Technology Collaboration Programme
by iea

Advancing the research, development and innovation of energy technologies

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TECHNOLOGY COLLABORATION PROGRAMME

OVERVIEW

The IEA global innovation network

- **38 autonomous expert groups, known collectively as the Technology Collaboration Programme and individually as collaborations or TCPs**
- **Thousands of experts from governments, academia and industry**
- **Entities participating from 55 countries**
- **All technology sectors**

Innovation is an essential underpinning of energy sector transitions worldwide. Given the growing complexity and interconnection of energy systems, co-operation and networking can increase effectiveness and maximise the impact of innovation efforts. Multilateral co-ordination can also facilitate greater confidence to align individual and collective action in terms of priorities, technology areas and desired goals for energy sector transition.

The **Technology Collaboration Programme (TCP)**, a multilateral mechanism established by the International Energy Agency (IEA) 45 years ago, was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of thousands of experts across government, academia and industry in 55 countries dedicated to advancing common research and the application of specific energy technologies.

Currently there are 38 individual technology collaborations working across several technology or sector categories: energy efficiency end-use technologies (buildings, transport, industry and electricity), renewable energy and hydrogen, fossil energies, fusion power, and cross-cutting issues. These technology collaborations are a critical, member-driven part of the IEA family, but they are functionally and legally autonomous from the IEA Secretariat. The breadth of the analytical expertise in the Technology Collaboration Programme is a unique asset in the global transition to a cleaner energy future.

TCP Universal Meetings

Since 2015 the IEA has hosted biennial TCP Universal Meetings to promote and increase the potential of this evolving asset. The 2019 event, under the direction of the IEA Committee on Energy Research and Technology (CERT) and the IEA Standing Group on Long-Term Co-operation (SLT), provided an opportunity for policy makers, TCP representatives, and leading strategic thinkers to discuss current trends to inform future priorities for energy research and innovation. A summary of the 2019 Universal Meeting by the Chairs of the CERT and SLT appears on the following page.

Fact Sheets

On the occasion of the 2019 TCP Universal Meeting, the IEA worked with each of the technology collaborations to prepare brief individual brochures providing an overview of the objectives, activities, accomplishments, and membership of each TCP. A key aspect of the of the success of the collaborations over the past decades has been their capacity to evolve and shift the focus of efforts to respond to new energy challenges over time, thereby remaining highly relevant vis-a-vis the transformation of energy technologies, systems, and policies worldwide. Readers are encouraged to visit the individual TCP websites for the latest updates and information about each collaboration.

Strengthening Energy Technology and Innovation

2019 IEA TCP Universal Meeting

CERT and SLT Chairs summary

Innovation is a critical driver of clean energy transitions. Through research, investments and collaboration, breakthroughs are happening in a wide variety of energy-technology fields, driving down costs, increasing efficiencies and boosting deployment in our societies. In order to maintain an environment that enables and accelerates energy innovation, policy frameworks must encourage the deployment and uptake of the latest technologies. At the same time, research and development programmes should focus on innovations that will accelerate the achievement of policy goals.

The SLT and CERT, as the main 'policy' respectively 'technology' bodies of the IEA, are well-placed to take advantage of the IEA's strengths in these areas to enhance coordination of energy policy and technology programmes. To this end, on 18 June 2019, we co-hosted and brought together both the policy and technology communities for the Third Universal Meeting of the IEA's Technology Collaboration Programme (TCP). This provided an important opportunity for key policymakers to engage representatives from the TCPs, which involve thousands of experts from governments and industries in 55 countries organised into 38 individual collaborations, each focused on a specific technology area.

At the Third Universal Meeting, participants discussed key trends related to energy technology, research and innovation, and explored ways to promote and increase collaboration between policymakers and technology experts. Participants considered the following steps that the IEA and its innovation network could take to improve the coordination of energy policy goals and technology programmes:

- Shift to a "system" approach that looks at how all energy technologies interact by enhancing collaboration across technologies;
- Bring in new perspectives by broadening the range of stakeholders from key emerging economies and from multilateral fora, such as Mission Innovation and Clean Energy Ministerial;
- Deepen cooperation between TCPs and the IEA, including by encouraging TCP input into technology-related IEA publications, and deeper participation from the IEA analysts in the TCPs' work;
- Utilise a "digital-first" strategy for TCP communications and better tailor key messages to the specific audiences, such as policy-makers and technology experts;
- Adopt a common brand strategy for the new TCP logo to enhance TCPs' online digital identities and to define the relationship to the IEA;
- Update and modernise the TCP legal mechanisms to simplify collaboration with external partners and streamline administrative processes and procedures; and
- Increase outreach and engagement with the private sector.

Recognising the importance of accelerated technology innovation, supported by sound energy policies, the CERT Chair and the SLT Chair convey appreciation for the work to enhance the Technology Collaboration Programme, and recommend that the IEA and TCPs further strengthen efforts to promote and foster its outputs and outreach.

Cross-cutting

- Clean Energy Education and Empowment (C3E TCP)
- Energy Technology Systems Analysis (ETSAP TCP)

TCP on Clean Energy Education and Empowerment (C3E)

The C3E TCP, originally created as a CEM initiative in 2010, aims to build a community of women leaders in the field of clean energy across diverse sectors; create a framework for co-operation and information sharing among participating countries; and share best practices for effective strategies to advance women in the clean energy field. These objectives will be pursued by collecting, integrating, synthesising and distributing information on promising practices and policies to engage women in clean energy careers and leadership positions.

Main areas of work

- Knowledge and data collection on women in clean energy
- C3E International Ambassadors program and mentorship network
- C3E Awards program – increase visibility of women in the energy sector
- Communications – to facilitate exchange of policies and activities that support women in clean energy

Cross-Cutting

Key accomplishments (2017-2018)

- Established as an IEA TCP in June 2017 by founding members Canada, Italy and Sweden
- Launch of Equalby30 campaign - a public commitment by public and private sector organizations to work towards equal pay, equal leadership and equal opportunities for women in the clean energy sector by 2030
- Publication of status report on gender equality in the energy sector

Women make up 52% of the world population, but only 30% of science researchers globally (Photo courtesy of the C3E TCP)

New projects (2019 – 2020)

- Focus on development of C3E Ambassador and mentorship network
- Revise status report on gender equality in the energy sector
- Launch of the inaugural C3E International Awards program (May 2019) and launch of the second nomination process
- Published Equal by 30 success stories brochure and work with 100+ signatories under Equal by 30 to develop concrete commitments and a reporting framework
- Establish a stand-alone C3E web page

Interested in collaboration with:

- Women's Global Network for Energy Trasnition (GWNET)
- Renewables Energy Policy Network for the 21st century (REN21)

Cross-Cutting

Membership

Why should your organisation become a member of the C3E TCP?

C3E TCP members participate in the dialogue to enhance collaboration and promote the participation of women in the clean energy transformation, at an international level. The activities of the C3E TCP can inform and complement national gender inititatives.

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C3E CEM website

TCP on Energy Technology Systems Analysis Programme (ETSAP TCP)

The ETSAP TCP, established in 1977, is among the longest running TCPs. Its mission is to support policy makers in improving the evidence base underpinning energy and environmental policy decisions. This is achieved through energy systems modelling tools and capability through a unique network of nearly 200 energy modelling teams from approximately seventy countries. The ETSAP TCP develops, improves and makes available the TIMES (and MARKAL) energy systems modelling platform. It also provides training to energy modellers to use this platform to build national, regional and global energy systems models. In addition, ETSAP supports policy makers in undertaking and interpreting energy technology assessments and scenario analysis to inform policy decisions.

Main areas of work

The current work programme of the ETSAP TCP focuses on understanding and facilitating the evolution of energy systems that contribute to the UN sustainable development goals. The focus is on:

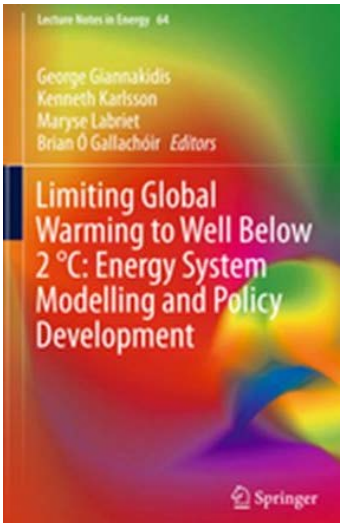
- Development and maintenance of tools and methodologies
- Supporting research and development activities to advance state-of-the-art analysis

Cross-Cutting

Key accomplishments (2018-2020)

ETSAP made progress in supporting policy making through analysis of technology pathways to achieve long-term amibitions for the transition to low carbon energy systems. ETSAP TCP highlights in this period were:

- ETSAP book *Limiting Global Warming to Well Below 2°C: Energy System Modelling and Policy Development* was published by Springer in 2018 – an energy system modelling perspective on the feasibility of the ambition of the Paris Agreement. The book provided new insights on national perspectives on how the Paris Agreement ambition might be met and its uniqueness in this regard was cited in the IPCC Report on Global Warming of 1.5°C.
- Significant advancement of methodologies to improve energy systems modelling and policy analysis, in better representation of variability of renewables, behavioural analysis, and interactions between the energy system and the economy.



Authored by ETSAP TCP members, this publication brings together techniaues and analyses that point the way toward a reduction in greenhouse gas emissions and a limit to global warming of less than 2°C.

ETSAP built substantial additional capacity worldwide in energy systems modelling, by training over 100 new energy systems modellers, organising about 10 workshops and conferences attended by 90 energy modellers and policy analysts on average.

- Introduced unit commitment, dispatch features and ancillary market modelling in TIMES modelling framework to improve modelling of variable renewable electricity.
- Extended the global ETSAP TIMES Integrated Assessment Model (ETSAP-TIAM) to assess trade-offs and co-benefits between climate change and air pollution policies.
- Collaborated with IRENA to compare TIMES and REMAP modelling frameworks.

Priorities and projects (2020 – 2021)

- Integrating sustainable development goals into energy systems models
- Further advance the development and improvement of tools, including modelling of variable renewables
- Improving the modelling of energy storage technologies in TIMES via collaboration with the TCP on Energy Storage
- Develop new approaches including interactions between society and the energy system
- Improved modelling of the interaction between the energy system and the economy

Multilateral collaborations

- The role of carbon capture and storage in integrated assessment models (with GHG TCP)
- Representation of hydrogen in energy system models (with Hydrogen TCP)
- The role of bioenergy in the energy system (with Bioenergy TCP)
- Supporting Clean Energy Ministerial Campaign on long term energy scenarios (in collaboration with IRENA) to promote wider adoption and improved use of long-term model-based energy scenarios
- Involved in inter-TCP collaboration on Integrated Energy Systems

Membership

- ENEL Foundation
- GE Global Research

Why should your organisation become a member of the ETSAP TCP?

The ETSAP TCP is a unique network of nearly 200 energy modelling teams in approximately seventy countries doing energy systems analysis to inform energy and climate policy decisions around the world.

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End use: Buildings

- Buildings and Communities (EBC TCP)
- District Heating and Cooling (DHC TCP)
- Energy Efficient End-Use Equipment (4E TCP)
- Energy Storage (ECES TCP)
- Heat Pumping Technologies (HPT TCP)

TCP on Energy in Buildings and Communities (EBC TCP)

The EBC TCP, created in 1977, carries out research and development efforts towards near-zero energy and carbon emissions in the built environment. Activities under the EBC TCP focus on the integration of energy-efficient and sustainable technologies into healthy buildings and communities.

Main areas of work

- Integrated planning and building design
- Building energy systems
- Building envelope
- Community-scale methods
- Real building energy use

Key activities and accomplishments (2017-2018)

- Deep energy retrofit of public buildings
- Ventilative cooling
- Occupant behaviour in buildings
- Energy strategies in communities
- Exergy performance of energy supply systems
- Performance of super-insulating materials
- Energy flexible buildings
- Thermal comfort in low energy buildings

ENERPOS, a net zero energy building in Reunion Island, a tropical climate. (Photo courtesy of Francois Garde)

Priorities and projects (2019 – 2020)

- Air Infiltration and Ventilation Center
- Indoor air quality in low energy residential buildings
- Building energy epidemiology: analysis of real building energy use
- Building energy performance assessment based on in-situ measurements
- Assessing environmental impacts caused by buildings
- Towards net zero energy communities
- Competition and living lab platform
- Cost-effective building renovation with energy efficiency and renewables
- Deep renovation of historic buildings towards low energy and emissions
- Integrated solutions for daylighting and electric lighting
- Energy impacts of supplementing ventilation with gas-phase air cleaning
- Occupant-Centric Building Design and Operation
- Resilient Cooling

Multilateral collaborations

- Deep renovation of historic buildings towards lowest possible energy demand and CO_2 emissions (with the TCP on Solar Heating and Cooling)
- Integrated solutions for daylight and electric lighting (with the TCP on Solar Heating and Cooling)
- Optimised performance of community energy supply systems with exergy principles (with TCPs on District Heating and Cooling and Solar Heating and Cooling)
- Joint Technical Day and meetings of the EBC TCP and SHC TCP Executive Committees in 2017 and 2018

End-Use: Buildings

Membership

Why should your organisation become a member of the EBC TCP?

The EBC TCP is an international energy research and innovation programme in the buildings and communities field. It enables collaborative R&D projects leading to high quality scientific reports and summary information for policy makers. EBC TCP guidance, methologies and tools have, over time, led to step-changes in support for practitioners, researchers and policy makers.

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TCP on District Heating and Cooling including Combined Heat and Power (DHC TCP)

The DHC TCP conducts research and development as well as policy analysis and international co-operation to increase the market penetration of district heating and cooling systems with low environmental impact.

Main areas of work

- DHC system technologies
- Transition to low DHC temperatures
- Strategies for increased DHC deployment

Key activities and accomplishments (2017-2019)

- Effects of loads on asset management of 4th Generation District Heating System
- Mapping the potential of waste heat from open data (MEMPHIS)
- Integrated cost-effective large-scale thermal energy storage for DHC
- Stepwise transition strategy for future district heating systems
- 16th International Symposium on District Heating and Cooling

Example of a heat exchanger in the CLIMESPACE "Canada" district cooling production centre in Paris. This unit uses river water from the Seine in the cooling production cycle. (Photo courtesy of John Dulac).

Priorities and projects (2020 – 2023)

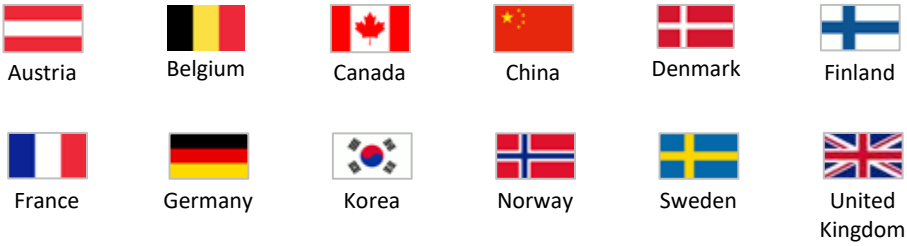
- Decarbonisation and temperature reduction in district heating networks
- Improving the business case of DHC including the integration of prosumers
- Digitalisation – systematic optimisation of DHC in the era of big data

Multilateral collaborations

- Co-operation with the TCP on Energy in Buildings and Communities (EBC TCP) on the Net Zero Emission Communities project
- Participation in the EBC TCP Working Groups on Cities and Communities
- Hybrid energy systems: a new task-shared annex in collaboration with ISGAN and other TCPs

End-use: Buildings

Membership



- International District Energy Association (IDEA)

Why should your organisation become a member of the DHC TCP?

District heating and cooling is an integrative and facilitative technology that is relevant to many policy areas and is key to a cost-effective transition towards a sustainable energy system. The DHC TCP works to raise awareness for district heating and cooling as a key energy efficiency and climate change mitigation strategy based on international research.

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TCP on Energy Efficient End-Use Equipment (4E TCP)

The aims of the 4E TCP are to promote energy efficiency as the key to ensuring safe, reliable, affordable and sustainable energy systems. As an international platform for collaboration between governments, the 4E TCP provides policy guidance to its members and other governments concerning energy using equipment and systems. The 4E TCP prioritises technologies and applications with significant energy consumption and energy saving potential within the residential, commercial and industrial sectors (not including transport). To meet its aims, the 4E TCP harnesses the expertise of governments, industry, experts and other TCPs for joint research related to the development and deployment of energy efficient equipment.

Main areas of work

- Electric Motor Systems (EMSA)
- Solid State Lighting (SSL)
- Electronic Devices and Networks (EDNA)
- Power Electronic Conversion Technology (PECTA)
- Monitoring, Verification and Enforcement (MV&E)

Key activities and accomplishments (2017-2018)

- Interlaboratory Comparison Programme for solid state lighting which includes 42 laboratories from 17 countries that support national and regional quality assurance programmes, vital to realising major energy savings.
- Round robin testing programme for motor system converters in co-operation with the International Electrotechnical Commission.

Priorities and projects (2019 – 2020)

- Product Energy Efficiency Trends (PEET) will undertake research into global energy efficiency trends for major appliances and equipment and potential for future technologies.
- Energy-using Systems: defining terminology and scope; and investigation of the most promising policy approaches to unlock the large savings potential.
- Network Zero Devices: mapping a technology and policy pathway towards "network zero" connected devices i.e. devices that do not rely on the grid for energy to remain connected to a communications network.

Utilising network connectivity to manage and automate services such as lighting, heating/cooling and washing in order to reduce energy consumption and operating costs (graphic courtesy of the 4E TCP).

Multilateral collaborations

- G20 Networked Devices: the 4E Electronic Devices and Networks Annex (EDNA) provides the Secretariat and collaborates with the Connected Devices Alliance (CDA), one of six initiatives under the G20 Energy Efficiency Action Plan.
- The 4E TCP works with international standradisation bodies to create high quality technical standards able to be referenced by national energy efficiency programmes.
- The 4E TCP provides input to many IEA publications, including the 'Energy Efficiency Market Report', 'Digitalization & Energy' and 'Tracking Clean Energy Progress'.
- The 4E TCP collaborates with the Super-efficient Equipment and Appliance Deployment (SEAD) initiative, the UN Environment Programme unitiative United for Efficiency (U4E) and other TCPs.

End-use: Buildings

Membership

Why should your organisation become a member of the 4E TCP?

Members of the 4E TCP gain access to information and expertise to support their own policy development processes for energy efficient end-use technologies. Through collaboration with countries, the 4E TCP is able to provide authoritative global assessments and push forward standardisation, capacity building and new policy agendas.

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TCP on Energy Storage (ECES TCP)

The mission of the ECES TCP is to facilitate research, development, implementation and integration of energy storage technologies to optimise the energy efficiency of all kinds of energy systems and enable the increasing use of renewable energy. Storage technologies are a central component in energy-efficient and sustainable energy systems. Energy storage is a cross-cutting issue that relies on expert knowledge of many disciplines. The ECES TCP fosters widespread experience, synergies and cross-disciplinary co-ordination of working plans and research goals.

Main areas of work

- Thermal storage (when the final energy to be stored is heat or cold)
- Electrical energy storage (such as pumped hydro, batteries, compressed air, etc.)
- Material storage systems (e.g. gas storage)
- Virtual storage (controllable loads which can be switched on or off depending on demand)

Key accomplishments (2017-2018)

- Improved knowledge on role and impact of energy storage in energy systems and models
- Pre-standardisation work on underground energy storage
- Compact thermal energy storage materials and components
- Joint activity with Mission Innovation
- Greater emphasis on policy aspects in project work

Energy storage for wind and solar energy. Source: ECES TCP

Transportable thermal energy storage. Source ECES TCP

Priorities and projects (2019 – 2020)

- Integration of energy storage in system analysis and use of Artifical Intelligence (AI)
- Affordable heating and cooling
- Flexible sector coupling
- Mid-size storage developments

Multilateral collaborations

- Affordable heating and cooling for buildings in the 21st century (joint project with the TCP on Heat Pumping Technologies (HPT TCP), linked to Mission Innovation Challenge #7 on Affordable Heating and Cooling)
- Material and component development for thermal energy storage (joint project with the TCP on Solar Heating and Cooling (SHC TCP))

Membership

- Dublin Institute of Technology
- University of Lleida

Why should your organisation become a member of the ECES TCP?

Improved energy storage solutions take an integrated view on the entire energy system,and the interaction between the use of electricity, heat, cooling and mobility - also referred to as "sector coupling". The ECES TCP enables high-level co-ordination in research, development, dissemination and market deployment of energy storage solutions, as well as co-ordination activities.

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TCP on Heat Pumping Technologies (HPT TCP)

The HPT TCP functions as an international framework of co-operation and knowledge exchange for the different stakeholders in the field of heat pumping technologies used for heating, cooling, air-conditioning and refrigeration in buildings, industries, thermal grids and other applications. The mission of the HPT TCP is to accelerate the transformation to an efficient, renewable, clean and secure energy sector in its member countries and beyond through collaboration research, demonstration and data collection and through enabling innovations and deployment in the area of heat pumping technologies.

Main areas of work

- Affordable and competitive heating and cooling technologies
- Flexible, sustainable and clean system solutions using heat pumps with other technologies
- Opportunities offered by developments in digitalisation and the Internet of Things
- New or special markets and applications for heat pumping technologies
- New, alternative or natural refrigerants with low global warming potential

Key activities and accomplishments (2017-2018)

- Heat pumps in smart grids
- Cold climate heat pumps
- Performance indicators for energy efficient supermarket buildings
- Organisation of the 12th Heat Pump Conference, 2017 (triennial event)

The role of heat pumping technologies in the future energy system (Source: Heat Pump Centre)

Priorities and projects (2019 – 2020)

- Heat pump systems with low global warming potential refrigerants
- Advanced cooling/refrigeration technologies development
- Long-term performance measurement of ground source heat pump systems serving commercial, institutional and multi-family buildings
- Reducing acoustic emissions and further increasing acceptance of heat pumps
- Heat pumps in multi-family buildings
- Design and integration of heat pumps for nearly zero energy buildings

Multilateral collaborations

- Comfort and Climate Box: Joint project with the TCP on Energy Storage and Mission Innovation Challenge on Affordable Heating and Cooling of Buildings (IC7)
- Strengthened collaboration with international partners including the European Heat Pump Association (EHPA), the International Institute of Refrigeration (IIR), and the European Commission

End-Use: Buildings

Membership

Why should your organisation become a member of the HPT TCP?

Heat pumping technologies play a vital role in achieving the ambitions for a secure, affordable, flexible, high-efficiency and low-carbon energy system for heating, cooling and refrigeration across multiple applications and contexts. The HPT TCP is the key worldwide player in this process by communicating and generating independent international collaboration.

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End use: Electricity

- High-Temperature Superconductivity (HTS TCP)
- Smart Grids (ISGAN TCP)
- User-Centred Energy Systems (USERS TCP)

TCP on High Temperature Superconductivity (HTS TCP)

The mission of the HTS TCP is twofold: to evaluate the status of and assess the prospects for the electric power sector's use of HTS within the developed and developing world; and to disseminate the findings to decision makers in government, the private sector, and the research and development community. The HTS TCP provides evidence from socio-technical research on energy use to policy makers to support clean energy transitions. Through its work the HTS TCP provides evidence on the design, social acceptance and usability of clean energy technologies in the area of high temperature superconductivity.

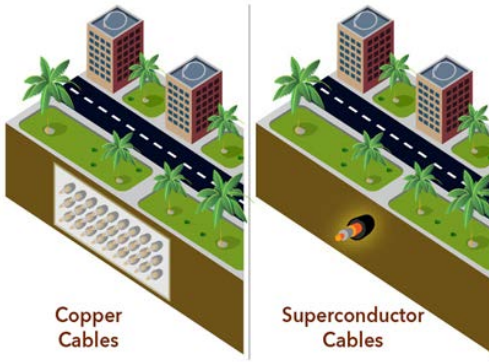
Main areas of work

- Roadmap documents examining current technology status and future direction
- Special session workshops highlighting technology progress and challenges
- Development of web-based technologies to highlight technology progress
- Development of policy and technical documents to highlight technology progress

Key activities and accomplishments (2017-2019)

Contribution to international events:

- 2019 workshop on HTS activities around the world (Switzerland)
- 2018 Applied Superconductivity Conference – presentations on HTS power applications at plenary and special sessions (United States)
- 2018 workshop highlighting HTS activities in the United States (United States)
- 2017 International workshop on HTS cables (Japan)



Copper vs superconductor cables. Source: HTS TCP

Work is underway to evaluate the possibility to replace large conventional wind generators with HTS-based devices. Courtesy o EcoSwing.

Priorities and projects (2019 – 2020)

- HTS application benefits analysis from energy efficiency, CO_2, cost savings, resiliency, life-cycle assessment, circular economy
- "World Projects at a Glance" interactive map – new projects
- EUCAS 2019: special session on applied HTS

Multilateral collaborations

- Collaboration with the TCP on Smart Grids (ISGAN TCP)
- Engagement with the Applied Superconductivity Conference 2018 planning committee
- Liaison with the International Symposium on Superconductivity organising committee for participation in a special session in 2019
- Interested in collaboration with other TCPs where HTS-based equipment could be an option for integration into their systems

End-Use: Electricity

Membership

- Columbus Superconductors SpA

Why should your organisation become a member of the HTS TCP?

The HTS TCP uses its broad network of public and private stakeholders to advance applied superconductivity so that it is used in innovative electric power devices that will significantly improve the generation, transmission, distribution, storage and final use of electricity.

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TCP on Smart Grids (ISGAN TCP)

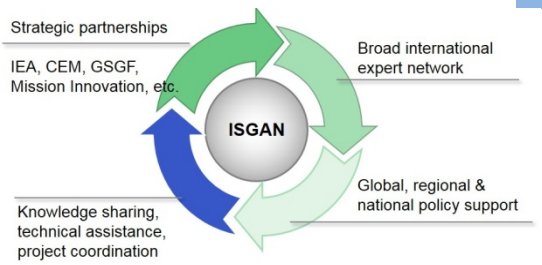
The ISGAN TCP is a strategic platform to support high-level government attention and action for the accelerated development and deployment of smarter, cleaner electricity grids around the world. Operating as both an initiative of the Clean Energy Ministerial, and as a TCP, the ISGAN TCP provides an important channel for communication of experience, trends, lessons learned, and visions in support of clean energy objectives as well as new flexible and resilient solutions for smart grids.

Main areas of work

- Smart Grid Case Studies
- Cost-Benefit Analyses
- Synthesis of Insights for Decision Makers
- Smart Grid International Research Facility Network (SIRFN)
- Transmission and Distribution Power Systems
- Smart Grids Transitions
- ISGAN Smart Grids Virtual Academy

Key accomplishments (2017-2018)

- Knowledge Transfer Projects (KTPs) on public support, Regulatory Sandboxes and KTP projects for Mexico and India
- Development of a web-based software tool for cost-benefit analysis and case studies
- Case studies on experimental (regulatory) sandboxes, market design, social costs and benefits, future power systems, TSO-DSO interaction, energy storage systems



Graphic courtesy of ISGAN TCP

Graphic courtesy of ISGAN TCP

Priorities and projects (2019 – 2020)

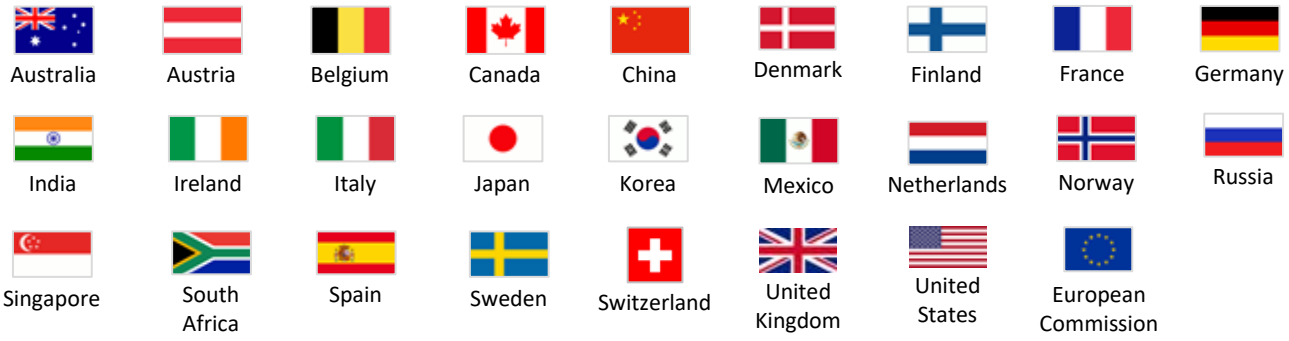
- Knowledge Transfer Projects (KTPs)
- ISGAN Award of Excellence
- Public workshops
- Strengthening outreach with other TCPs and strengthening or establishing new strategic partnerships
- Further developing methods for knowledge sharing (e.g. KTP workshops, case-books, etc.)

Multilateral collaborations

- Letter of Intent for co-operation with Mission Innovation Challenge #1 on Smart Grids
- Joint organisation of the InnoGrid 2019 conference with ENTSO-E
- Policy support and briefs at CEM events; co-ordination with other CEM initiatives
- Collaboration on power system related research with the IEA, the Working Party on Energy End-Use Technologies, and other TCPs
- Memorandum of Understanding with Global Smart Grid Federation and member organisations

End-Use: Electricity

Membership



Why should your organisation become a member of the ISGAN TCP?

ISGAN provides a strategic platform for high-level government attention and action to advance the development and deployment of smarter, cleaner, and more flexible electricity systems around the world.

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TCP on User-Centred Energy Systems (Users TCP)

The TCP's mission is to provide evidence from socio-technical research on the design, social acceptance and usability of clean energy technologies to inform policy making for clean, efficient and secure energy transitions. Decarbonisation, decentralisation and digitalisation are embedding energy technologies in the heart of our communities. Communities' response to these changes and use of energy technologies will determine the success of our energy systems. Poorly designed energy policies, and technologies that do not satisfy users' needs, lead to 'performance gaps' that are both energy and economically inefficient. User-centred energy systems are therefore critical for delivering socially and politically acceptable energy transitions.

Main areas of work

- Enabling end-users to contribute to and benefit from energy systems
- Regulatory conditions for successful integration of end-use resources
- Business models for energy service delivery
- The influence of social-structural and behavioural factors on energy use
- Opportunities to influence behaviour to support clean energy transitions
- Supporting the TCP community to integrate user perspectives in energy research

Key activities and accomplishments (2017-2018)

- Several award-winning behaviour change pilot programmes
- "Fit-to-Serve" tool for entrepreneurs to move towards energy service delivery
- Project-level accounting framework to attribute multiple benefits of building renovations
- Dissemination of best practice through the User-Centred Energy Academy (previously DSMU)

The Users TCP Academy builds on 20 years of experience of the Users TCP. Users TCP Academy provides access to the knowledge developed in the agreement in a structured way. The Users TCP Academy is active through monthly webinars (www.userstcp.org/academy).

Priorities and projects (2019 – 2020)

- Relaunching of the TCP with a new focus on user-centred energy systems
- Energy services supporting business models and systems
- Global Observatory on Community Self-consumption and peer-to-peer trading
- Social license to automate demand-side management
- Hard to reach energy users
- Harnessing behavioural insights for energy efficiency policy
- Best practices in designing and implementing energy efficiency obligations 2.0
- Building on the success of the Users TCP Academy

Multilateral collaborations

- In 2017-2018 the Users TCP contributed content to two high-level IEA publications and presented its analysis at a variety of IEA events, including a strategic discussion with the Mission Innovation Challenge on Smart Grids (IC1), and a G20 workshop on behaviour change.
- Collaboration with end-use TCPs on socio-technical projects which will enable inter-disciplinary policy-relevant research

End-Use: Electricity

Membership


Australia


Austria


Belgium


Canada


Finland


India


Ireland


Italy


Korea


Netherlands


New Zealand


Norway


Spain


Sweden


Switzerland


United Kingdom


United States

- Efficiency One
- European Copper Institute
- Regulatory Assistance Project

Why should your organisation become a member of the Users TCP?

With end-users becoming central to energy transitions globally, the Users TCP is unique, as the only TCP focussing on the vital role of people in energy technology systems. Join us to be part of a collaborative research network focussed on designing technologies, policies, and business models fit for today's user-centred energy systems.

TCP Chair: David Shipworth, United Kingdom (d.shipworth@ucl.ac.uk)
TCP primary contact: Samuel Thomas (samueldavidlloydthomas@hotmail.com)
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www.userstcp.org

End use: Industry

- Industrial Technologies and Systems (IETS TCP)

TCP on Industrial Energy-Related Technologies and Systems (IETS TCP)

The IETS TCP focuses on energy use in a broad range of industry sectors with significant potential for emissions and cost savings. The IETS TCP work programme ranges from aspects relating to development of processes and energy technologies, to overall system analysis and energy efficiency in industry sectors.

Main areas of work

- Analysis relating to scientific research, development, demonstration and deployment
- Technology and systems foresighting
- Technology and systems assessment of policies and consequence
- Information dissemination

Key activities and accomplishments (2017-2018)

- Industry-based biorefineries
- Membrane filtration for energy-efficient separation of lignocellulosic biomass components
- Industrial excess heat recovery – technologies and applications
- The role of process integration for greenhouse gas mitigation in industry
- The role of industrial biorefineries in a low carbon economy

Reports are available for all key activities

Industry is a key sector for greenhouse gas (GHG) emissions mitigation. The IETS TCP aims to support collaboration to reduce GHG emissions from industrial systems. Photo: Adobe Stock

Priorities and projects (2019 – 2020)

- Digitalization, artificial intelligence and related technologies for energy efficiency and GHG emissions reduction in industry
- Electrification in industry
- Decision support tools and ex-ante research for evaluating bioeconomy transformation strategies
- International expert workshop on deep decarbonisation in industry, Vienna, 9-11 October 2019

Multilateral collaborations

- Collaboration with other TCPs
  - Bioenergy TCP (joint workshops and planned project co-operation)
  - TCP on Heat Pumping Technologies (joint project)
  - TCP on Greenhouse Gas R&D (joint workshop)
  - The IETS TCP is open to closer collaboration with other TCPs and the European Commission

End-Use: Industry

Membership

- Central Research Institute of Electric Power Industry (CRIEPI)
- Ricerca sul Sistema Energetico (RSE)
- EURAC Research
- Limerick Institute of Technology
- Universidad de la Costa

Why should your organisation become a member of the IETS TCP?

Industrial systems must drastically reduce their GHG emissions in order to meet global emissions reduction target. Through its activities of knowledge sharing and dissemination among public and private sector, the IETS TCP increases awareness of technology and energy efficiency in industry, contributes to synergies between different systems and technologies, and enhances international cooperation related to sustainable development.

TCP Chair: Thore Berntsson, Sweden (thore.berntsson@chalmers.se)
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End use: Transport

- Advanced Fuel Cells (AFC TCP)
- Advanced Materials for Transportation (AMT TCP)
- Advanced Motor Fuels (AMF TCP)
- Clean and Efficient Combustion (Combustion TCP)
- Hybrid and Electric Vehicles (HEV TCP)

TCP on Advanced Fuel Cells (AFC TCP)

Created in 1990, the AFC TCP seeks to make a significant contribution to address the opportunities and barriers to fuel cell commercialisation by fostering the development of fuel cell technologies and their application on an international basis, and conveying key messages to policy makers and the wider community as appropriate.

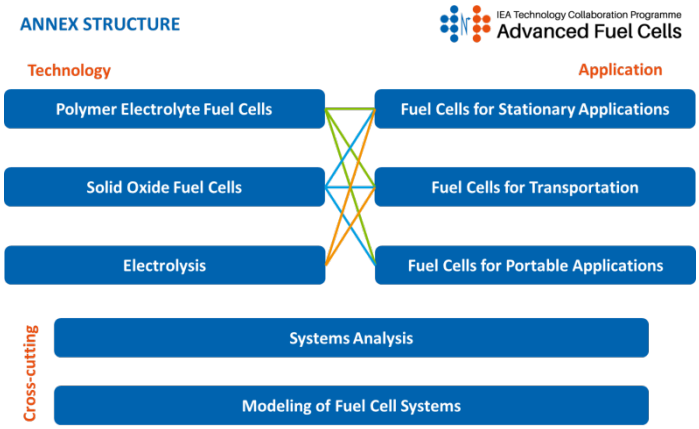
Main areas of work

- Modelling: validated open-source fuel cell models and degradation models
- Technology-based projects: electrolysis, SOFC and PEFC
- Stationary applications: analysis of real conditions and future possibilities; renewable fuels
- Fuel cell electric vehicles, light- and heavy-duty vehicles
- Systems analysis

End-Use: Transport

Key accomplishments (2017-2018)

- Performance enhancement of polymer electrolyte membrane electrolysers through iridium-coated titanium porous transport layers
- New projects on heavy-duty applications and alkaline fuel cells
- Survey on the deployment of fuel cell electric vehicles and hydrogen refuelling stations with future perspectives in 2018 and 2019 implemented
- First topical meeting on electrocatalysis on fuel cells



Annex structure of the AFC TCP (Source: AFC TCP)

Priorities and projects (2019 – 2020)

- Topical meeting on hydrogen refuelling stations (September 2019)
- Heavy duty applications
- Alkaline fuel cells
- Fuel cell modelling
- High-temperature electrolysis activities
- Analysis for the use of stationary fuel cells for combined heat and power (CHP)
- Seeking new applications where fuel cells can play an important role

End-Use: Transport

Multilateral collaborations

- Collaboration with the IEA on the annual *Global EV Outlook*
- The AFC TCP is open to all collaborative efforts including hydrogen and fuel cells in the future energy system

Membership

- VTT Technical Research Centre of Finland

Why should your organisation become a member of the AFC TCP?

By supporting the development of fuel cell technology, the AFC TCP can make a major contribution to environmental issues as fuel cells are capable of operating with much lower emissions of carbon dioxide, nitrogen oxides, particulate matter and noise than alternative combustion-based systems. Fuel cells also enable a fuel switch to renewable biofuels, as well as hydrogen, and therefore are a key instrument for achieving the Paris agreement targets.

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www.ieafuelcell.com

TCP on
Advanced Materials for Transportation (AMT TCP)

Created in 1979, the AMT TCP focuses on materials critical to fuel efficiency improvement for current and future transportation technologies. The AMT TCP conducts co-operative research activities on friction reduction, waste heat recovery, and lightweighting of vehicles. The TCP work programme includes the development of standard test methods, testing, demonstration and design guidelines.

Main areas of work

Friction reduction in vehicles

Thermoelectric materials

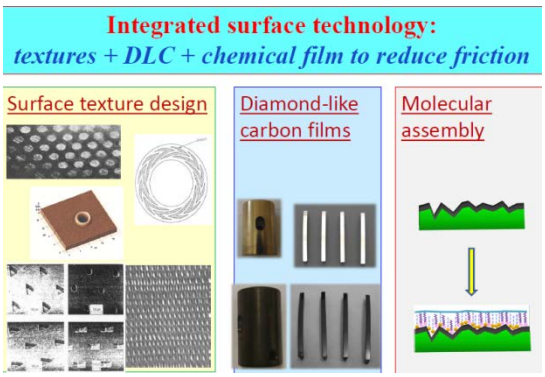
Model based coatings

Multi-material vehicle lightweight structures, materials joining technology

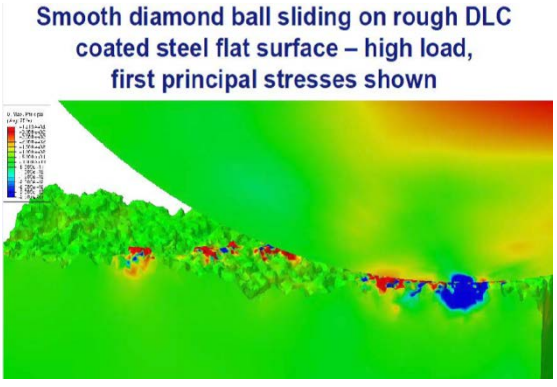
Automotive glazing, weight reduction, materials substitutions

Key accomplishments (2017-2018)

- Achieved 2.4% fuel economy gains via ultra-low viscosity lubricant
- Completed thermoelectric module efficiency round robin testing to establish a new measurement standard
- Established new project on automotive glazing
- Feasibility of model-based materials development



Integrated surface technology describing the textures, diamond-like carbon (DLC) thin films and the organic thin films on top of the DLC film (Source: Professor Stephen Hsu)



A sphere contacting DLC coating showing substrate damage. (Source: Dr. Hakala Timo, VTT)

Priorities and projects (2019 – 2020)

- Complete engine testing of surface friction materials technology
- Further thermoelectric module efficiency round robin testing

Multilateral collaborations

- The AMT TCP is a task-shared agreement. Joint activities are initiated and carried out in areas of common interest to the members, and to the related material research expert network of 34 research institutes and universities under the AMT TCP. The AMT TCP stands ready to explore opportunities of collaboration with other TCPs.

End-Use: Transport

Membership


Australia


Canada


China


Finland


Germany


Israel


Korea


United Kingdom


United States

Why should your organisation become a member of the AMT TCP?

The fuel economy of internal combustion engine technologies can significantly contribute to near- and medium-term carbon emission reduction goals. The AMT TCP provides a forum for experts to exchange information on improving fuel economy at regional and local level as well as to address global innovation priorities for material technologies.

TCP Chair: Jerry Gibbs, United States (jerry.gibbs@ee.doe.gov)
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www.tcp-ia-amt.org

TCP on Advanced Motor Fuels (AMF TCP)

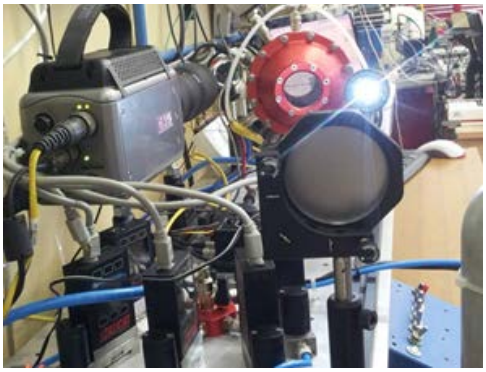
The mission of the AMF TCP is to advance the understanding and appreciation of the potential of advanced motor fuels towards transport sustainability. This is achieved by providing sound information and technology assessments designed to facilitate informed and science-based decisions regarding advanced motor fuels at all levels of decision-making.

Main areas of work

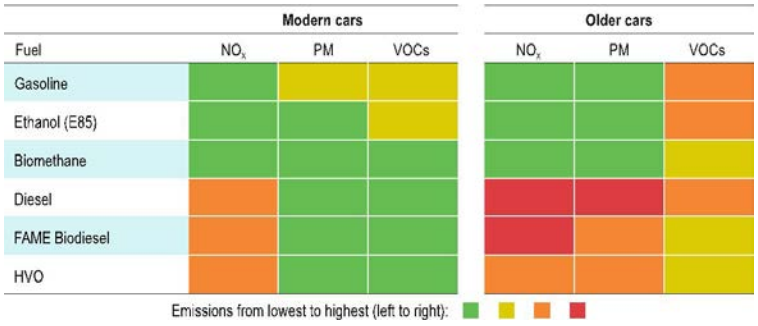
- Assessment of the applicability of new fuels
- Evaluation of fuel efficiency, regulated and unregulated pollutant emissions from specific fuel/engine/vehicle combinations
- Assessment of best matching fuel/vehicle technologies for specific applications

Key activities and accomplishments (2017-2018)

- Driving cycle for buses adopted by the Chilean government in Santiago
- Fuel efficiency and tailpipe emissions results contributed to international emissions model
- Using natural gas and biogas and their derivatives in road transport
- AMF fuels/vehicles evaluated and benchmarked against others



Laser measurement equipment. Source: AMF Report "Fuels for Efficiency". © Technion, Israel Institute of Technology



The positive effect of biofuels on vehicle exhaust emissions is more pronounced for older cars than for modern cars, Source and copyright: AMF Special Report "Air quality implications of transport biofuel consumption".

Priorities and projects (2019 – 2020)

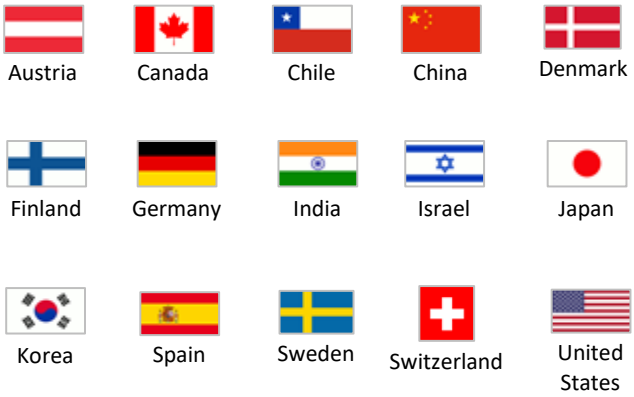
- Lessons learned from Alternative Fuels Experience
- The contribution of Advanced Renewable Transport Fuels to Transport Decarbonisation in 2030 and beyond
- Heavy duty vehicle evaluation
- Methanol as motor fuel
- Real driving emissions & fuel consumption
- GDI engines and alcohol fuels
- Sustainable bus systems – phase 2
- Methane emission control

Multilateral collaborations

- Joint project with the Bioenergy TCP; co-operation with TCPs on Combustion and Hybrid and Electric Vehicles
- Interests and priorities for further collaboration include:
  - Efficiency and emissions (Combustion TCP)
  - Emerging fuels (Hydrogen TCP)
  - Fuels for HEVs and FCVs: (HEV and AFC TCPs)
  - Lessons learned and deployment of new technologies (several TCPs)
  - Systems analysis (several TCPs)

End-Use: Transport

Membership



Why should your organisation become a member of the AMF TCP?

Advanced motor fuels, applicable to all modes of transport, significantly contribute to a sustainable society around the globe. The AMF TCP provides an international platform for co-operation and exchange of best practices, enabling stakeholders from different continents to pool and leverage knowledge and research capabiliites in the field of advanced and sustainable transport fuels.

TCP Chair: Magnus Lindgren, Sweden (magnus.lindgren@trafikverket.se)
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www.iea-amf.org

TCP on Clean and Efficient Combustion (Combustion TCP)

The Combustion TCP provides a forum for interdisciplinary exchange and enables international collaborative research to advance the understanding of combustion processes to:

- Accelerate the development of combustion technologies that demonstrate reduced fuel consumption and have lower pollutant emissions in transportation, power generation, industry and buildings
- Generate, compile and disseminate independent information, expertise and knowledge related to combustion for the research community, industry, policy makers and society.

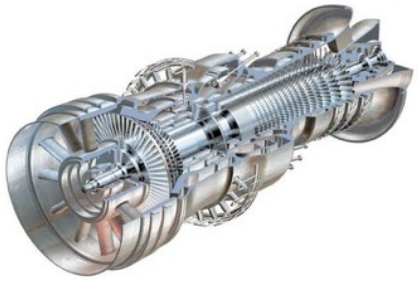
Main areas of work

- Low temperature combustion engines
- Gas engines
- Gas turbines
- Solid fuels
- Fundamental research on fuel sprays, soot formation and combustion chemistry

End-Use: transport

Key activities and accomplishments (2017-2018)

- Fundamental combustion science advancements documented in peer-reviewed journals;
- Advanced computer-aided design capabilities to enable clean combustor design;
- Demonstration of low temperature combustion showing potential for 20-25% higher fuel efficiency with lower CO_2 and pollutant emissions than current fleet averages;
- Developed pathways to substantial CO_2 savings and ultra-low pollutant emissions from high fuel efficiency, lean-burn natural gas engines;
- Established gas turbine tolerance to H_2 addition in the fuel stream, promoting the transition to an H_2 energy economy.



Gas turbine burning renewable, low-carbon fuels will help us meet peak power demands for decades to come (image courtesy of the Combustion TCP)

Priorities and projects (2019 – 2020)

- Synthesising the science base needed to optimise combustion technologies for use of renewable fuels and minimal environmental impacts;
- Promoting sustainable, economically accessible energy solutions;
- NEW – systems analysis: placing the impact of advanced combustion and renewable fuels in the broader context of other low-carbon solutions;
- NEW – exhaust aftertreatment: examining how closer collaboration between aftertreatment and combustion engineers can alleviate design constraints on both sides.

Multilateral collaborations

- Current collaboration on heavy duty vehicle performance evaluation with the TCP on Advanced Motor Fuels (AMF TCP)
- Interest in further collaboration with the AMF TCP and Bioenergy TCP, as well as in transportation energy systems analysis with the Energy Technology Systems Analysis Programme (ETSAP TCP) and Hybrid and Electric Vehicles TCPs

End-use: transport

Membership

Why should your organisation become a member of the Combustion TCP?

Clean, efficient, cost-effective combustion technologies are key elements of a reliable and sustainable, low-carbon energy system. The Combustion TCP provides a forum for exchange and collaborative research to advance the understanding of combustion processes, and to generate independent information, expertise and knowledge to the wider research community, industry, policy makers, and society.

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www.ieacombustion.com

TCP on Hybrid and Electric Vehicles (HEV TCP)

In operation since 1993, the HEV TCP provides a forum for global co-operation on the development and deployment of electric vehicles. It supplies objective information to support decision making, functions as a facilitator for international collaboration in pre-competitive research and demonstration projects, fosters international exchange of information, and it can promote projects and programmes for research, development, demonstration and deployment.

Main areas of work

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

Key accomplishments (2017-2018)

- Electrification of transport logistic vehicles (final report)
- Impact of different drivetrain options, fuels and vehicle use on GHG emissions of cars (final report)
- V2X Roadmap, based on the work of 12 participating countries in 7 workshops, identifies challenges and actions needed for better electric vehicle integration in the grid

The largest battery driven ferry. (Photo courtesy of HH-ferries/Scandlines)

Dutch truck manufacturing company DAF partnered VDL Groep to build a new all-electric truck. The CF electric truck has a 170 kWh battery pack and a 210 kW electric motor. DAF was among the first manufacturers to introduce a hybrid electric distribution truck in Europe and has continued to develop hybrid and electric powertrains. As cities announce their intention to require zero emissions and ultra-low noise, electric trucks provide an optimal solution. (Photo courtesy of DAF Trucks N.V.)

Priorities and projects (2019 – 2020)

- EV deployment strategies and EV policy
- EV infrastructure
- EV batteries and electric drive technologies
- Niche markets and new markets

Multilateral collaborations

- Collaboration with the Clean Energy Ministerial Electric Vehicle Initiative (EVI)
- Collaboration with the TCP on Energy in Buildings and Communities (EBC TCP) through the Working Group on Cities and Communities

End-Use: Transport

Membership

- King Abdullah Petroleum Studies and Research Center (KAPSARC)

Why should your organisation become a member of the HEV TCP?

With more than six million electric vehicles on the road today, electric mobility contributes significant energy savings, CO_2 emissions reductions, and energy security. The HEV TCP facilitates international collaboration projects and activities of research, development, demonstration and deployment with shared resources from countries worldwide.

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www.ieahev.org

Fossil energy

- Clean Coal Centre (CCC TCP)
- Enhanced Oil Recovery (EOR TCP)
- Fluidized Bed Conversion (FBC TCP)
- Gas and Oil (GOTCP)
- Greenhouse Gas R&D (GHG TCP)

Clean Coal Centre TCP (CCC TCP)

The CCC TCP provides independent information and analysis on all coal related trends and all aspects of coal production, transport, processing and utilisation within the rationale for balancing security of supply, affordability and environmental issues. Topics include efficiency improvements, lowering greenhouse gas and non-greenhouse gas emissions, reducing water stress, ensuring poverty alleviation through universal access to robust and reliable electricity, together with other sustainability and socially led goals.

Main areas of work

- Reports and reviews on technological developments for the cleaner use of coal, and on relevant markets and policies
- Extensive outreach activities, particularly in developing and industrialising economies
- Facilitation of research and development
- Support to industry professionals through workshops and conferences

Key activities and accomplishments (2017-2018)

- Detailed analyses of developments in the cleaner use of coal (21 studies and accompanying webinars)
- Organisation of numerous international events
- Extensive outreach with UNECE and UNEP, participation in the negotiation for the Minamata Convention
- Specialised assistance to members

Steam turbines at Waigaoqiao, Shanghai. (Photo courtesy of the CCC TCP)

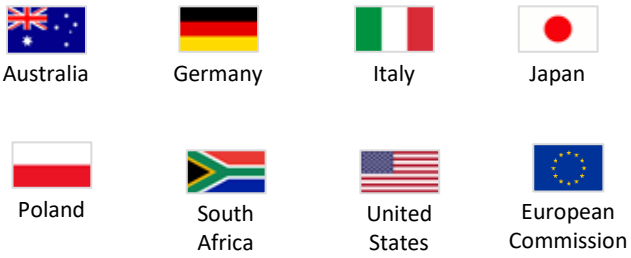
Priorities and projects (2019 – 2020)

- Publication of 12 reports and webinars on all subjects related to coal, as selected by the membership
- Increased collaboration with other multilateral organisations to facilitate the use of cleaner coal in emerging economies
- Organisation of the biennial Clean Coal Technologies Conference and other international events
- Support members' requests for assistance, analysis and information
- Develop a section of the website in Chinese Mandarin language

Multilateral collaborations

- Ongoing collaboration with the United Nations Economic Commission for Europe (UNECE), United Nations Environment Programme (UNEP), the Asian Development Bank, United States Department of State, Euracoal
- Interest in collaborating with other organisations in the emerging economies of Asia and Africa

Membership



• Anglo American (South Africa) • Banpu Public Company Limited (Thailand)
• Bharat Heavy Electricals Ltd (India) • Beijing Research Institute of Coal Chemistry (China)
• Dubai Electricity and Water Authority (UAE) • Electric Power Planning and Engineering Institute (China)
• Greenbank (United Kingdom) • Siberian Coal Energy Company (Russia)

Why should your organisation become a member of the CCC TCP?

To contribute to a wider understanding of the role of coal now and in a low-carbon future and to participate in progress towards making it a cleaner global source of reliable, affordable energy, compatible with the UN Sustainable Development Goals. To have access to independent analysis and information on all aspects of coal production, transport and utilisation, and to benefit from high-level international networking.

TCP Chair: Scott Smouse, United States (scott.smouse@hq.doe.gov)
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IEA contact: Raimund Malischek (raimund.malischek@iea.org)

www.iea-coal.org

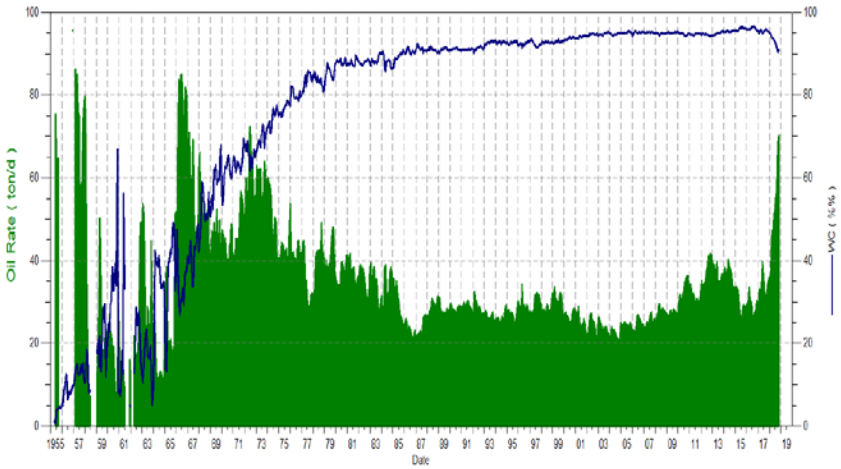
TCP on Enhanced Oil Recovery (EOR TCP)

Created in 1979, the EOR TCP evaluates and disseminates the results of research and development of enhanced oil recovery (EOR). Its primary focus is on improving the economics of EOR, increasing the recovery of oil originally in place, and extending reservoir economic life. The activities of the EOR TCP mainly cover information exchange on independent research activities carried out by the participating countries, the results of which are disseminated through annual Executive Committee meetings, two-day workshops and one-day symposia.

Main areas of work

The work programme is largely one of basic research, laboratory investigations and field testing or implementation in areas of mutual interest, divided into the following tasks:

- Fluids and interfaces
- Surfactants and polymers
- Development of gas flooding techniques
- Thermal recovery
- Dynamic reservoir characterisation
- Emerging technologies



EOR might lead to substantial increases in oil production and recoverable volumes of oil. In the case shown here, polymer EOR resulted in rejuvenation of the area of the field.

Key activities and accomplishments (2017-2018)

- 39th Annual Workshop and Symposium, Denmark – developing cost-efficient technologies to meet increasing world oil demand
- 38th Annual Workshop and Symposium, Mexico – EOR in fractured reservoirs

Priorities and projects (2019-2020)

- 40th Annual Workshop and Symposium, Colombia on Innovative EOR Technologies

Multilateral collaborations

- Interested in collaboration with Argentina, Ecuador and Malaysia, all of whom have substantial activities in EOR

Fossil Fuels

Membership

Why should your organisation become a member of the EOR TCP?

The EOR TCP plays an important role in fostering international collaboration. Each member country obtains access to a large pool of knowledge and experience in all aspects of EOR, from fundamental research to field implementation. Results of research and field trials are shared and knowledge gaps can be identified. There is also strong participation from universities, research institutes and industry.

TCP Chair and primary contact: Torsten Clemens, Austria (Torsten.clemens@omv.com)
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http://iea-eor.ptrc.ca/

TCP on Fluidized Bed Conversion (FBC TCP)

The FBC TCP provides a framework for international collaboration on energy technology development and deployment of the fluidized bed conversion of solid fuels applied to clean energy. The main activity of the FBC TCP is technical exchange during meetings and workshops. Participants carry out research on operational issues in support of commercial fluidized bed conversion activities and share results. Fluidized bed conversion offers several advantages over pulverized fuel combustion, notably low emissions and the ability to burn a wide range of fuels including waste and biomass.

Main areas of work

- Co-firing and ash problems
- Energy crops and fluidized bed conversion of biomass and waste
- Fluidized bed design aspects
- Mathematical, three-dimensional modelling

Key activities and accomplishments (2017-2018)

- Developments in fluidized bed conversion during 2011-2016 (report)
- Gasification of biomass and waste (joint workshop with Bioenergy TCP)
- Fluidized bed conversion of low-quality coal and waste fuels (technical meeting)
- Long-term FBC operational experience (technical meeting)

The new 4x550 MWe FBC combustor in Samcheok, South Korea (courtesy of KEPCO, 2019)

Priorities and projects (2019 – 2020)

- CO_2 reduction applications (oxyfuel, looping cycles)
- Boiler, cyclone and heat exchanger design aspects
- Impact on operation of renewables in the energy systems
- Co-firing of renewable and fossil fuels
- Sewage sludge conversion
- Ash-related problems with biomass and waste

Multilateral collaborations

- Joint workshop in 2017 with the Bioenergy TCP on the gasification of biomass and waste, with another one under consideration for 2020
- Interest in exploring membership with Estonia, Germany, Brazil and South Africa

Fossil Fuels

Membership

- Shaw Consultants International, Inc.

Why should your organisation become a member of the FBC TCP?

Continued research and development in this field is needed to further improve fuel combustion efficiency and to maintain high fuel flexibility at stringent emission limits. The FBC TCP provides a platform for co-operation among representatives from governments, industry and academia to expand the knowledge base and accelerate technology deployment.

TCP Chair: Lyu Junfu, China (lvjf@mail.tsinghua.edu.cn)
TCP primary contact: Mikko Hupa (mikko.hupa@abo.fi)
IEA contact: Raimund Malischek (raimund.malischek@iea.org)

www.ieafbc.org

TCP on Gas and Oil (GOTCP)

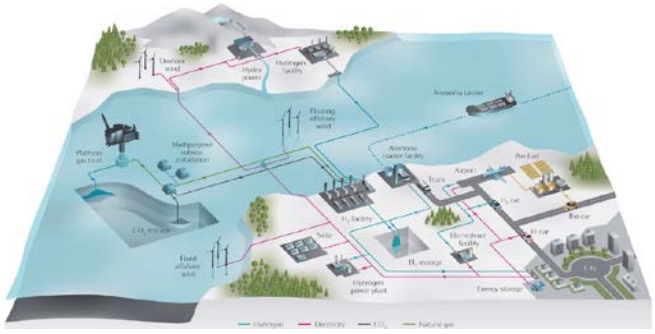
Created in 2013, the GOTCP brings together representatives from governments, industry and academia in a global dialogue to explore the role of oil and gas technology in the energy transition. GOTCP aims to catalyse innovation across oil and gas technologies and to provide collaborative opportunities for enhancing national capabilities within both onshore and offshore activities.

Main areas of work

- Hydrocarbon renewable nexus
- Energy choice assessment and dialogue programme
- Gas to market
- Brownfield, greenfield, and unconventional oil and gas

Key activities and accomplishments (2017-2018)

- Establishment of a new workstream on the hydrocarbon - renewables nexus
- Expanding activities to align with the evolution of integrated energy markets
- Networking and outreach at international events



Hydrocarbons-Renewables nexus – accelerating the energy transition. (Graphic courtesy of Equinor)

Priorities and projects (2019-2020)

- Hydrocarbon - renewables nexus – mapping of regional activities
- Joint research activity with industry examining national energy options, implications and choices

Multilateral collaborations

- Pursuing collaboration with the TCP on Greenhouse Gas R&D (GHG TCP) and the Hydrogen TCP.

Fossil Fuels

Membership


Argentina


Australia


Brazil


Canada


Netherlands


Norway


Spain


Switzerland


United States


European Commission

Why should your organisation become a member of the GOTCP?

The GOTCP offers access to a dialogue forum exploring major issues related to technology innovation and the future of hydrocarbons. The GOTCP provides an opportunity to network with and influence decision makers and experts among governments, academia and industry.

TCP Chair: Michael Layer, Canada (Michael.layer@canada.ca)
TCP primary contact: Jostein Dahl Karlsen (jostein.dahl.karlsen@gotcp.net)
IEA contact: Raimund Malischek (raimund.malischek@iea.org)

www.gotcp.net

TCP on Greenhouse Gas R&D (GHG TCP)

Founded in 1991, the remit of the GHG TCP is to evaluate options and assess the progress of carbon capture and storage, and other technologies that can reduce greenhouse gas emissions derived from the use of fossil fuels, biomass and waste. The aim of the TCP is to help accelerate energy technology innovation by ensuring that stakeholders from both the public and private sectors share knowledge, work collaboratively and, where appropriate, pool resources to deliver integrated and cost-effective solutions.

Main areas of work

- To evaluate technology options for greenhouse gas mitigation from fossil fuels
- To facilitate implementation of potential mitigation options
- To facilitate international collaborative activities
- To widely disseminate results

Key activities and accomplishments (2017-2018)

- GHGT-14
- Post Combustion Conference (PCC) 4
- 12th International CCUS Summer School
- 3rd International Workshop on Offshore CCS
- 5th CCS Cost Network meeting
- Modelling and Risk Management Network Meeting
- Lead organiser of the only UNFCCC side event on CCS

Stand at GHG-14. (Photo courtesy of GHG TCP)

GHG-14. (Photo courtesy of GHG TCP)

Priorities and projects (2019 – 2020)

- GHGT-15, Abu Dhabi, UAE

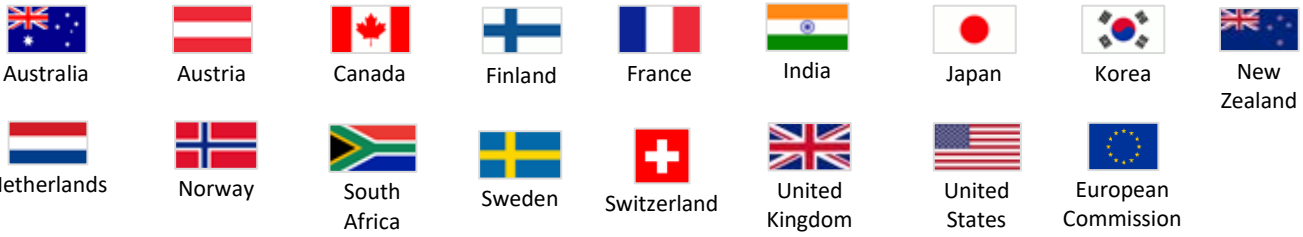
Research priorities:

- Emphasis on understanding the value of CCUS
- CCUS and hydrogen in industry
- Bio-CCS and negative emission technologies

Multilateral collaborations

- Carbon Sequestration Leadership Forum (CSLF) Technical Group
- Clean Energy Ministerial Carbon Capture, Utilisation, and Storage (CCUS)Initiative
- UNFCCC and IPCC
- International Oranization for Standardization carbon dioxide capture, transportation, and geological storage (ISO TC/265)
- Mission Innovation Innovation Challenge on Carbon Capture (IC#3)

Membership



- Chevron (United States)
- Coal Industry Advisory Board (CIAB)
- Doosan Babcock (United Kingdom)
- Electric Power Research Institute (United States)
- Equinor (Norway)
- Exxon Mobil (United States)
- Forschungszentrum Jülich (Germany)
- INEEL (Mexico)
- Institut Teknologi Bandung (Indonesia)
- JGC Corporation (Japan)
- J-Power (Japan)
- Khalifa University (UAE)
- OPEC
- Petrobras (Brazil)
- RWE (Germany)
- Shell (Netherlands)
- Southern Company (United States)
- Total (France)

Why should your organisation become a member of the GHG TCP?

Greater efforts need to be made to deploy CCUS at scale globally. The GHG TCP aims to provide its members with definitive information on the role that technology can take in reducing greenhouse gas emissions and takes pride in being an unbiased source of technical information.

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Fusion power

- Environmental, Safety, Economic Aspects of Fusion Power (ESEFP TCP)
- Fusion Materials (FM TCP)
- Nuclear Technology of Fusion Reactors (NTFR TCP)
- Reversed Field Pinches (RFP TCP)
- Spherical Tori (ST TCP)
- Stellarator-Heliotron Concept (SH TCP)
- Tokamak Programmes (CTP TCP)

TCP on Environmental, Safety and Economic Aspects of Fusion Power (ESEFP TCP)

The ESEFP TCP provides a platform for scientists and engineers to exchange information and further enhance the collaboration, co-ordinating international efforts to bridge the scientific and technical gaps between the International Thermonuclear Experimental Reactor (ITER) and DEMO*, and supporting governmental policies and raising awareness of fusion energy developments and potential to the general public.

Main areas of work

- In-vessel tritium source terms (Task 1)
- Activation products source terms (Task 3)
- Failure rate database (Task 5)
- Radioactive waste study (Task 6)
- Socio-economic aspects of fusion power (Task 7)
- Magnet safety (Task 8)

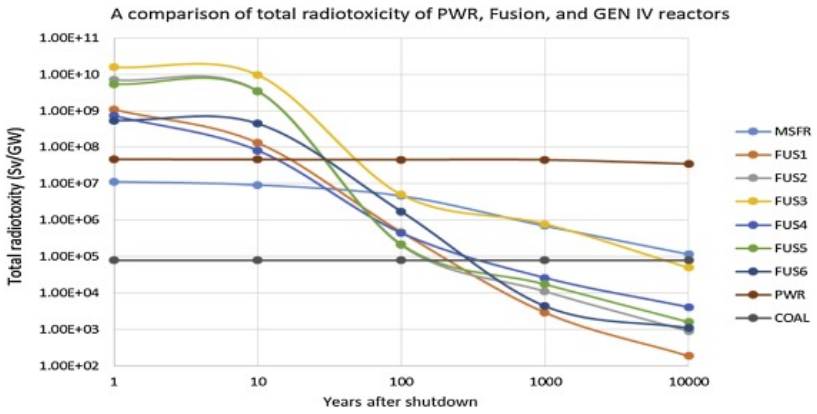
Key activities and accomplishments (2017-2018)

- Inventory and removal methods of hydrogen isotopes (Task 1)
- Development of the MELCOR fusion codes (Task 3)
- Data collection and analysis aimed toward failure rates and repair times (Task 5)
- Study of water leaks on the Fusion Neutron Source (Task 6)
- European survey to assess public attitude towards fusion; focus on public acceptance (Task 7)
- Design study for a post-large helical device (REBCO) (Task 8)

Priorities and projects (2019 – 2020)

- Dynamic tritium transport simulation development (Task 1)
- Ongoing assessment of safety impact of liquid metal plasma facing components (Task 3)
- Data collection and analysis aimed toward failure rates and repair times of individual components for support for RAMI (reliability, availability, maintainability and inspectability)(Task 5)
- Energy scenario evolutions explored by EUROfusion TIMES model (Task 7)

** DEMO is a proposed nuclear fusion power station that is intended to build upon the ITER experimental nuclear fusion reactor.*



A comparison of total radiotoxicity of PWR, Fusion, and GEN IV reactors. Radioactivity from coal-fired plant ashes are also included. All results are normalised to a 1000 MWe power electricity production (Zucchetti, Massimo, et al. "Fusion power plants, fission and conventional power plants. Radioactivity, radiotoxicity, radioactive waste." Fusion Engineering and Design 136 (2018): 1529-1533.)

Fusion Power

Multilateral collaborations

- It would be valuable to further co-ordinate internationally socio-economic studies relating to fusion power.
- Chairs of the ESEFP TCP and TCP on Nuclear Technology of Fusion Reactors (NTFR TCP) attend each other's meetings with a view to finding work areas of mutual interest.

Membership

Canada, China, Japan, Korea, Russia, United States, European Commission

Why should your organisation become a member of the ESEFP TCP?

Participants in the ESEFP TCP exchange expertise with a view to better understanding the environmental, safety and economic issues associated with fusion power. Broad stakeholder engagement, managing public opinion, and a positive media framing of fusion devices is key in dealing with the overall socio-economic impact of this technology. The work of the ESEFP TCP serves to bring fusion science closer to the public and thus contribute to greater social consensus.

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TCP on Fusion Materials (FM TCP)

The scope of the FM TCP covers materials needed to meet the requirements of structural, thermal management, fuel breeding and processing, and neutron economy of fusion systems. Relevance and application of the results of this work range from meeting the needs of existing plasma physics devices, through International Thermonuclear Experimental Reactor (ITER), and DEMO* stages of fusion development, to the application of advanced materials in fully mature fusion power plants serving the base energy needs of society.

Main areas of work

- Beryllium technology
- Materials theory and modelling
- Silicon carbide composites
- Tungsten alloys
- Irradiation facilities and testing
- Radiation effects in ceramic insulators
- Reduced activation ferritic/martensitic steels
- Vanadium alloys

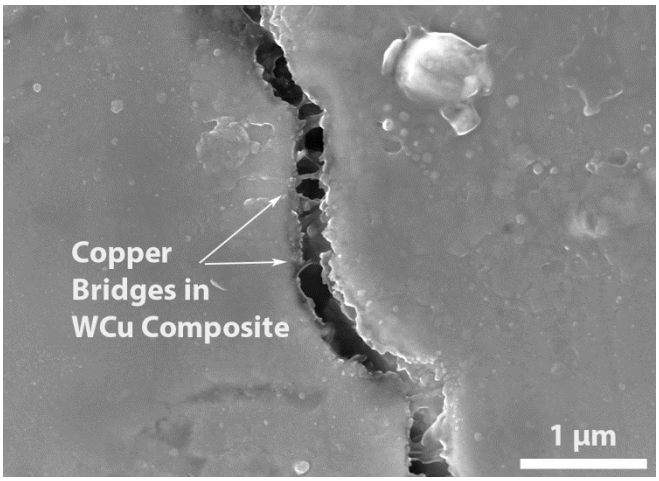
Key activities and accomplishments (2017-2018)

- **Materials theory and modelling**: a planning meeting was held on 11 March 2018 in conjunction with the Minerals, Metals & Materials 2018 Annual Meeting and Exhibition in Arizona, USA
- **Radiation effects in ceramic insulators**: the 27th Workshop on Radiation Effects in Ceramic Insulators was held on 20 September 2018 on the margins of the SOFT-30 conference

Priorities and projects (2019 – 2020)

- **Beryllium technology**: the next workshop will be held prior to the 19th International Conference on Fusion Reactor Materials (ICFRM-19) in Los Angeles, California, USA
- **Materials theory and modelling**: Detailed planning is underway for an invitation-only workshop to enable selected participation by FM TCP members and to allow for focused discussions, with the goal of producing a technical journal paper to document the proceedings. The next workshop is scheduled for 24-26 June 20149 in Walla Walla, Washington, USA
- **Radiation effects in ceramic insulators**: The next workshop will be held in conjunction with the 14th International Symposium on Nuclear Technology in Budapest, Hungary, 22-27 September 2019 or in conjunction with the 2020 SOFT conference.
- **Reduced activation ferritic and martensitic steels, vanadium alloys, and tungsten alloys**: the next meetings are planned on the margins of ICFRM-19, 27 October – 1 November 2019 in California, USA

** DEMO is a proposed nuclear fusion power station that is intended to build upon the ITER experimental nuclear fusion reactor.*



Ductile copper "bridges" form across cracks in tungsten-copper (WCu) composites providing greater resistance to fracture in otherwise brittle tungsten materials. Development of fracture resistant tungsten materials is critical for successful fusion power development. (Photo courtesy of C.H. Henager, Jr., Pacific Northwest National Laboratory).

Multilateral collaborations

- The European Union is organising a multilateral collaboration on the effects of neutron irradiation on tungsten base materials for high-heat load application. The FM TCP periodically exchanges information on current activities with the TCP on Nuclear Technology of Fusion Reactors (NTFR TCP), and the TCP on Environment, Safety, and Economics Aspects of Fusion Power (ESEFP TCP). Going forward, further exchanges with the TCP on Plasma Wall Interaction (PWI TCP) would be beneficial.

Fusion Power

Membership

Canada, China, India, Japan, Korea, Russia, United States, European Commission

Why should your organisation become a member of the FM TCP?

The FM TCP aims to achieve the broader goals of developing the materials needed to allow fusion to reach its full potential as a safe, economical and environmentally attractive energy source. Activities of the FM TCP enhance the co-operation and collaboration of the parties interested in understanding the behaviour and development of materials for a fusion power system environment.

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TCP on Nuclear Technology of Fusion Reactors (NTFR TCP)

The NTFR TCP is a collaborative programme on the research and development of nuclear technology of fusion reactors, a priority area for fusion energy. The TCP focuses on technologies of components located close to the fusion plasma and subjected to high-energy neutron irradiation, in particular tritium production and processing, energy extraction, radiation shielding and components such as the first wall, blanket, shield and plasma facing components.

Main areas of work

Work is structured in 2 main tasks ('annexes'):

- Annex 1 addresses the characterisation of blanket: tritium breeding blankets, radiation shielding and tritium processing systems
- Annex 2 addresses the characterisation of tungsten as a plasma-facing material

Key activities and accomplishments (2017-2018)

- 74 publications in peer-reviewed journals
- MaPLE-U facility at UCLA (USA) fully operational after major upgrades by a US and EU joint team
- Design activities on several devices; development of codes and nuclear libraries; nuclear analyses and model developments for ITER, the DTT, MAST, DEMO and HELIAS
- R&D in support of ITER and DEMO tritium systems
- Testing of plasma Facing Components in support of ITER

Tungsten tiles of different shapes for the study of tritium (Source: NFRI, Korea)

Experimental set-up for the study of tritium permeation barriers (Source: CIEMAT, Spain)

Priorities and projects (2019 – 2020)

- Launch of co-permeation experiments (solid breeder blankets)
- Testing in upgraded MaPLE-U facility
- Continue activities on neutronics experiments, code development, nuclear data and design analysis
- Continue studies and R&D on a tritium permeation barrier and tritium breeder materials
- Assessment of fuel retention in PFCs and material behaviour under plasma exposure

Multilateral collaborations

- The work programme of the NTFR TCP is closely linked to that of the TCP on Fusion Materials (FM TCP) and the TCP on Environmental, Safety and Economic Aspects of Fusion Power (ESEFP TCP).
- Results of the NTFR TCP are distributed to representatives of countries and fusion energy experts through the annual report, at international conferences and in scientific publications. Some workshops are open also to researchers from countries not signatory to this TCP.

Fusion Power

Membership

Why should your organisation become a member of the NTFR TCP?

The NTFR TCP provides a unique framework for co-ordinating and collaborating international research and development activities in fusion nuclear technologies that will be essential for the successful realisation of fusion as an energy source. Most activities undertaken under the framework of the NTFR TCP are of direct relevance to ITER.

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TCP on Reversed Field Pinches (RFP TCP)

The RFP TCP aims to advance the development of fusion power through research on the Reversed Field Pinch (RFP) magnetic configuration. The three members of the RFP TCP co-ordinate RFP experiments, and can share equipment and computational tools, as well as supporting staff exchanges.

Main areas of work

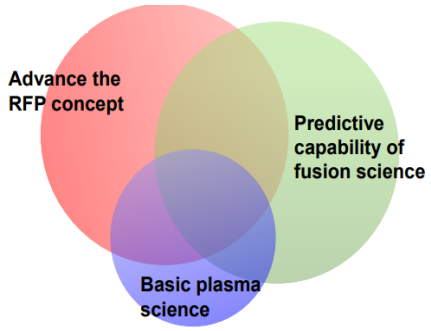
RFP experiments worldwide, all in academic environments:

- Extrap T2R (Sweden)
- Keda Torum eXperiment (KTX) (China)
- Madison Symmetric Torus (MST) (USA)
- RELAX (Japan)
- RFX-mod (Italy)

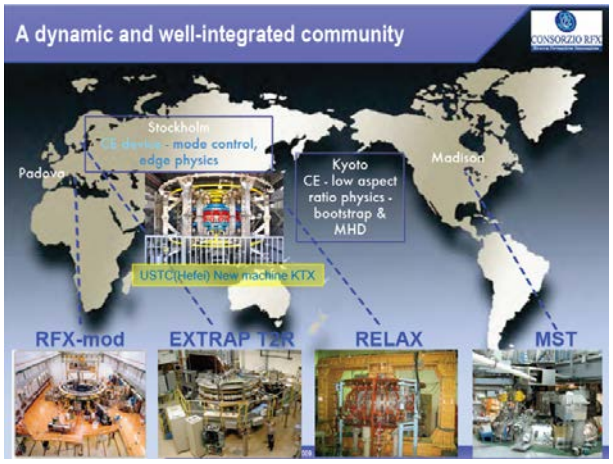
Key activities and accomplishments (2017-2018)

Milestones reached in the following areas:

- Deeper understanding of helical RFP
- Active MHD control for mode stabilisation and plasma control
- Turbulence and transport
- Deeper understanding dynamo and associated physics in RFP
- Tokamak configuration studies
- Status of KTX (China)



Three missions goals define unique RFP opportunities in fusion and plasma science.



RFP machines operating around the world.

Priorities and projects (2019 – 2020)

- A new algorithm for an upgraded active controller will be developed for Extrap T2R (EU)
- Upgrading of RFX-mod to RFX-mod2 with plasma experiments to begin in 2020
- Collaboration works progressing on MST under the new research facility in Wisconsin (WiPPL)
- Machine modifications; diagnostics development

Multilateral collaborations

- The RFP TCP seeks to raise awareness for fusion power research, both among fellow experts and non-specialist communities. The TCP participates in joint meetings, public lectures, demonstrations of plasma science, communication of RFP research activities directed towards university and secondary schools, including seminars, guided laboratory tours, social media, and videos
- Collaboration with China is under discussion

Membership


Japan


United States


European Commission

Why should your organisation become a member of the RFP TCP?

As a close relative to the tokamak and stellarator configurations, RFP research advances fusion science and engineering generally, while resolving key challenges specific to a RFP-based fusion reactor.

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TCP on Spherical Tori (ST TCP)

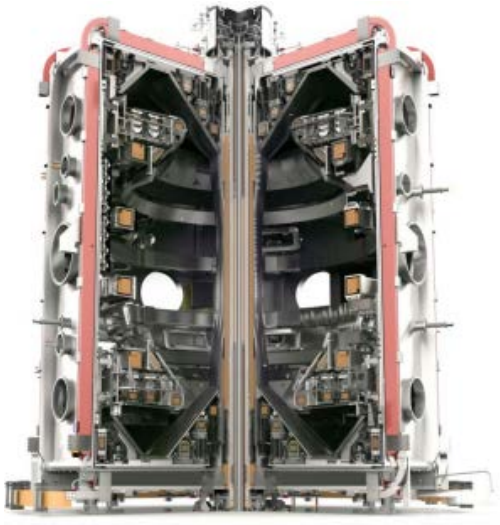
Created in 2007, the ST TCP aims to enhance the effectiveness and productivity of fusion energy science and technology by strengthening co-operation among spherical torus research programmes and facilities; contributing to and extending the scientific and technology database of toroidal confinement concepts to the spherical torus physics regime; and providing a scientific and technological basis for the successful development of fusion power using the spherical torus.

Main areas of work

- Co-operation on spherical tori science R&D
- Co-operation on the physics and technology of future spherical torus devices
- Co-operation on steady state operation of fusion devices

Key activities and accomplishments (2017-2018)

- Ten new projects funded for collaborative research on upgrade of the Mega Amp Spherical Tokamak Upgrade (MAST-U)
- Construction of the MAST-U completed
- Proto-Sphera produced its first confined toroidal plasma
- NSTX-U recovery project completed major technical milestones
- LTX-beta device made plasmas with plasma currents of about 40kA
- Understanding of non-inductive ST plasma start-up



Mega Amp Spherical Tokamak Upgrade (MAST-U).
http://www.ccfe.ac.uk/assets/documents/other/M

Priorities and projects (2019 – 2020)

- Continue and extend bilateral and multilateral collaborations including exchange of equipment and personnel
- Continue and extend collaborative research on the physics and technology of future fusion devices
- Address physics and technology challenges related to steady state operation
- Continue organisation of international worshops and meetings

Multilateral collaborations

- There is a growing spherical tori community worldwide and a number of productive collaborations, many involving exchange of equipment and personnel

Fusion Power

Membership


Japan


China


Korea


United States


European Commission

Why should your organisation become a member of the ST TCP?

The ST TCP contributes to the development of conventional tokamak devices (e.g. ITER) and alternate approaches such as the innovative ST concept, by strengthening co-operation among ST research programmes and facilities. The ST TCP helps to avoid unnecessary duplication of effort and helps to ensure complementarity between the research programmes through co-ordinated exchange of personnel and equipment among its members.

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TCP on Stellarators and Heliotrons (SH TCP)

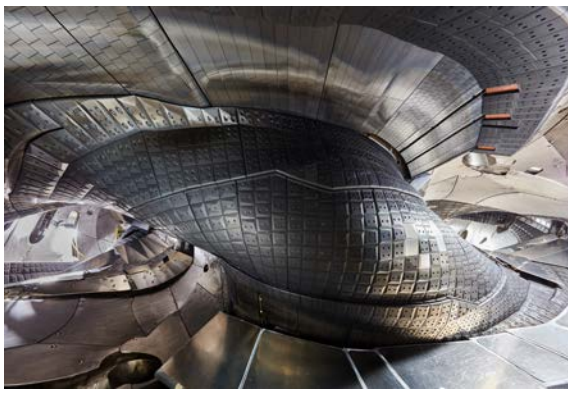
The strategic objective of the SH TCP is to improve the physics base of the Stellarator concept and to enhance the effectiveness and productivity of research by strengthening co-operation among member countries.

Main areas of work

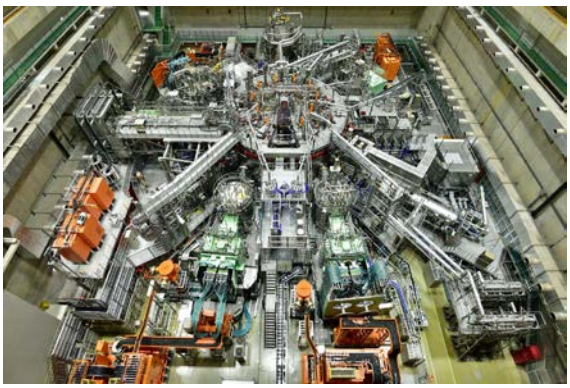
- Plasma heating and fuelling
- Plasma confinement: influence of turbulent and neoclassical (collisional)transport, effects of isotope composition and impurities on plasma transport
- Stability and equilibrium: high-beta operation, stability limits
- Exhaust of heat and particles from the plasma and plasma wall interaction
- Support and extension of databases

Key activities and accomplishments (2017-2018)

- Two experimental campaigns with the Wendelstein 7-X stellarator (OP1.2a and OP1.2b)
- Successful deuterium operation of Large Helical Device (LHD) (2017, 2018)
- Co-operation with China on a quasi-axisymmetric stellarator



Plasma vessel of Wendelstein 7-X, IPP. (Photo courtesy of Bernhard Ludewig)



Large Helical Device (LHD). (Photo courtesy of National Institute for Fusion Science)

Priorities and projects (2019 – 2020)

- Completion of Wendelstein 7-X to full steady state capability
- Development of a steady state pellet injector for Wendelstein 7-X
- Full exploitation of the isotope-effect on heliotrons

Multilateral collaborations

- SH TCP representatives in the topical groups of the ITER Tokamak Physics Activity (ITPA)
- Strong interest from Costa Rica to join the SH TCP
- Presentation of the Chinese stellarator activities to the 2019 Executive Committee meeting of the SH TCP

Membership


Australia


Japan


Russia


Ukraine


United States


European Commission

Why should your organisation become a member of the SH TCP?

Worldwide collaborative activities on the stellarator and heliotron research are combined under the umbrella of this programme, which promotes the exchange of information among the partners, the secondment of specialists to facilities and research groups, joint planning and co-ordination of experimental programmes in selected areas, joint experiments, workshops, seminars and symposia, joint theoretical, design and system studies, and the exchange of computer codes.

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TCP on Tokamak Programmes (CTP TCP)

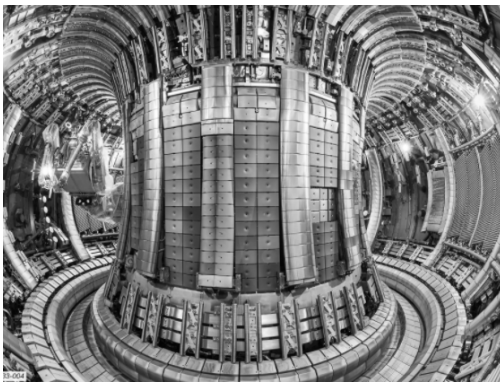
The CTP TCP supports the development of fusion energy by contributing to the physics basis of the International Thermonuclear Experimental Reactor (ITER), and DEMO* design optimisation. The CTP TCP provides a forum for tokamak programmes of the ITER Members to co-ordinate tokamak research by carrying out scientific and technological exchanges, holding workshops and meetings for the purpose of advancing the tokamak concept in the context of fusion energy, and supporting ITER physics and technology needs.

Main areas of work

- Experimental programme plans for the tokamak facilities
- Design and planning of experiments to contribute to the database for the next-generation tokamak devices including, but not limited to, support of activities identified by the International Tokamak Physics Activity (ITPA)
- Experimental, theoretical and technical studies

Key activities and accomplishments (2017-2018)

- Co-ordinated multi-experiments and simulations aimed at improving the physics basis of plasma facing components power loading and melt dynamics
- Improved understanding of the dynamics and control of ITER plasma terminations



JET Tokamak, Europe (photo courtesy of EUROfusion)

ITER Tokamak (photo courtesy of ITER Organization)

Priorities and projects (2019 – 2020)

- Addressing the avoidance, control and mitigation of the key plasma instabilities
- Protection of the plasma facing components and access to good confinement plasma regimes in ITER
- Specific test for one of the systems to be installed in ITER to mitigate the consequences of the abrupt termination of the plasma "Disruptions" to be installed on JET (Joint European Torus)

** DEMO is a proposed nuclear fusion power station that is intended to build upon the ITER experimental nuclear fusion reactor.*

Multilateral collaborations

- Framework agreement between four CTP TCP partners to design, construct, install and operate ITER relevant hardware on JET. Mitigation of disruptions is a critical issue for ITER; it is important to test the concept of Shattered Pellet Injection (SPI) for mitigation of runaway electrons during the disruption current quench. The commissioning with plasma of the JET SPI and experimental campaign will take place in 2019.

Membership


Australia


China


India


Japan


Korea


United States


European Commission

- International Thermonuclear Experimental Reactor (ITER) Organization

Why should your organisation become a member of the CTP TCP?

The CTP TCP is one of the main programmes for the implementation of the ITPA, which now operates under the auspices of the ITER Organisation and co-ordinates activities among the domestic programmes of the signatories to the ITER Agreement. The next critical step in demonstrating the scientific feasibility of fusion energy is to demonstrate burning plasmas in long pulses. As achieving this objective is a great challenge, and there are many scientific and technological issues to be addressed, this is the primary mission of ITER and of tokamak research programmes worldwide.

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Renewable energy and hydrogen

- Bioenergy TCP
- Concentrated Solar Power (SolarPACES TCP)
- Geothermal TCP
- Hydrogen TCP
- Hydropower TCP
- Ocean Energy Systems (OES TCP)
- Photovoltaic Power Systems (PVPS TCP)
- Solar Heating and Cooling (SHC TCP)
- Wind TCP

TCP on Bioenergy (Bioenergy TCP)

The aim of the Bioenergy TCP is to increase knowledge and understanding of bioenergy systems in order to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive, low-carbon bioenergy systems and technologies, and to advise policy and industrial decision makers accordingly.

Main areas of work

- Enabling bioenergy to provide substantial contributions to future global energy demand
- Stimulating the development and application of innovative bioenergy technologies for heating, electricity and transportation sectors
- Exploring global opportunities for increased sustainable biomass production in agricultural and forestry systems, as well as sustainable landscape management

Key activities and accomplishments (2017-2018)

- Measuring, governing and gaining support for sustainable bioenergy supply chains and related technologies
- Bio-CCS and bio-CCUS solutions for climate change mitigation
- Integrating bioenergy and other renewables in hybrid systems
- Analyzing biomass pre-treatment options to diversify the supply base

Municipal wastewater plant in Enköping, Sweden, with water storage ponds and (behind the ponds) willow fields that are used as vegetation filters, the harvested willow fuelling an adjacent power plant - (Photo: Pär Aronsson, SLU)

Priorities and projects (2019 – 2020)

- Demonstrating the key role of bioenergy in a decarbonising world
- Embedding bioenergy into the broader bioeconomy
- Incorporating the reliability of bioenergy in energy systems
- Enabling the development and application of innovative technologies
- Developing advanced biofuels for mobility
- Developing sustainable biomass supply chains

Multilateral collaborations

- Collaborations with the Biofuture Platform, the *below50* initiative, and IRENA
- Letter of co-operation with the Global Bioenergy Partnership (GBEP)
- Memorandum of Understanding with the Food and Agriculture Organisation (FAO)
- Ongoing collaboration with the TCP on Advanced Motor Fuels (AMF TCP)
- Interest in collaboration with the TCP on Greenhouse Gas R&D (GHG TCP) on Bio-CC(U)S, and with the ETSAP TCP and other renewable energy-related TCPs on the complementary roles of bioenergy and other renewables in future energy systems

Renewable Energy

Membership

Why should your organisation become a member of the Bioenergy TCP?

Acceleratedbioenergy deploymentis urgently needed across all end-uses, notably in the transport sector where consumption is required to triple by 2030. The Bioenergy TCP provides a science-based platform for international collaboration and information exchange in bioenergy research, technology development, demonstration, and policy analysis, as well as development of networks and dissemination activities.

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TCP on Concentrated Solar Power (SolarPACES TCP)

The SolarPACES TCP supports collaboration to advance development and deployment of concentrating solar thermal technologies. From a system perspective, concentrating solar power (CSP) offers significant advantages. With built-in thermal storage, CSP can improve the flexibility and stability of power systems, provide dispatchable electricity and help integrating more variable renewables.

Main areas of work

- Design, testing, demonstration, evaluation and application of concentrating solar power technologies
- Platform for international co-operation to advance solar driven thermochemical processes for the production of fuels and materials
- Development and promotion of solar process heat
- Assessment of solar energy resource for concentrating solar technologies

Key activities and accomplishments (2017-2018)

- Ongoing updates to international CSP project database
- Completed national assessments of the grid integration value of CPS systems in South Africa and Chile
- Published guidelines for modelling the performance of CSP parabolic trough and power tower systems
- Initiated a working group to promote collaboration of particle based receivers and storage systems for CSP

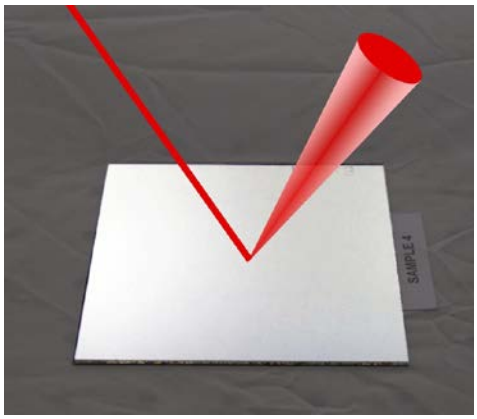

Illustration of sunlight reflection and scattering on a sun-tracking mirror (Almeria, Spain). (Photo courtesy of SolarPACES TCP).

New projects (2019 – 2020)

- Activities to identify and estimate the value of CSP for energy systems, facilitate cost reductions (e.g. development of technical guidelines) and foster awareness of the excellent value proposition of solar chemistry technologies (such as dispatchability, hybridisation)
- Process heat applications
- Further membership outreach

Multilateral collaborations

- Joint project on solar resource for high penetration and large scale applications in collaboration with the TCP on Photovoltaic Power Systems (PVPS TCP)
- Project in solar process heat in collaboration with the TCP on Solar Heating and Cooling (SHC TCP)
- Review of CSP market and cost data with the International Renewable Energy Agency (IRENA)

Renewable Energy

Membership

Why should your organisation become a member of the SolarPACES TCP?

Participation in the SolarPACES TCP will help you to get access to the leading international export network in concentrating solar technologies and co-ordinate your R&D efforts to increase the field of application of the technologies your organisation is focusing on.

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TCP on Geothermal Energy (Geothermal TCP)

The Geothermal TCP promotes international collaboration fostering and enhancing the development and sustainable use of geothermal energy. Activities are chiefly directed towards the sharing of information; developing technologies, techniques and best practices for exploration, development and utilisation; and producing and disseminating authoritative geothermal information and data.

Main areas of work

- Environmental impacts of geothermal development
- Direct use of geothermal energy
- Deep roots of volcanic geothermal systems
- Emerging geothermal technologies
- Data collection and information dissemination

Key activities (2017-2018)

Participation at international events:

- Offenburg, Germany
- Florence, Italy
- Hanoi, Vietnam
- Vienna, Austria
- Petropavlovsk, Russia
- Daejeon, Korea
- Canary Islands, Spain

Rotary drilling bit in front of a drilling rig. (Source: Stadtwerke München SWM)

Priorities and projects (2019 – 2020)

- Costa Rica Geothermal Workshop (in conjunction with Grupo ICE and the German Corporation for International Co-operation (GIZ)
- Gran Canaria Geothermal Workshop
- Baltic Nations Geothermal Symposium
- North Atlantic Symposium, GeoTHERM Expo 2020

Renewable Energy

Multilateral collaborations

- The Global Geothermal Alliance, supported by the International Renewable Energy Agency (IRENA
- International Geothermal Association (IGA)

Membership

- Spanish Geothermal Technology Platform (GEOPLAT)
- ORMAT Technologies

Why should your organisation become a member of the Geothermal TCP?

The Geothermal TCP is a powerful framework for international collaboration and networking among nations, companies and industry organisations on all aspects of geothermal resources and geothermal energy.

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TCP on Hydrogen (Hydrogen TCP)

The Hydrogen TCP, founded in 1977, works to accelerate hydrogen implementation and widespread utilisation in the areas of production, storage, distribution, power, heating, mobility and industry. The Hydrogen TCP seeks to optimise environmental protection, improve energy security, transform global energy systems and grid management, and promote international economic development, as well as serving as the premier global resource for expertise in all aspects of hydrogen technology.

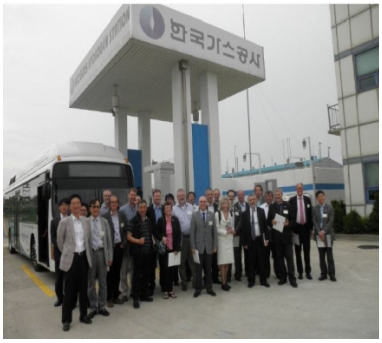
Main areas of work

- Collaborative R,D&D that advances hydrogen science and technology such as hydrogen production, storage, and integration in energy systems including in infrastructure and transport;
- Hydrogen analysis,including technical studies and market reviews;
- Hydrogen understanding, awareness and social acceptance, including information dissemination, safety and outreach.

Key activities and accomplishments (2017-2018)

- Contribution of resources and expertise to the IEA 2019 report *The Future of Hydrogen*
- Research on Power to Hydrogen examining all aspects of hydrogen as an element of an integrated energy system
- Launch of hydrogen in maritime applications project
- Ongoing use tools such as the life cycle sustainability analysis (LCSA) method, market readiness assessment and data modelling
- Paper on Global Outlook and Trends for Hydrogen

Energy Observer, launched in April 2017, is the first hydrogen vessel in the world (Photo courtesy of Energy Observer)



Hydrogen TCP Executive Committee meeting in Korea (photo courtesy of Mary-Rose Valladares)

New priorities and projects (2019 – 2020)

- Approve and launch R&D analysis tasks, explore new hydrogen carriers
- Extend the scope of hydrogen applications: electrofuels, industry, chemicals
- Align and deepen co-operation with IEA analytics via data/modelling task
- R&D analysis promoting hydrogen in climate sensitive energy transition, including trade
- Identify key barriers to hydrogen development/deployment and related solutions

Multilateral collaborations

- Staff loan to the IEA to work on the IEA G20 Hydrogen Report
- Co-operation with the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) under a Memorandum of Understanding
- Collaboration with Capenergies, French energy cluster, under Hydrogen TCP's Task 38 (power-to-hydrogen and hydrogen-to-X)

Interest in future collaboration

- Interest in collaboration with the ETSAP TCP and other TCPs in the transport, fossil fuels and renewables sectors
- Liaison with international hydrogen initiatives under the Clean Energy Ministerial, Mission Innovation, IPHE
- Proposed future project with the United Nations Industrial Development Organization (UNIDO)
- Interest in collaboration with the International Renewables Energy Agency (IRENA)

Membership

Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, Greece, Israel, Italy, Japan, Korea, Lithuania, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, European Commission, UNIDO

• Hydrogen Council • Hychico • NOW GmbH • Reliance Industries Limited (RIL)
• Shell Global Solutions International BV • Southern Company Services, Inc.

Why should your organisation become a member of the Hydrogen TCP?

Hydrogen TCP members benefit from the TCP's global research outreach and robust industry participation. The Hydrogen TCP provides a strategic platform to make sense of the "hydrogen" momentum. Hydrogen TCP enables high-level co-ordination in research, development, dissemination and market deployment, as well as technology and market analysis.

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TCP on Hydropower (Hydropower TCP)

Hydropwer is the largest source of renewable electricity in the world and it is particularly suited to providing system flexibility. The Hydropower TCP is a global platform for advancing hydropower technology, encouraging the sustainable use of water resources for the development and management of hydropower.

Main areas of work

- Optimising the value of hydropower and system integration services
- Technical, social, andenvironmental aspects of hydropower
- Communication, learning and engagement

Key accomplishments (2017-2018)

- Completed phase 1 of valuing hydropower services project
- Workshop on hydropower and fish: research and innovation in the context of the European policy Framework
- Kick-off workshop on Phase II of valuing hydropower services
- Kick-off workshop on hidden hydro opportunities
- Meetings with hydropower utilities in Canada and USA to investigate asset management approaches covering modernisation of existing projects

Gordon Dam in Tasmania (Photo courtesy of Hydro Tasmania)

New priorities and projects (2019 – 2020)

- Initiate phase II of valuing hydropower services project
- Launch hidden hydro project, focussed on the use of unharnessed water flow and hydraulic head at non-power dams and improving the performance of existing facilities
- Initiate joint annex project on value of hydropower in mitigating climate change impacts

Multilateral collaborations

- Interested in collaboration with the Wind TCP and the TCP on Solar Heating and Cooling (SHC TCP)on best practices in optimising energy and system integration services.
- Interested in collaboration with the TCP on Ocean Energy Systems (OES TCP) on kinetic or very low head technologies, as well as use of sea water pumped storage to support tidal/wave energy.

Renewable Energy

Membership

Why should your organisation become a member of the Hydropower TCP ?

Hydropower is a safe, reliable and a cost-effective source of clean energy in use in over 160 countries, proving more than 15% of the world's electricity. Hydropower generation could increase from over 4000 TWh at present to over 7000 TWh by 2050 – through new plant as well as modernization of existing equipment and structures.

The Hydropower TCP is working cooperatively with the participating national governments, multi-lateral organisations, industry and other associations to raise the profile of hydropower in energy policy formulation, market regulation and adoption of hydropower specific strategies.

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TCP on Ocean Energy Systems (OES TCP)

The OES TCP connects organisations and individuals working in the ocean energy sector to accelerate the viability, uptake and acceptance of ocean energy systems in an environmentally acceptable manner. The work of the OES TCP covers all forms of energy generation in which sea water forms the motive power through its physical and chemical properties i.e. wave, tidal range, tidal and ocean currents, ocean thermal energy conversion and salinity gradients.

Main areas of work

- Assessment of environmental effects and monitoring efforts for ocean wave, tidal and current energy systems
- Cost of energy assessment for wave, tidal, and ocean thermal energy conversion (OTEC) at an international level
- Performance metrics international framework for ocean energy
- Wave and tidal current energy numerical modelling

Key activities and accomplishments (2017-2018)

- Development of an international vision for ocean energy
- Reliable and credible levelised cost of energy assessment for ocean energy
- State of science report on the interactions and effects of ocean energy devices on the marine environment
- Publicly available, searchable online database TETHYS on environmental effects of ocean energy
- Interactive worldwide web GIS database for ocean energy

MeyGen deployment (Source: SIMEC Atlantis Energy)

CorPower Ocean C3 deployment at EMEC (Source: CorPower Ocean)

New priorities and projects (2019 – 2020)

- Assessment of environmental effects and monitoring efforts for wave, tidal and current energy systems
- Analysis and forecasts of the cost of ocean energy converters
- Assessment on jobs creation in ocean energy
- Ocean energy in insular conditions

Area of interest for multilateral collaboration

- Sponsorship of the International Network on Offshore Renewable Energy (INORE)
- Collaboration with the TCP on Wind Energy
- Collaboration with the OECD on jobs assessment for ocean energy
- Collaboration with the International Conference on Ocean Energy (ICOE)

Renewable Energy

Membership

Why should your organisation become a member of the OES TCP?

The OES TCP facilitates:

- access to advanced R&D teams in participating countries;
- development of a harmonised set of measures and protocols for the testing of prototypes;
- reduction of national costs by collaborating internationally;
- creation of valuable international contacts between government, industry and science.

Through regular meetings, each member provides a well established platform where high-profile ocean energy issues can be addressed by experts and officials close to government policy making in each member country.

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TCP on Photovoltaic Power Systems (PVPS TCP)

Established in 1993, the PVPS TCP supports international collaborative efforts to enhance the role of photovoltaic solar energy (PV) as a cornerstone in the transition to sustainable energy systems. The PVPS TCP seeks to serve as a global reference for policy and industry decision makers; to act as an impartial and reliable source of information on trends, markets and costs; and to provide meaningful guidelines and recommended practices for state-of-the-art PV applications.

Main areas of work

- Strategic PV analysis and outreach
- PV sustainability
- Performance, operation and reliability of PV systems
- Solar PV in a future 100% renewables-based power system
- Enabling framework for the acceleration of building-integrated photovoltaics (BIPV)
- Solar resource for high penetration and large-scale applications
- PV and transport
- Off-grid and edge-of-grid photovoltaic systems

Key activities and accomplishments (2017-2018)

- Recommended Practises for Wind and PV Integration Studies
- Net metering and PV self-consumption in emerging countries
- Compilation and Analysis of User Needs for BIPV and its Functions
- TRENDS in Photovoltaic Applications (23rd edition)
- Human Health Risk Assessment Methods for PV Part 1: Fire Risks
- National Survey Reports of PV Power Applications 2017
- Photovoltaic Module Energy Yield Measurements: Existing Approaches and Best Practice
- Snapshot of Global PV Markets 2018

Photovoltaic system installed at Incheon Airport Terminal 2, Incheon, Korea (Photo courtesy of Korea National University of Transportation)

New priorities and projects (2019 – 2020)

- Increased focus on the role of PV in future energy systems, PV interaction with other technologies (e.g. storage, grids and heat pumps) and integration of PV into buildings and the mobility sector
- PV and transport
- Off-grid and edge-of-grid photovoltaic systems

Multilateral collaborations

- The PVPS TCP collaborates intensively with the IEA Secretariat as well as with numerous other TCPs in the building, electricity, transport and renewable energy sectors.
- Other collaborations include:
  - International Renewable Energy Agency (IRENA)
  - International Electrotechnical Commission
  - International Solar Energy Society
  - International Solar Alliance
  - Global Solar Council
  - SOLARUNITED

Renewable Energy

Membership

- SolarPower Europe
- Solar Energy Industries Association (SEIA)
- Solar Electric Power Alliance (SEPA)
- International Copper Association - Copper Alliance

Why should your organisation become a member of the PVPS TCP?

The PVPS TCP serves as a global reference on PV for policy and industry decision makers. Members have access to a truly global network of expertise and experts as well as the latest technical, economic and framework related information in selected areas of interest. Moreover, a member can propose new items to be investigated. A further benefit of participation is the personal network that can be built beyond the collaborative work and the joint analysis.

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TCP on Solar Heating and Cooling (SHC TCP)

Through multi-disciplinary international collaborative research and knowledge exchange, as well as market and policy recommendations, the SHC TCP works to increase the deployment rate of solar heating and cooling systems by breaking down the technical and non-technical barriers to increase deployment.

Main areas of work

- Building applications (solar water heating, solar combi systems, photovoltaic thermal systems and solar air conditioning;
- District scale systems for solar heating and cooling;
- Thermal storage (diurnal to seasonal);
- Solar process heating and cooling and water treatment assisted by solar energy for agriculture and industry.

Key activities and accomplishments (2017-2018)

- Solar Heat Worldwide: Global Development and Trends -annual statistics report covering 95% of the global solar thermal market
- Position Papers - published 3 papers on Solar Heating and Cooling & Solar Air-conditioning, Daylighting in Non-residential Buildings, and Solar Standards and Certification
- Solar Academy onsite trainings, webinars and national days
- 5th International Conference on Solar Heating and Cooling for Buildings and Industry (SHC 2017) in Abu Dhabi, UAE
- SHC Solar Award presented at SHC 2017 in Abu Dhabi to Austria's Climate and Energy Fund who challenged how subsidies are implemented

Wits Junction solar system is the largest solar thermal installation in Sub-Saharan Africa. It combines solar, co-generation and gas heating technologies, servicing 14 student residence buildings with one centralised hot water plant. Installation includes a 600m2 heating plant with 10m2 of collectors. (Source: Wits Junction/SOLTRAIN).

The solar heating plant in Silkeborg is 156 694m2 and covers 20% of the annual heat demand in Silkeborg, Denmark. (Source: Silkeborg Forsyning A/S).

New priorities and projects (2019 – 2020)

- To remain the primary source worldwide of high quality technical information and analysis
- To contribute to a significant increase in the cost effectiveness of solar heating and cooling technologies
- To increase awareness and understanding on the potential and value of solar heating and cooling systems

Multilateral collaborations

- Material and Component Development for Thermal Energy Storage with the TCP on Energy Storage
- Integrated Solutions for Daylighting and Electric Lighting and Deep Renovation of Historic Buildings Towards Lowest Possible Energy Demand and CO2 Emission (NZEB) with the TCP on Buildings and Communities
- Towards the Integration of Large SHC Systems into District Heating and Cooling Network with the TCP on District Heating and Cooling

Renewable Energy

Membership

- East African Centre for Renewable Energy and Energy Efficiency (EACREEE)
- Economic Community of West African States (ECOWAS)
- International Solar Energy Society (ISES)
- European Copper Institute (ECI)
- Regional Center for Renewable Energy and Energy Efficiency (RCREEE)
- The SDC Centre for Renewable Energy and Energy Efficiency (SACREEE)

Why should your organisation become a member of the SHC TCP?

The SHC TCP is the worldwide reference for tracking innovation and increasing deployment of solar energy used for heating and cooling.

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TCP on Wind Energy Systems (Wind TCP)

The Wind TCP's mission is to stimulate co-operation on wind energy research, development, and deployment (RD&D). The Wind TCP provides high quality information and analysis to member governments and commercial sector leaders by addressing technology development, deployment and its benefits, markets, and policy options.

Main areas of work

- Resource and site characterisation
- Advanced technology for wind energy
- Energy systems with high amounts of wind
- Social, environmental and economic impacts
- Communication, education and engagement

Key activities and accomplishments (2017-2018)

- Best practices publications on Wind and Solar Energy Curtailment, Wind Integration Impacts in Hydro-dominated Systems, Capacity Value of Wind, Power System Stability Issues
- Recommended Practices on Wind Energy Projects in Cold Climates
- Recommended Practices on Floating Lidar Systems (offshore wind resource assessments)
- Adaptive Management White Paper on environmental assessment and monitoring for wind energy systems project

Blades for Block Island project in the US transported from Denmark. Source: LM Wind Power

Intertidal project in Xiangshui, China. Source: Goldwind

Priorities and projects (2019 – 2020)

- Industry research objectives will continue to focus on larger land-based and offshore wind turbines
- Research into floating offshore wind is becoming more prevalent as developers pursue wind resources farther from shorelines and at greater depths
- Reducing cost and improving reliability through improved technology and information sharing continues to be a primary objective

Multilateral collaborations

- Collaboration on grid integration and forecasting with the TCP on Photovoltaic Power Systems (PVPS TCP)
- Interest in further potential collaborations in the following areas:
  - Cost of energy
  - Systems engineering
  - Distributed energy

Renewable Energy

Membership

• Wind Europe • Chinese Wind Energy Association

Why should your organisation become a member of the Wind TCP?

Participation in the Wind TCP is a cost-effective way to leverage available research funds. Wind TCP members collaborate on RD&D projects to increase the impact of wind technology. The research topics are relevant to land-based, offshore, and distributed wind power development.

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https://www.iea.org/areas-of-work/technology-collaboration