Overview IEA Technology Collaboration Platforms (TCPs)

Sacha Scheffer

TTG Meeting, Buenos Aires, September 2018

IEA

Hybrid and Electric Vehicles (HEV-TCP)

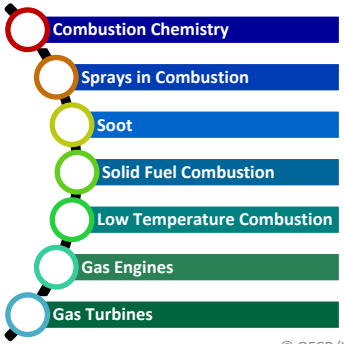
- **Origin**: Founded in 1994 and currently 17 member countries and one sponsor organization
- **Work HDV:** Priority themes
  - Electrification of non-automotive (e.g., **trucks, buses**, ships, bicycles)
  - Infrastructure,
  - Connected and automated vehicles
  - Life-cycle assessment
- Task 41: Electric freight vehicles (EFVs) – Monitor technologies, costs and policies
- Task 33: Electric buses - Analyze state of technology and systems of battery electric buses
- **Future**: HEV-TCP participants are presenting 14 papers at the 30th International Electric Vehicle Symposium (EVS31) in Kobe, Japan, October 1-3, 2018
- http://www.ieahev.org/

IEA Bioenergy TCP

- **Origin**: Currently 23 member countries/regions
- **Objective**: Commercializing Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks
- **Work HDV**: Analyze policy, markets and sustainable biofuel implementation
- 2016-2018 Achievements on trucks: Report surveying advanced biofuels in advanced engines (with IEA AMF) (final revisions underway; publish internally in Q3 2018)
- **Future:** Proposed program, 2019-2021:
  - Cover all transport biofuels including conventional and advanced liquid biofuels
  - Address policy/legislative /regulatory and infrastructure compatibility concerns
  - Facilitate knowledge transfer and information dissemination
  - https://www.ieabioenergy.com/

IEA Combustion TCP

- **Origin:** Created in 1977 as the Technology Collaboration Program (TCP) on “Energy Conservation and Emissions Reduction in Combustion”.
- **Objective:** Our collaborative tasks address specific research questions from combustion fundamentals to technical applications in, amongst others, internal combustion engines.
- **Work HDV**: Low temperature combustion (LTC) task: Processes can improve light- and **heavy-duty vehicle** fuel economy by 20-25% while maintaining ultra-low emissions.
- https://www.ieacombustion.com/



IEA Hydrogen TCP

- **Objective:** Accelerate H2 implementation and utilization to optimize environmental protection, improve energy security and economic development

- **Work HDV**:
  - Task 28 HRS Infrastructure – Viable network of fast-filling HRS open to fleets/public around the world.
  - Task 38 - Power to Hydrogen and Hydrogen to X
  - Sustainable H2 Transport Market potential – multiple applications including trucks, buses and trains.

- **Future:**
  - Collaborative RD&D Portfolios (production, storage, integrated systems, infrastructure)
  - Analysis Portfolios (technical, market and political decision making)
  - Awareness, Understanding & Assessment (AUA) Portfolios

- http://ieahydrogen.org/

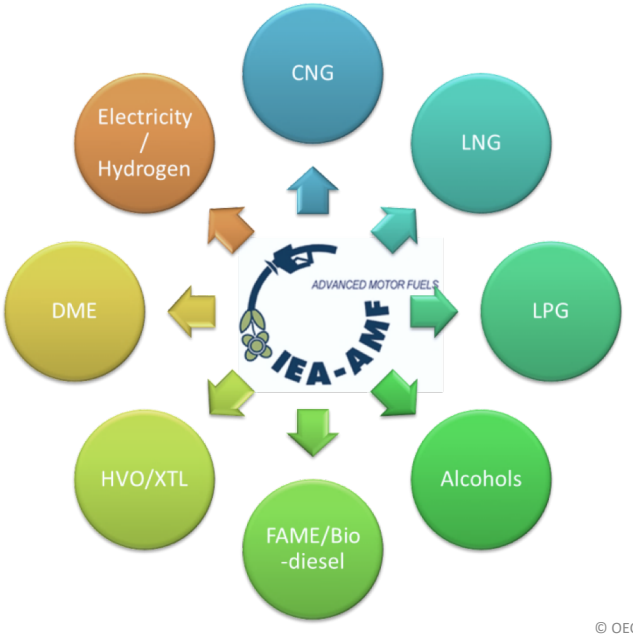
IEA Advanced Motor Fuels (AMF) TCP

- **Objective:** AMF TCP works on the entire spectrum of fuels from feedstock, through fuel processing, distribution, and, finally, end use in vehicles.

- **Work HDV**:
  - Annex 53 – Sustainable Bus Systems
  - Annex 54 – Engines and Aolcohol Fuels
  - Annex 55 – Real Driving Emissions and Fuel Consumption.
  - Heavy Duty Vehicle Evaluation
  - Methanol as a motor fuel

- **Future:** Current end-of-term is February 2020.

- www.iea-amf.org

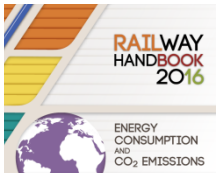


Other IEA involvement with transport

MoMo is the main analytical tool used for projections of transport activity, energy demand and CO_2 emissions in the IEA

An essential tool for activities on:

- Energy Efficiency: Global Fuel Economy Initiative (GFEI)
- Energy Technology: Electric Vehicle Initiative (EVI)
- Cooperative Efforts: Railway Handbook on Energy Consumption and CO_2 emissions with International Union of Railways



MoMo is shared with:

- Other Directorates in the IEA (e.g. WEO; EEfD)
- the International Transport Forum, who uses it for the formulation of its Transport Outlook
- "MoMo partners", i.e. sponsors – mainly from the private sector – that provide Voluntary Contributions and/or in-kind support

BACKUP SLIDES

IEA

Electric Vehicles Initiative (EVI)

Electric Vehicles Initiative

Multi-government policy forum dedicated to conducting collaborative activities that support the design and implementation of domestic electric vehicle (EV) deployment policies and programs

In 2010, EVI was one of several initiatives launched under the CEM

Currently co-chaired by Canada and China, and coordinated by the IEA

Released several analytical publications, demonstrating leadership to strengthen the understanding of the opportunities offered by electric mobility to meet

Members

in 2018

Instrumental to mobilize action and commitments (Paris Declaration on Electro-Mobility and Climate Change at COP21, Government Fleet Declaration at COP22)

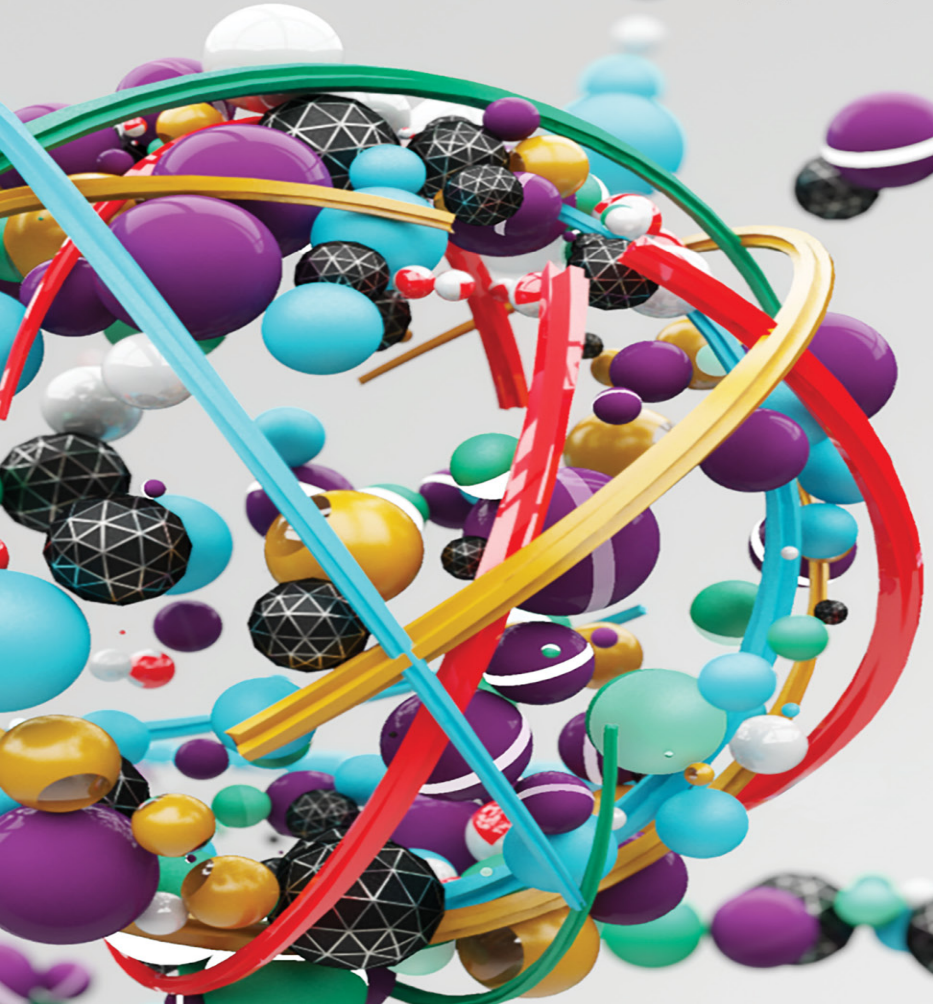
Launched the EV30@30 Campaign in June 2017

Now launching the **Pilot City Programme**

Also working with the **Global Environment Facility** on the preparation of a project for the support of

gef

Technology Collaboration Programmes



TCP on Hybrid & Electric Vehicles (HEV-TCP)

iea Energy Technology Network
Technology Collaboration Programmes

HEV-TCP Participants

- Founded in 1994, 17 member countries today:

Austria	Germany	South Korea
Belgium	Ireland	Sweden
Canada	Italy	Switzerland
Denmark	Netherlands	Turkey
Finland	UK	France
Spain	USA	

- One sponsor: KAPSARC

About the HEV-TCP

Current high-priority themes

- Transport electrification beyond automotive
  (e.g., trucks, buses, ships, bicycles)
- Infrastructure issues (extreme fast charging, interoperability, wireless charging, vehicle/grid interactions)
- Connected and automated electric vehicles
- Environmental impacts and life-cycle analysis

Task 41: Electric freight vehicles (EFVs)

- **Objectives**
  - Monitor technological progress and cost developments in EFVs
  - Analyze the potential contribution of EFVs to CO2 reduction targets
  - Evaluate the role of monetary and non-financial incentives, and wider long-term policy frameworks

- **Technical approach and scope**
  - Conduct workshops with experts (from manufacturers, researchers, city planners, policy makers and stakeholders)
  - Exchange methodologies and data, problems and opportunities
  - Collaborate with AMF-TCP and other international stakeholders

- **Participating countries**
  - Germany (Operating Agent), UK, US
  - Three-year effort (ends June 2021)

Task 33: Electric buses

Objectives:

- Analyze state of technology and systems of battery electric buses
- Collect and document "International Success Stories“ in common format
- Give overview of systems & technology providers with characteristic data
- Analyze combination of trolley and battery systems
- Integration and use of existing infrastructure of trams, trolleys and metro
- Identify success factors (e.g. size of bus, distances between bus stops)
- Analyze sustainability issues – economic, environmental &social aspects
- Identify R&D demand
- Summarize future perspectives

- Operating Agent: Joanneum Research (Austria) gerfried.jungmeier@joanneum.aut

Recent Highlights

- Over 4 million electric vehicles have been sold globally
  - Over 1 million EVs sold in Europe
- The environmental and economic benefits of these electric vehicles have been quantified under HEV-TCP activities
- HEV-TCP participants are presenting 14 papers at the 30th International Electric Vehicle Symposium (EVS31) in Kobe, Japan, October 1-3, 2018
- Annual report will be released at EVS31

IEA Bioenergy Task 39
2016-2018 & 2019-2021

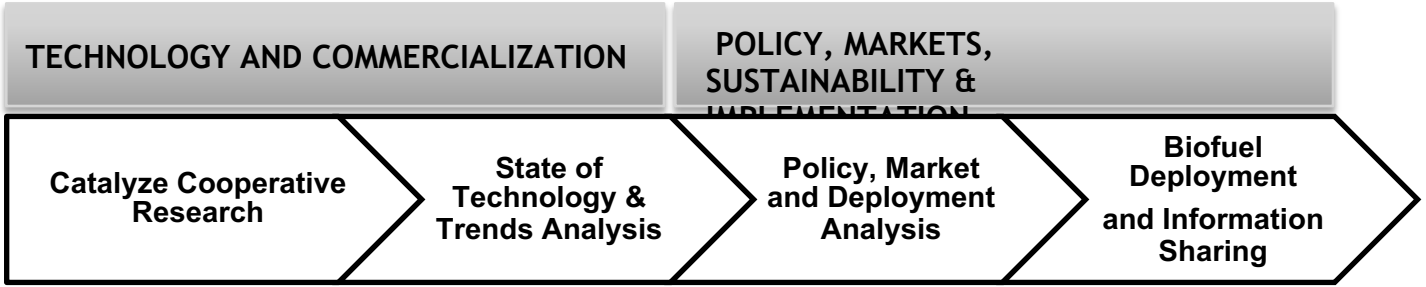
"Commercializing Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks"

Proposers: Jim McMillan[1] (Task Leader)
and Jack Saddler[2] (Co-Task Leader)
[1]National Renewable Energy Laboratory, USA
[2]University of British Columbia, Canada

IEA Bioenergy Task 39 - objectives, 2016-2018

- "To facilitate commercialization of conventional and advanced liquid biofuels"

- Collaboration between 14 countries
- Analyze policy, markets and sustainable biofuel implementation
- Focus on **Technical** and **Policy** issues
- Catalyze cooperative research and development
- Disseminate information & outreach with / to engage stakeholders



IEA Bioenergy Task 39
Liquid biofuels focus
14 member countries 2016-2018

www.Task39.org

European Commission - Luisa Marelli, Adrian O'Connell

Sweden - Tomas Ekbom, Leif Jonsson

Denmark - Claus Felby, Michael Persson, Anders Kristoffersen

Germany - Franziska Mueller-Langer, Nicolaus Dahmen

The Netherlands - Timo Gerlagh, Johan van Doesum

Austria - Dina Bacovsky

Canada - Jack Saddler

United States - Jim McMillan

South Korea - Jin Suk Lee, Kyu Young Kang, Seonghun Park

Japan - Satoshi Aramaki, Shiro Saka

Brazil - Antonio Bonomi

South Africa - Emile van Zyl

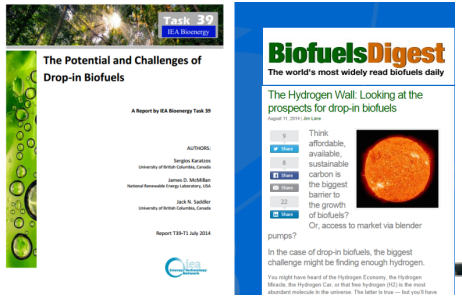
New Zealand - Ian Suckling

Australia - Steve Rogers

Significant achievements: 2016-2018

Drop-in biofuel update report: The potential and challenges of drop-in biofuels production (Report completed by November, 2018)

- Assess the challenges of technology platforms to produce drop-in biofuels
- Discuss the stages of commercialization and the current commercial volumes of produced drop-in biofuel through oleochemical platform
- Facilitate co-processing and refinery integration and the development of standards to commoditize the produced bio-intermediates in biorefineries
- Assess effective financial and policy fram production of drop-in biofuels
- LCA comparison for technologies



Significant achievements: 2016-2018

Potential and challenges of drop-in marine biofuels (report and webinar completed)

- Assess the current and developing marine fuel regulations
- Discuss marine fuel characteristics and new CO2 monitoring regime for ships
- Discuss current biofuel production technologies and marine biofuel development outlook
- SWOT analysis for marine biofuels

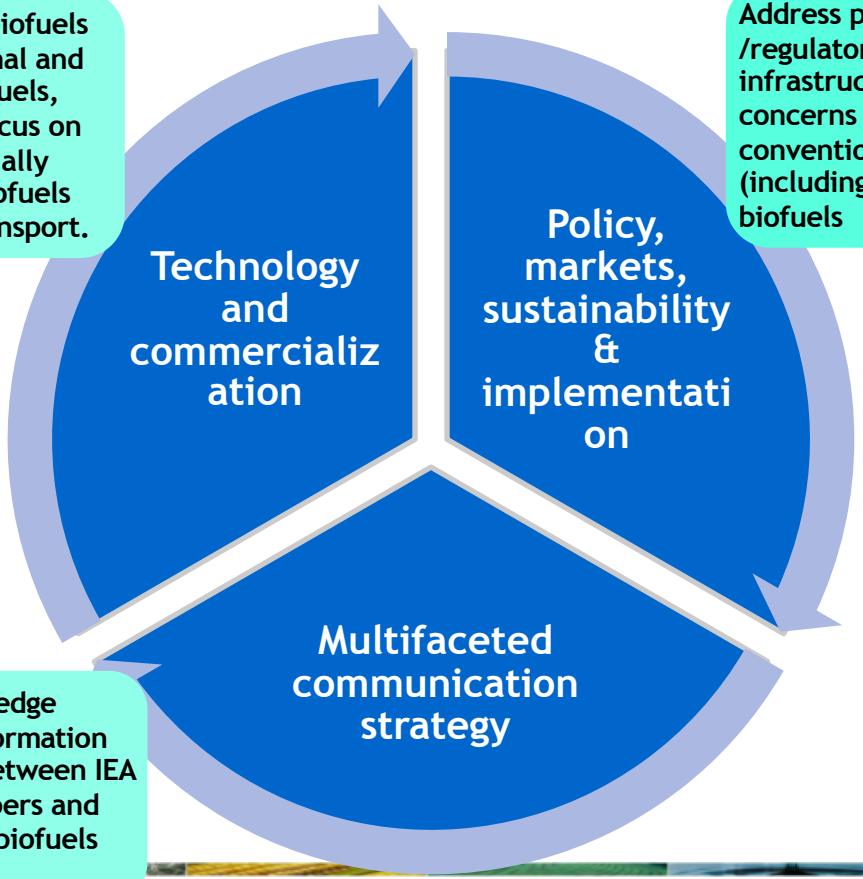
Significant achievements: 2016-2018 (other reports)

- Biofuel production and consumption in emerging economies (China) (2016)
- Update status and potential for algal biofuels production in a biorefinery context (2017) – also report launch webinar Feb 2017
- Assessment of large-scale demonstration plants (with Bioenergy 2020+) (2017)
- Comparison of LCA models (with Task 38 & contributing to interTask activities) (Phase 1 publications pending, peer review progressing)
- Report surveying advanced biofuels in advanced engines (with IEA AMF) (final revisions underway; publish internally in Q3 2018)
- Newsletters (3 publications annually with articles on biofuel production, consumption, policies, sustainability and LCAs in different regions)

Proposed program, 2019-2021

Cover all transport biofuels including conventional and advanced liquid biofuels, with an increased focus on advanced and especially advanced drop-in biofuels for long distance transport.

Address policy/legislative /regulatory and infrastructure compatibility concerns about expanding conventional and advanced (including drop-in) transport biofuels

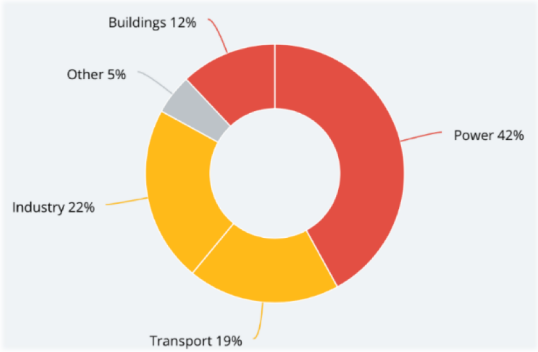


Facilitate knowledge transfer and information dissemination between IEA Bioenergy members and other transport biofuels stakeholders

Welcome to the Combustion TCP!

- Created in 1977 as the Technology Collaboration Program (TCP) on **"Energy Conservation and Emissions Reduction in Combustion"** to accelerate the development and deployment of combustion technologies with reduced fuel consumption and lower pollutant emissions

- Today, our collaborative tasks address specific **research questions from combustion fundamentals to technical applications** in internal combustion engines, furnaces & gas turbines, thus enabling efficiency gains and emission reductions in the
  - industry,
  - buildings,
  - transportation and
  - power generation sectors.



2017-2040 cumulative emissions reductions by sector (SDS vs. NPS, incl. indirect)
www.iea.org/tcep

Our trend analysis leads to these research & development objectives

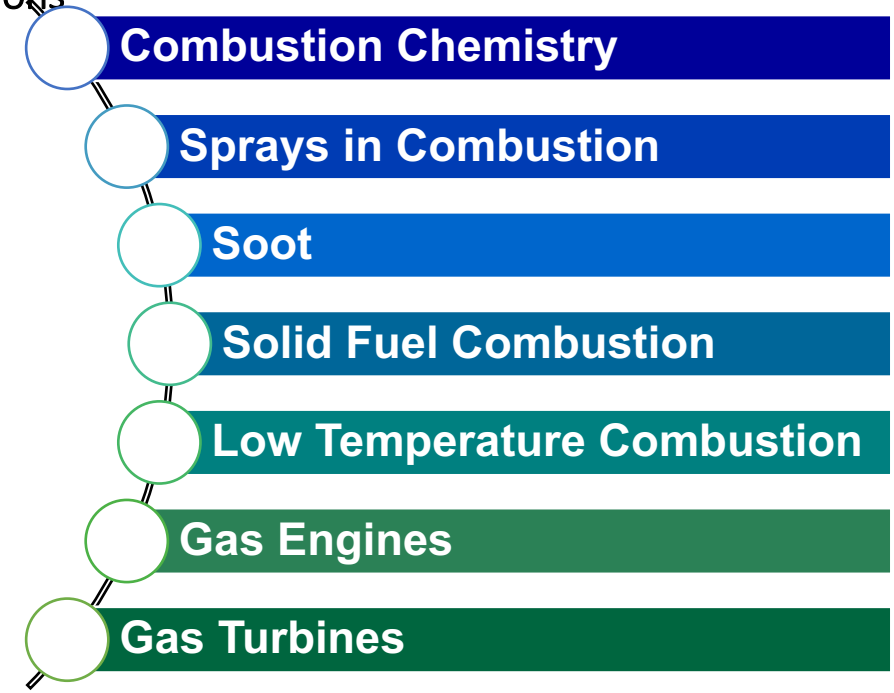
1) Accelerate the development of **fuel-efficient, cost-effective, low-greenhouse-gas combustion** technologies to protect the global environment and to conserve natural resources — OBJ 1

2) Minimize the emissions of harmful pollutants to protect local environments and minimize impacts on human health by developing **clean combustion systems** that are compatible with and complement exhaust aftertreatment devices. — OBJ 2

3) Enable a more reliable and secure energy system by adapting combustion technologies to promote **fuel flexibility** and optimal use of **renewable fuels** with unconventional properties — OBJ 3

4) Develop combustion technologies to optimize the use of **local, sustainable energy resources** to strengthen local economies and broaden energy options available to isolated communities — OBJ 4

Our research spans from combustion fundamentals to technical applications



Our collaborative tasks generate valuable insights

Science-based **computer design models** support the optimization of multiple combustion technologies for highest efficiency & lowest emissions

Sprays in Combustion Task

Low temperature combustion (LTC) processes can improve light- and heavy-duty vehicle fuel economy by 20-25% while maintaining ultra-low emissions.

LTC Task

Blending **bio-based octane boosters** into gasoline increases engine efficiency thus has a dual impact on GHG emissions from vehicles.

Combustion Chemistry Task

Understanding soot/**particulate formation** is key to preventing undesirable design trade-offs between efficiency and particle emissions.

Soot Task

Our collaborative tasks generate valuable insights

Solid fuel combustion technologies allow **local use of biomass**, reducing waste and providing climate-friendly energy to specialized industries as well as isolated communities.

Solid Fuel Task

Gas turbines will remain a critical component of the electric grid as they allow **"on demand" power generation** to compensate for fluctuating renewable energy sources.

Gas Turbines Task

The use of gas-hydrogen blends paves a path for early adoption of hydrogen & **reduced greenhouse gas emissions in the power sector**.

Gas Turbines Task

Gas engines with their unique fuel flexibility can make significant contributions to greenhouse gas reductions in both stationary power applications as well as transportation.

Gas Engines Task

IEA Hydrogen TCP Transport Overview for G20 Transport Task Group

Mary-Rose de Valladares, Paul Lucchese

September 2018

IEA Hydrogen TCP – Origins to Present

Created 6 October 1977

Membership – 20 countries, the EC, UNIDO, 4 Sponsors ***Pending - 1 country, 3 sponsors***

40 tasks approved to date – production is most frequent task topic

NR	NAME	13	14	15	16	17	18	19	20	21	22	23	STATUS
32	H2Based Energy Storage												current
34	BioH2 for Energy & Environment (Successor to Task 21)												completing
35	Renewable Hydrogen (Super Task)												completing
36	Life Cycle Sustainability Assessment (LCSA) (Successor Task 30)												completing
37	Safety (Successor to Task 31)												current
38	Power-to-Hydrogen and Hydrogen to X												current
39	Hydrogen in Marine Transport												current
40	Energy Storage and Conversion based on Hydrogen												approved
i	Analysis and modeling – a reference database (likely to become a "standing task")												in definition
ii	Market Deployment and Pathways to Scale												In definition
iii	Biological production & conversion of H2 for energy and chemicals (Successor Task 34)												proposed
iv	Hydrogen Export Supply Chains												proposed
v	Hydrogen Applications In Primary Sectors (mining, resources and agriculture)												proposed
vi	Successor tasks for renewable electrolysis, photoelectrochemical water-splitting (PEC), and solar thermochemical hydrogen production												proposed

i. IEA Hydrogen TCP – *Global Hub for Hydrogen R,D&D*

Vision – a hydrogen future based on a clean, sustainable energy supply of global proportions that plays a key role in all sectors of the economy

Mission – accelerate H2 implementation and utilization to optimize environmental protection, improve energy security and economic development

Overarching Objectives

- Communicate role and value of hydrogen as flexible energy carrier in future integrated multi-sector energy system
- Analysis – IEA & other
- Infrastructure
- Industry engagement

Strategic planning underway for 2020-2025

Collaborative R,D&D Portfolios
- Production
- Storage
- Integrated Systems
- Integrated Infrastructure

Analysis Portfolios
- Technical
- Market
- Political Decision-making

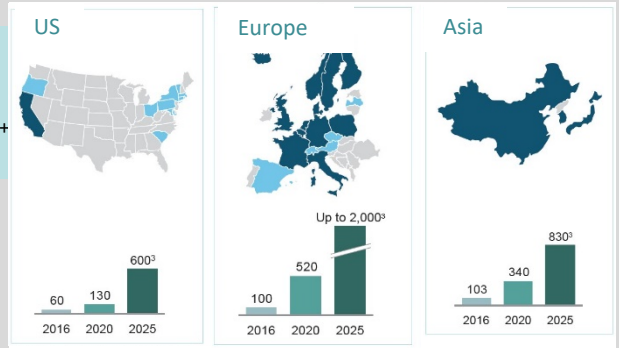
Awareness, Understanding & Assessment (AUA) Portfolios
- Information Dissemination
- Safety
- Outreach

IEA Hydrogen – Sustainable Transport Tasks

Recent

Task 28 HRS Infrastructure – viable network of fast-filling HRS can come from many station types. No single blueprint for HRS type. Different strategies for H2 Infrastructure. Government funding pivotal. Today 250+ HRS open to fleets and/or public around the world.

Infrastructure cost caveats - don't compare H2 HRS and Recharging point one for one: an HRS is equivalent of 600 slow charging point in term of service-km filled per hour (factor 20 for Quick charging point. At scale (million +) H2 infrastructure cheaper than any electric infrastructure

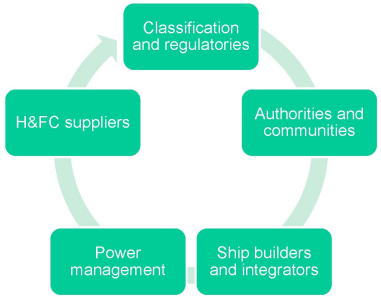


NEW! Task 39 Maritime

Contributing to healthy and sustainable oceans

Subtasks:

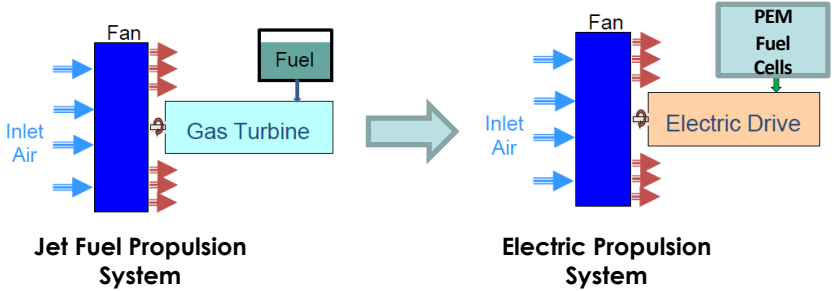
- Technology overview * New concepts * Safety & Regulations * Demonstration



IEA Hydrogen – Sustainable Transport Tasks *continued*

Task 37 – Safety is expanding FCEV focus to include emerging H2-based technologies

- Safe use of hydrogen in hybrid-electric and all-electric aircraft
- Hydrogen production in the international space stations (ISS)



Jet Fuel Propulsion System

Electric Propulsion System

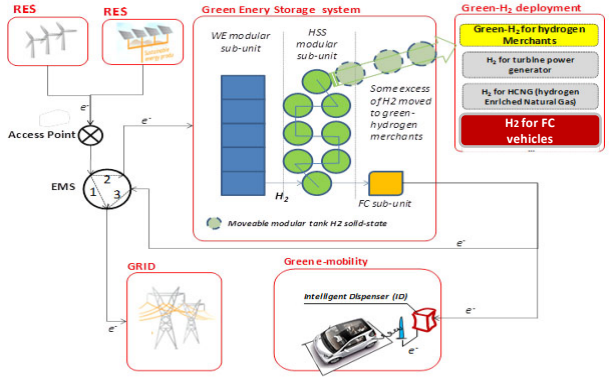
Task 38 - Power to Hydrogen and Hydrogen to X

from low-cost decarbonized electricity via electrolysis (on or off grid)

Objective: understand technical and economic pathways and existing legal frameworks for H2 as a key energy carrier/chemical intermediate

- H2 to X – Mobility, Industry, Stationary, Power (Mobility – H2 for fuel cells, biofuels, synthetic methane for transport)

Upcoming reports: literature review of Power to H2; modeling and macro impact



Sustainable H2 Transport Market potential – multiple applications including trucks, buses and trains!

Buses

UC Transit in Oakland, CA, USA - largest fleet in North America, with 12 fuel cell buses.

Foshan and Yunfu – $17 million order for 300 fuel cell buses.

European Union
Coordination a national Call for order in progress for a 1000 FC Buses

South Korea - planning to replace 27,000 CNG buses with FC buses by 2030.

Heavy Duty Trucks

Nikola Motor Company H2 powered **long range tractor trailer**

Logistics Vehicles

UPS - first hydrogen fuel cell electric class 6 delivery van. 17 vans in the U.S. by year end 2018.

Toyota a heavy duty drayage vehicle (class 8), **Amazon** buying $70 million of **fuel-cell forklifts.**

Light Rail Trains

In 2017, **Alstom** unveiled its **Coradia iLint**, which will **replace diesel trains** in the extensive, **un-electrified sections** of rail in Germany.

Airplanes

Hydrogen-powered Drone
Fuel cell technologies power drones varied applications from lightweight Hycopter to larger military based applications like the Boeing Insitu's ScanEagle drone.

HY4 Hydrogen Fuel Cell Electric Aircraft, World's first 4 seater H2 plane.

Maritime

90% of all trade is by ship. Maritime tourism is huge global industry.

The **Red and White Ferry Company** and **Sandia National Laboratory** have teamed up on a feasibility study for designing, building and operating a high-speed hydrogen fuel cell powered passenger ferry and refueling station.

Thank you from IEA Hydrogen
IEA Hydrogen: global hub for hydrogen R,D&D

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