

TECHNOLOGY COLLABORATION PROGRAMME (TCP)

EUWP ANNUAL BRIEFING TEMPLATE

TCP NAME	Report Date
Advanced Materials for Transportation (AMT)	05/06/2024

Main Technology Policy Messages/Recommendation

- Explore, discover, and put into practice critical material technologies to enable the development of the technologies.
- Advanced materials are foundational technologies, especially during the transition to low-carbon fuels.
- Expanding material technology development to support the carbon emission lifecycle and electrification.
- Explore materials compatibility for low-carbon fuels and hydrogen.
- Capture critical and sustainable materials data that impacts technologies.

Achievements (recent developments in the last year only)

- Updated strategic work plan to align with new initiatives and accomplishments. Submitted to IEA for review.
- **Annex XII – Tailored Engineered Surfaces** - Started research on the following activities:
 - Surface impacts on tire wear (pavement, street, road)
 - Microplastics impact on the environment
- **Annex XIII: Low Carbon Fuels** - Initiated four new subtasks
 - Subtask 1: Challenges of current biofuels
 - Subtask 2: Nanotechnology of biofuels
 - Subtask 3: Fuel/material/surface/lubricant challenges in green fuels
 - Subtask 4: Material/tribological challenges in fuel cells
- Reorganized structure to formally establish four Research Task Areas and five supporting subtasks for **Research Task Area 1**.
 - **Research Task Area 1 – Life Cycle Greenhouse Gas and Critical Materials Assessment**
 - Subtask 1a: GREET + Model Development for Automotive Life Cycle Assessment (Lead Country: United States)
 - Subtask 1b: Lightweighting of EVs (Lead Country: Canada)
 - Subtask 1c: Medium-Duty Truck Technology Assessment (Lead Country: United States)
 - Subtask 1d: Heavy-Duty Truck Technology Assessment (Lead Country: United States)
 - Subtask 1e: Critical Materials for Transportation (Lead Country: United States)
- Focused two existing IEA AMT Annexes and three research task areas on finding synergies with complementary TCPs
 - **IEA AMT TCP Annex VIII: Thermoelectric Materials and Thermal Management** exploring synergies with IEA's High Temperature Superconductivity (HTS) TCP, Hybrid Electric Vehicle (HEV) TCP and Advanced Motor Fuels (AMF) TCP
 - **IEA AMT TCP Annex XIII: Low Carbon Fuels** is exploring opportunities for expanding joint efforts with the IEA's Bioenergy TCP, Sustainable Combustion TCP and Advanced Motor Fuels (AMF) TCP
 - **Research Task Area 2: Advanced materials for Hydrogen**
 - Held mini workshop to help identify roadmap to commercialize hydrogen-fueled internal combustion engines.
 - Collaboration established with Hydrogen TCP, Hybrid Electric Vehicle (HEV) TCP, and other research activities including the US National Laboratories, Canada's National Research Council and Austria's corporate research updates
 - **Research Task Area 3: Carbon capture and utilization** and **Research Task Area 4: Green chemistry and sustainable materials** are exploring opportunities across several TCPs

Outlook to the Future (optional)

- Annex XI – Automotive Glazing
 - Final report summarizing 5 years or research on lightweighting glass and improve insulation

Dissemination and publications (other than EXCO meetings and workshops included below)

- Contributed to the revision of a new USDRIVE Roadmap for Lightweight, Sustainable, and Critical Automotive Materials, final publication expected in mid 2024.

Collaboration and Co-operation

Other IEA network TCPs and coordination groups

- Expanding the coordination between the AMT TCP and other IEA TCPs with related missions
 - Will expand new website platform to include a TCP coordination section to help align related research areas.
 - Developing a communication plan to continue conversations with TCPs where correlated research can occur.
 - Participating in two IEA TCP Coordinating Groups
 - Critical Minerals
 - Hydrogen

IEA secretariat

- AMT Annexes and Research Areas are assessing alignment to correlate research topics more closely. This may be through the two established TCP Coordinating Group or directly with related TCPs.

Membership

- Membership continues to be maintained at 11 member countries
 - Following up on inquiries from South Africa, Singapore and Thailand for information and procedures for possible participation to join AMT.
 - Discussing adding new country partners through our interaction with other TCPs.
 - Developing a “members-only” page on the AMT TCP website to house administrative documents.

Management

- Two EXCO meetings held since the last report:
 - One hybrid EXCO meeting held on June 29-30 in Vienna, Austria.
 - One virtual EXCO meeting held January 16-18, 2024
 - Review milestones and update the strategic work plan (SWP)
 - Focus on information exchange with other TCP members
 - Held a mini-workshop on H2 ICE challenges and developed input for a H2 ICE work plan
- AMT leadership position were not up for renewal. Current positions are:
 - AMT Chair: Jerry Gibbs (USA)
 - AMT Vice Chair Americas: Kumar Sadayappan (CAN)
 - AMT Vice Chair Asia: Shengqiang Bai (CHN)
 - AMT Vice Chair Europe: Carsten Gachot (AUT)
 - AMT Secretary (Acting): Thomas Perrot (USA)
- Annex task managers (active) continue to be:
 - Annex VIII: Thermoelectric Materials – Hsin Wang (USA)
 - Annex XI: Automotive Glazing - YS Yoon (KOR) – CLOSED 12/31/2023
 - Annex XII (NEW): Tailored Engineered Surfaces – Carsten Gachot (AUT)
 - Annex XIII (NEW): Low Carbon Fuels – Roberto Souza (BRA)
- Research Task Area Managers were assigned:
 - Research Task Area 1: Life Cycle Greenhouse Gas and Critical Materials Assessment – Christopher Kolodziej (USA)
 - Research Task Area 2: Advanced Materials for Hydrogen – Tilmann Hickel (DEU)
 - Research Task Area 3: Carbon Capture and Utilization – Özlem Özcan (DEU)
 - Research Task Area 4: Green Chemistry and Sustainable Materials – Özlem Özcan (DEU)
- EXCO meets semiannually to develop and evaluate ideas for new tasks, and to conduct a progress assessment of ongoing tasks.
 - Next IEA AMT TCP EXCO meeting (hybrid) scheduled for June 2024 in Toronto, Canada.

MEETINGS OR WORKSHOPS

Latest EXCO meetings			
Place	Date	Place	Date
Virtual meeting	1/16/2024 - 1/18/2024	Hybrid (Toronto, CA)	6/26/2024 - 6/28/2024

FUTURE ANNEX OR TASK MEETINGS

Annex/Task	Place	Date
None planned	TBD	TBD

CLOSED ANNEXES

Name	Objectives / key deliverables	Launch/end dates	Participants	Key learnings
Annex IV: Friction Reduction Surface Technology	Investigate technologies that could potentially increase fuel economy by 5-7% (combined) when fully adopted	2009 / 2019	Australia, China, Israel, South Korea, UK, US	<p>Developed a low-cost surface texture fabrication technique to facilitate possible commercialization.</p> <p>Verified the use of diamond-like-carbon (DLC) coatings that extend texture life.</p> <p>Verified the use of ultralow viscosity lubricants to improve fuel economy.</p>
Annex V: Advanced Corrosion Protection Technologies for Structural Magnesium	Advanced corrosion protection technologies for structural magnesium alloys used in transportation industry	2009 / 2012	Canada, China, Germany, US	A cost-effective cold spray coating was developed that showed successful corrosion control of magnesium alloys when used as automotive parts. This removes a major hurdle for the use of magnesium alloys in automotive application, lowering the weight of the vehicles
Annex VI: Carbon Fibers and Composites	Identify gaps in international standards and test methods	2009 / 2013	UK, US	AMT assessed the feasibility and means whether it is appropriate to develop the standards. Gaps in international standards and test methods were identified. The development and acceptance of appropriate standard test techniques were vital to promote widespread adoption.
Annex VII: Nanomaterials	Develop, evaluate and standardize	2009 / 2013	Canada, China, Germany, Israel, UK, US	The Annex staff determined to be impractical to reach the desired

	methods for testing mechanical properties of nanomaterials.			objectives due to technical barriers to achieve a precision statement.
Annex IX: Model-based Coatings	Integrate computational material engineering modeling with coating testing to develop advanced energy efficiency and durability coatings in engines	2012 / 2021	Australia, China, Israel, Finland, UK, US	Multiscale computational material science models revealed that surface roughness, coating defects played a crucial role in initiating microcracks leading to surface damage and higher frictions.
Annex X: Multi-materials Joining	Develop novel joining methods and improve joint mechanical and corrosion properties	2013 / 2021	Canada, Germany, South Korea, US	<p>Identified 5 standard materials for joining tests. The materials identified for testing were high strength steel sheet, aluminum sheet, magnesium sheet, and 2 carbon fiber composites.</p> <p>Evaluated conventional and unconventional joining methods such as refill friction-stirred spot welding, braze-welding, friction bit joining, ultrasonic welding, and friction self-piercing riveting, etc.</p> <p>Standardized joint types, sample sizes and shapes, and mechanical testing methods.</p> <p>More than 30 unique combinations of materials and joining methods were evaluated and results were shared with industry and stored in a database.</p>
Annex XI	Develop material specifications for automotive glass replacement materials, test method development and standardization of test methods	2017 / 2023	China, South Korea	Replacing glass with lighter weight polycarbonate-based materials and various coatings to improve the optical and UV resistance. Test methods and standards are also being developed.

ONGOING ANNEXES

Name	Objectives / key deliverables	Launch/end dates	Participants	Key learnings so far
Annex VIII: Thermal management	Develop thermoelectric materials for waste heat recovery in transportation industries.	2009 / 2028	Australia, Canada, China, Germany, South Korea, US	Material/device/system level integration strategies are needed to optimize thermoelectric, phase change material (PCM), thermal interface material (TIM) and other relative materials to manage thermal inputs.
Annex XII: Tailored Engineered Surfaces	Explore multiscale, multifunctional surface treatments for self-adjusting surfaces to maximize energy efficiency	2021 / 2028	Australia, Austria, Brazil, China, Israel, South Korea, UK, US	Identifying reliability improvement applications. Assessing new coating concepts using Selenides with nano-Se-powder and MXenes. Assess new lubricant materials by using computational approaches to combinatorial materials tribology. Model assessment using polycrystalline CuNi alloys.
Annex XIII: Low Carbon Fuels	Examine the effect of materials on low carbon fuels (biofuels, ammonia, eFuels, hydrogen, etc.) performance during power generation cycles.	2022 / 2028	Brazil, US	Establish engine testing protocols baseline (starting with biofuels) and seek industrial participation to access other fuel sources. Facilitate transition to low carbon fuels to reduce carbon emissions.

PLANNED ANNEXES

Name	Expected Objectives / key deliverables	Launch date	Potential Participants	Main planned activities
None	N/A	N/A	N/A	N/A

ACTIVE RESEARCH AREA TASKS

Name	Expected Objectives / key deliverables	Launch date	Potential Participants	Main planned activities
Task 1: Life Cycle Greenhouse Gas and Critical Materials Assessment	Develop a consistent and comparable LCA modeling platform to examine GHG effects of technologies spaces of the IEA transport TCPs in different global regions	June 2022	US (lead), Canada	<p>Build a user-selectable vehicle lightweighting module into GREET (US) and GREET+</p> <p>Investigate moderate ($\approx 10\%$) to higher ($\approx 25\%$) vehicle lightweighting with various lightweighting materials</p> <p>Update life cycle inventory for Advanced High Strength Steel (AHSS)</p>
Task 2: Advanced materials for hydrogen	Address material barriers to successfully deploy hydrogen as fuel for a commercial vehicle	June 2022	Germany (lead), US	<p>Investigate hydrogen embrittlement resistant alloys for combustion and catalysts for green hydrogen generation.</p> <p>Investigate materials suitable for hydrogen storage and fuel cell power units.</p>
Task 3: Carbon capture and utilization	Research will focus on the electrochemical catalytic conversion of carbon dioxide for chemical industries, converting this industrial by-product in useful products like synthetic fuels, syngas and carbon-based functional materials	June 2022	Germany (lead), US	<p>Developing nanoparticle-based electrocatalysts to increase the conversion rate.</p> <p>Initial efforts are focusing on developing copper-based catalysts that have shown high efficiency and selectivity when comparable to precious metal catalysts.</p>
Task 4: Green chemistry and sustainable materials	Address the need to move towards green chemistry, using renewable resources to produce products that can be both recycled and upcycled	June 2022	Germany (lead), US	<p>Initial efforts will explore the development of novel synthesis approaches for functional materials and material acceleration platforms (MAPs) which can support autonomous materials discovery. A special focus will be on the exploration of substitute materials that support the clean energy transition</p>

PLANNED RESEARCH AREA TASKS

Name	Expected Objectives / key deliverables	Launch date	Potential Participants	Main planned activities
None	N/A	N/A	N/A	N/A