An Overview of the

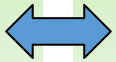
Clean and Efficient Combustion Technology Collaboration Progamme

Öivind Andersson
Lund University, Sweden

Chair of the Combustion TCP

The Combustion TCP serves three key purposes

Expand scientific knowledge base
to speed development and adaptation relating to low-carbon fuels



Remove technological barriers
that impede decarbonization and emission reduction

Guide decision makers
through systems analysis and policy recommendations

Our Vision –

Clean, efficient, cost-effective combustion technologies are key elements of a reliable and sustainable, low-carbon energy system

We are closely aligned with IEA objectives

Energy Security (ES)

Promoting diversity, efficiency and flexibility within all energy sectors

Higher conversion efficiencies
- Reduced fuel demand & risk of supply shortages

Improved fuel flexibility, use of local fuel resources
- Protection from fuel supply disruptions

Environmental Awareness (EA)

Enhancing international knowledge of options for tackling climate change

Emission reductions (CO_2, pollutants)
- R&D shows potential for further improvements

Synergistic technology innovations, e.g. highly efficient internal combustion & hybrid technologies
- Effective transport solution, esp. where electricity generation is not decarbonized

Economic Development (ED)

Ensuring the stable supply of energy to IEA member countries; and promoting free markets to foster economic growth and eliminate energy poverty

Global value chains
- Employment & economic value worldwide, high growth rates in emerging markets

Affordability
- Attractive esp. in countries with limited or unequally distributed wealth.

Engagement Worldwide (EW)

Working closely with non-member countries, especially major producers and consumers, to find solutions to shared energy and environmental concerns

TCP as a global forum of knowledge sharing
- Impactful dissemination of research findings

Ongoing outreach efforts
- Engaging new countries & institutions, resp. research groups in current member countries

TCP history & management

- Created in 1977 as the TCP on "Energy Conservation and Emissions Reduction in Combustion"
- Oversight provided by an Executive Committee (ExCo) with representation from all member countries
  - Chair rotates annually – incoming chairs serve the previous year as a vice-chair and the subsequent year in an emeritus role to provide continuity of leadership
  - Monitors Task progress and reviews and approves new Task proposals
  - Approves TCP budget
  - Develops overall TCP strategy
- Administrative duties handled by a paid Executive Secretary
  - Provides additional continuity of leadership and institutional memory

TCP structure

- Collaborative task-shared operation
  - Only administrative expenses are cost-shared ($5000 annual fee)
- Tasks are pre-competitive, but closely linked to industry/societal needs
- Our principal output is technical information published in the scientific and applied engineering literature
- Annual Task Leaders meeting provides for technical exchange and coordination of efforts
- Focus on transportation and industrial technologies; both renewable & conventional fuels
- Part of IEA Transportation End Use Working Party since 2014

Benefits to member countries

- Leverages work from multiple funding sources
  - Provides a forum for *researchers* to develop coordinated *technical* efforts
  - Provides a forum for *governments* to develop coordinated *programmatic* efforts
- Minimizes duplication of effort
- Provides access to best-in-class practices and tools
- Links research output to industry and to policy makers – participation in a global energy hub
- Builds networks and integrates young researchers into an international community

Current member countries

- Finland
- France
- Germany
- Italy
- Japan
- Korea
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

Seeking new members and direct industrial sponsorship

Current Tasks and objectives

TCP Subtask	Key 2025-2030 Priority Research Objectives
Combustion Chemistry	Develop predictive kinetic models for combustion of renewable fuels such as H_2, ammonia, methanol, and low net-carbon fuels. Initiate new foci for sustainable aviation fuels, battery fires, and metal fuels. Improve and extend models for soot precursors and other emissions.
Fuel Injection Processes	Develop a foundational scientific understanding of spray formation and mixing, especially for new CO2-neutral fuels, along with a capability for computationally designing fuel and air mixing processes. This will speed the design of efficient, clean-burning, CO2 -free combustion systems.
Soot	Create accurate, predictive models for soot emissions. Cross-cutting work will support clean technology development for transportation, industrial, commercial, and residential use. A new focus on nucleation processes impacting aviation contrail formation will be pursued.
Solid Fuels	Develop detailed, model-based design and optimization techniques to assist the valorization of biomass and the development of combined heat and power technologies with higher efficiency, lower emissions and more flexibility.
Net-Zero Carbon Engine Tech.	Remove barriers to the use of low-carbon fuels derived via sustainable pathways with attention to durability and compliance with exhaust emission regulations. Develop efficient combustion strategies for transitional dual-fuel engines using low cetane fuels like methanol and ammonia.
Gas Engines	Deepen the understanding of ignition and combustion in gas engines to support development of next-generation high-efficiency, low-emission engines for transportation and power (co-) generation. Increase focus on unique barriers to H_2 engines, such as backfire and pre-ignition.
Gas Turbines	Enable the use of future (hydrogen-rich/non-carbon) fuels in stationary power generation and (aircraft) propulsion systems by improving safety, reliability, controllability, and transient emissions.
Systems Analysis	Employ life-cycle analysis to evaluate fuel and powertrain/propulsion technologies for both ground and air transportation for a variety of applications; identify anticipated aftertreatment and precious metal requirements. Support GREET+ extension to H_2-fueled propulsion systems.
Policy Briefs for H_2 & Its Vector Fuels	Identify and assess techno-economic feasibility of H_2 and its associated vector fuels for transportation, power generation and storage, and mixed fuel combustion (transitional). Develop recommendations for policy makers and key private sector stakeholders.

Thank You!

For more information see:

www.ieacombustion.com