification methodology with objective of: validating and verifying safety (also considering cooling system), include test method standardisation and tools to cut certification costs.
- Considering different vessel types, address battery system integration.
- Undertake cost benefit analysis, assess end of life strategies, develop business case & potential finance models.

RIA: Suggested contribution EUR 8-12 million

Total topic budget EUR 20 million
LC-BAT-11: Reducing the cost of large batteries for waterborne transport

Impact:

• Substantially reduce the lifetime cost of large waterborne battery systems.
• Enhance the competitiveness of European industry within the waterborne battery market.
• Cut greenhouse gas emissions from waterborne transport.
• Increase the European skills base in large battery technology and manufacturing processes.
• Support European jobs and growth.
• Increase confidence in waterborne battery technology investment.
• Speed up the transition of most waterborne short range freight and ferry services towards zero emissions.
Thank you!

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**Horizon 2020 Work Programme for Research & Innovation 2018-2020**

*H2020 Transport info day – 7 October 2019*

**Fuel Cells and Hydrogen Joint Undertaking**

Ask your question on sli.do

Bart Biebuyck
FCH JU
Executive Director

#H2020Transport
H2020 Transport Info Day: Successful implementation of Hydrogen and Fuel Cell technology by FCH-JU

Bart Biebuyck, Executive Director
07 / 10 /2019 Brussels
Strong public-private partnership with a focused objective
A combined private-public of 1.85 billion Euro has been invested to bring products to market readiness by 2020

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Energy
- H₂ production and distribution
- H₂ storage
- F/C for CHP

Transport
- Road vehicles
- Non-road vehicles
- Refueling infra
- Maritime, rail and aviation applications

Cross-cutting
- standards, safety, education, consumer awareness, ...

246 projects supported for 915 m€

Similar leverage of other sources of funding: 935 m€

428 million euros
136 projects
47 %

388 million euros
66 projects
42 %

53 million euros
40 projects
6 %

46 million euros
4 projects
5 %
The role of hydrogen in our society & economy

Hydrogen allows more renewables in the energy system through storage and enables sectoral integration.

(1) STORAGE (seasonal)

(2) SECTORAL INTEGRATION

- Industry
- Feedstock
- Electrolyser
- Storage $H_2$
- Transport
- Heating & Cooling
Besides CO₂ abatement, deployment of the hydrogen roadmap also cuts local emissions, creates new markets and secures sustainable employment in EU

**2050 hydrogen vision**

- ~24% of final energy demand¹
- ~560 Mt annual CO₂ abatement²
- ~EUR 820bn annual revenue (hydrogen and equipment)
- ~15% reduction of local emissions (NOₓ) relative to road transport
- ~5.4m jobs (hydrogen, equipment, supplier industries)³

1 Including feedstock  
2 Compared to the reference technology scenario  
3 Excluding indirect effects

SOURCE: Hydrogen Roadmap Europe team
All FCH-JU projects together will put 1600 vehicles on the EU market to gain experience with the technology.

- **Audi model**
- **BMW Small series**
- **New Toyota Mirai**
- **Lexus model**
- **New Honda Clarity**

**About 1300 FCEV’s on EU roads**

- EU OEM’s: small demo’s ~2025, mass production 2025~ (EU OEM’s part of FCH-JU) PSA: start FCV development
- FIA: In 2024 a H\(_2\) class @ Le Mans
- California & Japan sales are going fast due to strong policy support
- EU mobility package is good chance to catch up

**In H2ME projects**

- '13 Hyundai IX35
- '15 Renault Hykangoo
- '15 Toyota Mirai
- '16 Honda Clarity
- '18 Mercedes DLE
- '18 Hyundai NEXO

**FCEV’s on EU roads**

2018 (Today) 2025

- '13 Hyundai IX35
- '15 Renault Hykangoo
- '15 Toyota Mirai
- '16 Honda Clarity
- '18 Mercedes DLE
- '18 Hyundai NEXO

**Market in Fast Expansion...**

**Hydrogen fuel cell cars & vans in Europe**

- **2018 (Today)**
  - 2018: 1600 vehicles
  - 2025: target 4000 vehicles

**In H2ME projects**

- 2018: 1439 vehicles
- 2019: 517 vehicles

**EUROPE**

- S1 '19
- 2020
- 2022
- 2025
- 2030

- **Europe**
  - 2018: 1731
  - 2020: 50.000
  - 2025: 800.000
  - 2030: 1 million

- **China**
  - 2018: tbc
  - 2020: 50.000
  - 2025: 1 million

- **Japan**
  - 2018: 3219
  - 2020: 40.000
  - 2025: 50.000
  - 2030: 1 million

- **USA**
  - 2018: 7450
  - 2020: 200.000
  - 2025: 800.000

- **S-Korea**
  - 2018: tbc
  - 2020: 16.000

*According to the action plan of Alternative Fuel Directive

Roll-out of the required infrastructure in Europe

Europe installs Hydrogen Refuelling Stations thanks to European programs (FCH-JU & CEF) & national programs.

Source: FCH JU KM data collection file, 20/09/2017, public stations
USA-DoE & CaFCP, Japan-HySUT
To date ca. S1 2017

Public hydrogen refueling stations

Development of a system for HRS availability in the EU

Possible end users

“H2 live” App
H2 mobility Deutschland

https://h2-map.eu/

Japan: Air Liquide opens a hydrogen station in Shichinomiya, Kobe

<table>
<thead>
<tr>
<th>Country</th>
<th>2019</th>
<th>2020</th>
<th>2022</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>134</td>
<td>-</td>
<td>-</td>
<td>(820~842)</td>
<td>Tbc **</td>
</tr>
<tr>
<td>China</td>
<td>Tbc</td>
<td>100</td>
<td>-</td>
<td>350</td>
<td>1000</td>
</tr>
<tr>
<td>Japan</td>
<td>108</td>
<td>160</td>
<td>-</td>
<td>320</td>
<td>(900)</td>
</tr>
<tr>
<td>USA</td>
<td>41</td>
<td>100</td>
<td>-</td>
<td>200~225</td>
<td>-</td>
</tr>
<tr>
<td>S-Korea</td>
<td>tbc</td>
<td>-</td>
<td>310</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* According to the action plan of Alternative Fuel Directive
** McKinsey study H2: Europe roadmap to be released Oct ‘18.

<table>
<thead>
<tr>
<th>KPI</th>
<th>2017</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy demand (kWh / kg H2)</td>
<td>10</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>System cost (Thousands € / kg H2/day)</td>
<td>7</td>
<td>4 – 2,1</td>
<td>2,4 - 1,3</td>
</tr>
<tr>
<td>Availability ( %)</td>
<td>95</td>
<td>96</td>
<td>99</td>
</tr>
</tbody>
</table>
Roll-out of FC buses accelerates and become commercial

Europe is supporting totally 360 Hydrogen buses deployment that lead to a price reduction of 66% vs 2010 and a new initiative of 1000 buses in EU create scale and get cheaper than other zero-emission buses.

10 European OEM’s are developing H₂ buses: [www.fuelcellbuses.eu](http://www.fuelcellbuses.eu)

**Achieved**
- > 6,000,000 km driven since projects started
- > 92 t of H₂ consumed only in 2017
- > 25,000 h lifetime reached
- 625,000 €/bus offered
- From order to operation, 18m delivery time

**Average availability**

- 2013: 65%
- 2015: 74%
- 2017: 80%

**88% green hydrogen**

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**H₂Bus Europe**

**UK - Denmark - Latvia**

- First targeted rollout -

**Single Deck - 12 m**
- Price < €375k
- Range >450 km * Extended >675 km*
*Depended on duty cycle calculated at 35%*

**Double Deck - 10.9 m**
- Price < €410k
- Range >310 km * Extended >420 km*
*Depended on duty cycle calculated at 35%*

**Articulated - 18 m**
- Price < €465k
- Range >520 km * Extended >750 km*
*Depended on duty cycle calculated at 35%*

Everfuel, Wrightbus, Ballard Power Systems, Hexagon Composites, Nel Hydrogen and Ryse Hydrogen, leading players in the hydrogen fuel cell electric value chain, are joining forces to form the H₂Bus Consortium. The members are committed to deploying 1,000 hydrogen fuel cell electric buses, along with supporting infrastructure, in European cities at commercially competitive rates.

It is essential that commercial players join forces to realize the true zero-emission mobility society. The hydrogen fuel cell electric bus is the ideal substitute for fossil solutions, without compromising range, operational ability or cost. We are expanding our product portfolio to accommodate different market needs. The first phase of the project, totalling 600 buses, is supported by €40 million from the EU’s Connecting Europe Facility (CEF). The grant will enable the deployment of 200 hydrogen fuel cell electric buses in each of Denmark, Latvia and the UK by 2023.
In 2017 first trucks appeared on the EU roads and more are to come. Worldwide there is a clear traction towards Hydrogen for trucks due to the limited range of batteries.

FCH-JU started with Fuel Cells in trucks for APU’s but was found to expensive, therefor focus shifted to developing and testing trucks with range-extenders or fuel cell only e.g.: garbage trucks in mayor cities.

Hyundai signs deal to sell 1,600 hydrogen-powered trucks in Switzerland.

Norway aims for 1000 hydrogen trucks by 2023.
Rail accelerates Hydrogen and Fuel Cells technology

The first business models are appearing

German H₂ train

- 42% of EU railway not electrified
- 17 Sept. ’18 commercial operation starts in Germany. Other EU countries are on the way. Recently a big order of 27 H₂ trains placed in Germany.

• FCH trains make economic sense above all on longer non-electrified routes >100 km
• FCH trains esp. for last mile delivery & main routes with very low utilisation (<10 trains/day)
• Low electricity costs (<EUR 50 /MWh) & high infra utilisation (HRS...) favour FCH technology;
• FCH trains has downtimes <20 minutes (due to fast refuelling) and withstand long operating hours >18 hours w/o refuelling;
• FCH trains are economically feasible clean alternative to diesel trains in many cases;
• In some cases, battery trains may appear as more cost-effective option but come with operational constraints resulting from highly route-specific tailored battery configurations.

Maritime discovering Hydrogen and Fuel Cells

To accelerate the decarbonisation of Maritime, regulation for hydrogen need to be prepared.

- IMO April 2018: “at least 50% of CO₂ reduction by 2050”

IMO targets are not achievable with current technologies, converting the entire fleet to LNG will not be sufficient. Urgent need to regulate H₂ for ships.

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Reduction in emissions by fuel conversion (Petroleum oils → Natural gases)

<table>
<thead>
<tr>
<th>GHG</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>80%~90% reduction</td>
</tr>
<tr>
<td>SOx, PM</td>
<td>Zero emission</td>
</tr>
<tr>
<td>GHG</td>
<td>20%~25% reduction</td>
</tr>
</tbody>
</table>

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**PURE** aims at developing auxiliary power units (APUs) for recreational yachts

- **DURATION**: 2013-2016
- **FCH JU Funding**: ~1.6M€

**MARANDA**: H₂ PEMFC based hybrid powertrain for marine applications, validated on board the research vessel Aranda

- **DURATION**: 2017-2021
- **FCH JU Funding**: ~3M€

**FLAGSHIPS**: will deploy 2 commercially operated 0-emission hydrogen vessels in France and Norway

- **DURATION**: 2019-2022
- **FCH JU Funding**: ~5M€

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Joined R&D in the area’s of LH₂ storage (bunkering), MW scale Fuel Cells, carriers,…
Aviation sees a future in Hydrogen for small planes

Hydrogen in the aviation sector causes much less noise and no pollution.

- In 2016, the first 4-seater plane propelled by H₂ took off from Bonn airport.
- Development of H₂ powered small business jets is ongoing, with an expectation of around 2030.

**HYCARUS (5.2 M€)**: Where the kitchenette runs entirely on Hydrogen and Fuel Cells.

**HEAVEN (4 M€)**: Modular architecture of a 90 kW fuel cell based on two 45 kW FC stacks fit for aeronautic use.

- Cryogenic H₂ storage with 10% weight efficiency.

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I am proud that European researchers and manufacturers are launching this hydrogen fuel cell powered aircraft.

Kolinda Brede
EU Transport Commissioner

POC: josef.kallo@dlr.de
FCH-JU Research boosts EU supply chain!

Europe is leading in several parts of the Hydrogen and Fuel Cells technologies sector

**EU H2 TANK DEVELOPMENT**
- Reduced cost by 5 to 3000€
- 20% reduced mass by design
- Use of robots to produce

**EU FUEL CELL STACK DEVELOPMENT**
- Established a EU supply chain for a fuel cell stack.
- Standardisation based on OEM requirements

June ’17: 4 German OEM’s will industrialise this stack
Nov. ’17: Nikola US truck OEM buy stacks in Sweden

**REDUCTION OF CRITICAL RAW MATERIAL (PLATINUM)**
- 70% reduction between 1st & 2nd generation
- Fuel cell platinum amount about equal to diesel catalyst
- 2 projects aiming for zero-platinum

**FCH-JU Value Chain study**
Europe leads in several parts of the Hydrogen and Fuel Cells sector such as:
- Electrolysers
- Solid oxide Fuel Cells
- Hydrogen Refuelling Stations
- Hydrogen buses
- ...

“Value Chain and Manufacturing Competitiveness Analysis for Hydrogen and Fuel Cells Technologies”
LAST CALL IN 2020
Topics are under discussion

Indicative:
• Call and topics will be released mid. Jan 2020
• Proposals to be submitted by mid April
• Evaluation result by August.

• Several transport topics will be included.