



IEA AMT TCP

*(International Energy Agency Advanced Materials For
Transportation Collaboration Program)*

KATECH

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➤ Background



The transport sector worldwide accounts for 24% of direct CO₂ combustion emissions in 2016.



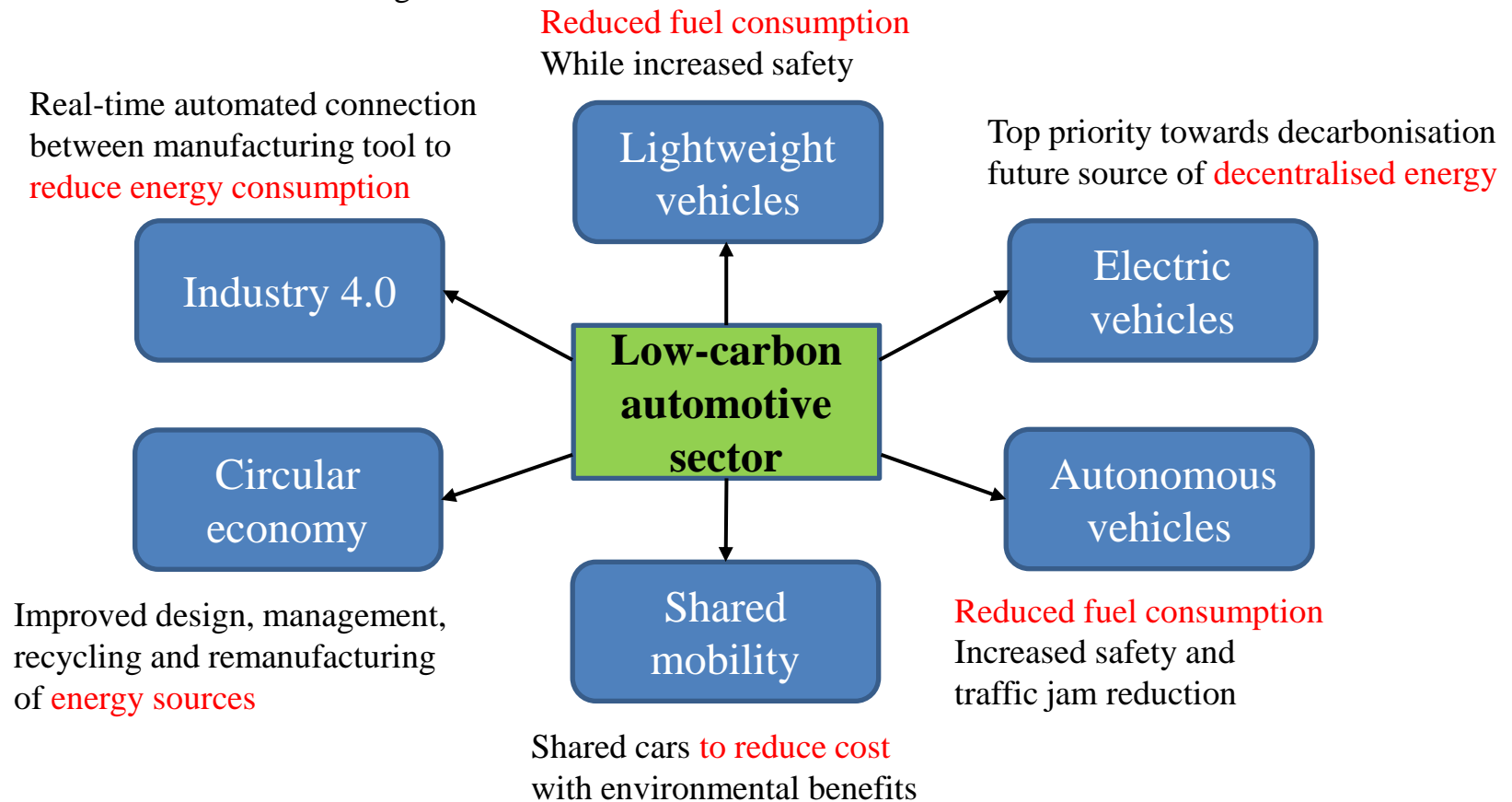
Limit value for carbon dioxide emissions

year	US	KOREA (Administrative notice)	EU (Domestic measurement method onversion value)
2021	110g/km	97g/km	95(91)g/km
2025	103g/km	89g/km	81(77)g/km
2030	Unpublished	70g/km	59(56)g/km


- By 2030, the standard will be strengthened with an average greenhouse gas of 70g /km and an average fuel consumption of 33.1 km / L
- The greenhouse gas reduce in the of future car

➤ Strategies towards a low-carbon automotive sector

- 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

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- The 4th industrial revolution.
 - Autonomous vehicles, internet of things (IoT), artificial intelligence (AI), machine learning (ML), are enabling and creating smart cities, digital manufacturing, 3-D automated printing, advanced robotics, and automated autonomous systems.
 - Transportation will be going through revolutionary changes from ownership driving to transportation on demand, autonomous EV, and zero carbon systems.
 - For all of these advances to be realized, **materials technology remains the building block for the next generation** of self-healing, self-adjusting autonomous systems.
 - Many of the changes will take place in the ten years.
 - At the same time, the legacy vehicles in the world will continue to produce carbon emission.
 - **Reducing this carbon source, dramatic energy efficiency improvement, design, ride share, and fast low cost public transportation will be needed**
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➤ **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 program includes the development of standard test methods, testing, demonstration and design guidelines

➤ Current membership

- ① Germany -- Bundesanstalt für Materialforschung und –prüfung (BAM);
 - ② United States -The United States Department of Energy (DOE)
 - ③ Canada – CanmetMATERIALS, Natural Resources Canada;
 - ④ China – Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Shanghai
Institute of Ceramics, Chinese Academy of Sciences
 - ⑤ United Kingdom- NPL, UK
 - ⑥ Australia- Curtin University, Perth, Australia
 - ⑦ Finland – TEKES, Finland (VTT designated by TEKES)
 - ⑧ Israel – Technion, Haifa, Israel
 - ⑨ Korea – Korea Institute of Energy Technology Evaluation and Planning (KETEP)
- (Official subscription: 2013)
- Austria – Österreichische Tribologische Gesellschaft – ÖTG, pending IEA official approval
 - Brazil -- Universidade Federal do Rio Grande – FURG, pending IEA official approval,



Australia



Canada



China



Finland



Germany



Israel



Korea



United
Kingdom



United
States



➤ AMT TCP Mission

- AMT focuses on achieving fuel economy improvement for the legacy fleet of currently 1.2 B vehicles, growing towards 2B in 2030.
- Fuel economy improvement remains a viable way to reduce greenhouse gas emission in a short term. Electrification will take a longer time to achieve climate policy goals.
- AMT focuses on selected material technologies to promote fuel economy, emission reduction, global warming mitigation, and facilitate the insertion of environmentally friendly and sustainable materials.
- AMT approaches include friction surfaces, ultra-low viscosity lubricants, coatings, lightweighting, and thermal management.
- The mission of AMT TCP is to conduct cooperative research activities on advanced materials technologies, and where appropriate, jointly develop new testing methods, standards, demonstrations to facilitate and validate new materials for the development of energy efficient, environmental friendly transportation technologies.
- And design guidelines and materials technology selection guides.



➤ AMT TCP Planned Contribution

- AMT has world class materials network across four continents focus on developing fuel efficient material technologies.
- The network provides a forum for material experts to exchange latest information and work together as a team to improve fuel economy in their regions as well as addressing global challenges in material technologies.
- Engine test results (or results from unique facilities) can be shared to enhance the combined capabilities, personnel exchanges can jump start collaboration on shared interests.
- International round robin studies (e.g. in thermoelectric material measurements) enable mutual learning experience together, sharing expertise and resulting in international standard practice.
- The diffusion of knowledge and expertise also enhances local economic well-being.
- In working together, we not only enhance the probability of success, we also multiply our resources towards our common goals.
- The goal of improved energy efficiency is in line with CERT's and EUWP's goals of reducing carbon emission.



➤ Achievements

- AMT has achieved **2.4% fuel economy improvement** with a novel ultra-low viscosity lubricant in a standard engine test.
- Surface texturing shows **energy efficiency improvement in the range from 1-3%** depending on the engine speed and load.
- **Annex XI on automotive glazing** has reported initial success substituting glass with polymers. First results in a road driving test are promising.

➤ Dissemination Activities

- Open technical symposia are being held in conjunction with every ExCo meeting



➤ AMT TCP Strategic Work Plan(2020-2030)

- COP21 pledged significant carbon reduction in the next ten years to curb global temperature rise to less than 2 degrees.
- The world vehicle fleet stands at 1.3B and is projected to grow to 2B by 2035.
- While the demand for energy largely remains the same, but the energy supply is shifting.
- US has become a major source of supply of oil and gas, which led to oil price instability.
- Wind and solar continue to be installed to prepare for the electrification of the transport sector by 2050.
- The world's industries appear to agree with the electrification and began investing heavily in EV in the last several years.



➤ **AMT program for the next 5 years:**

- The Strategic direction for AMT-TCP continues to focus on fuel economy improvement of vehicles by accelerating adoption of advanced materials for lightweighting, friction reduction, and thermal management.

① **Friction reduction (Annex IV):**

- Recent progress 2015-2020 and project to 2025: Surface technology including surface texture, coatings, and ultra-low viscosity lubricants.

The low viscosity lubricant, jointly developed with an industrial partner has achieved 2% fuel economy gain (using standardized engine tests) over current commercial lubricants.

② **Thermoelectric materials (Annex VIII):**

- Recent progress 2015-2020 to 2025: Five international round robin tests on thermal electric materials (Bismuth Telluride, half-Haessler) and devices have been conducted. The measurement methods have been improved.
- Rationale for future work: current studies on devices are continuing and the Annex will expand to include thermal management and EVs in the future.



③ Model-based coatings (Annex IX)

- Recent progress 2015-2020 to 2025: Multiscale computational material models have been developed. The effect of surface roughness on coatings has shown significant influence. The models have now incorporated lubricant effect on substrate damage.
- Rationale for future work: will continue to investigate how coatings can protect surface damage under a wide variety of operating conditions. Will also explore optimum coating design for specific applications.

④ Multi-materials Joining (Annex X)

- Recent progress 2015-2020 to 2025: A data base listing various joining techniques using standard sample specimens has been developed; various joining method of dissimilar materials are under investigations. .
 - Rationale for future work: the project will continue to generate data on the mechanical properties of various joints. The data base will be made available to industry.
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⑤ Automotive Glazing (Annex XI): Korea is leading

- Recent progress 2017-2020 to 2025: Advanced polymer replacing glass panel on cars is being tested in a vehicle, showing fuel economy improvements due to increased insulation and weight reduction. Currently advanced coatings are being tested
- Rationale for future work: continue to test various coatings to enhance reflectivity and optical properties.

⑥ Tailored Engineered Surfaces for energy efficiency (proposed Annex XII)

- New Annex proposed: based on the progress made from Annex IV, the Annex will explore multiscale multifunctional surface treatment for self-adjusting surfaces to maximize energy efficiency.
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➤ Anticipated output and impact

- 1) The low viscosity lubricant has been commercialized by the industrial partner. The surface material technology is being tested in engines by an engine manufacturer. Results showed 3% energy efficiency improvement.
- 2) More efficient and cost-effective thermoelectric materials will emerge as a result of the standards set by the Annex VIII, making waste heat recovery viable for trucks and other applications, improving fuel efficiency.
- 3) The model-based coating research will provide design guidelines for future coating solutions to be used in engine companies with enhanced durability and performance.
- 4) A joining method selection guide with mechanical properties of the joint will accelerate the development of multimaterials vehicles, creating optimum weight reduction and longer durability. Limited multimaterials vehicles have already been commercialized by vehicle manufacturers.



➤ Summary

- AMT has developed a strategy to make progress towards the goals specified in this report to **enable new material technologies for significant fuel economy improvements through weight reduction, friction control, and improved efficiency via novel materials.**
- The majority of our efforts for the upcoming term will focus on how to achieve the specific goals set out in the attached annexes.



➤ AMT-Korea 2020-25 Plan

- Goals of 2020-25 AMT-Korea Activities

- Continuous information exchange through experts network
- Investigation on the other country's R&D trend and strategy on vehicles
- Offer the information to the auto companies & universities
- Report on the technical investigation, R&D trend, EXCO minutes etc.
- **New Annex proposal on the environmental friendly materials**
- **Expand Automotive Glazing (Annex XI)**

- Goals Technical council of AMT-Korea

- Member : 5 researchers & 1 professor
 - Working area : surface texturing, coating, thermoelectric & joining, materials
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➤ Necessity of cooperation activities with AMT TCP

- The automobile industry is an industry that is essential for human welfare, global economy and environmental sustainability, and has given considerable value to Korea's national economy.
- Represents a variety of material expertise and professional responsibilities on four continents, and can share material solutions for future vehicle systems for energy security.
- By sharing technical information for the mutual benefit of member countries and conducting research activities negotiated with each other, related technologies will be able to contribute to the development of the domestic automobile industry.
- A material expert group that can provide material-based solutions for improving and improving vehicle fuel economy in the present and future, and providing standard test methods, vehicle tests, simulations, and design guidelines for applying related technologies. Need to accelerate
- Information related to advanced materials and applications developed between member countries will be able to contribute to the development and market access to the domestic automobile industry and materials industry in the future.



➤ To improve cooperation activities with AMT TCP

- Currently, AMT's technical activities consist of surface engineering technology, thermoelectric materials, multi-material bonding, and model-based coating development, making it difficult to derive overall issues for automotive core materials.
- It is necessary to configure customized materials and related technologies applicable to future vehicles such as electric vehicles and autonomous vehicles in the future.
- Domestic future automobile technology needs to preempt domestic technological excellence and technological superiority by actively introducing related technologies to international activities with the same level of technology as advanced countries.
- Necessary to secure experts in activities such as securing experts in domestic automotive material activities and presenting new Annex.



➤ Activity goal

- (1) IEA-AMT TCP Purpose International network formation and mutual information exchange of related technologies
- (2) Proposal of new Annex and subtask in AMT technology field
- (3) Consist of a domestic council for Korean's initiative Annex
- (4) International research trend survey of high-efficiency materials for automobiles and related technologies
- (5) Providing technical information related to domestic affiliated companies and academia, and inducing participation in activities



➤ **Goal**

Indicators	Items	Goal
Common indicators	Composition and operation of domestic council (about 5 people) and holding results	2
	Attend international conferences and analyze reports before and after attendanceComposition and operation of domestic council (about 5 people) and holding results	2
	Sectoral Annex or Task Activity Analysis Report	2
	Information dissemination	2
Individual indicators	New Annex or Task Proposal, Participation Activity	1
	Create or review ETP, Annual Report, or Technical Roadmap Reports	1
	Establishment and utilization of international networks	1



➤ Promotion strategies

- Active participation in IEA-AMT TCP, secure effective advanced technology by international network formation and mutual information exchange.
- Korea takes the lead in the technology of advanced automobile materials by providing and participating in new Annex and subtask in the AMT.
- Expansion of presenting new Annex and forming a national council for participation
- Information and technology acquired by IEA-AMT TCP activities will be shared with domestic related academic societies and spread domestically through the holding of symposiums.
- Providing technical information related to domestic affiliated companies and academia, and inducing participation in activities
- IEA-AMT TCP derivation of issues for international cooperation that can share the technologies of participating countries



➤ Draft composition of domestic council

- The TCP activity experts will be organized as an industry-academia-research council to proceed.
- Participated in the consultation as a member of the automobile industry as a member of the industry, consisting of experts in the Annex activities currently in progress ...
- Spreading and disseminating information through regular technical seminars among members of the council so that the information obtained from TCP can be spread both domestically and internationally
- Securing domestic experts to promote or participate in new Annex



➤ Personal introduction

- Personal history
 - Graduated from Chungbuk National University & received Ph. D. in 2005
 - Worked at Korea National University of Transportation from 2007 to 2010 as Adjunct-professor
 - Working for KATECH since 1996
- International activities experience
 - No experiences of internationally cooperating projects
 - AMT Activities since 2017
 - Currently, [AMT-TCP Annex XI Leader](#) since 2019

➤ Schedule

No	Contents of Activities	Schedule (Mon)					
		2021년					
		4	5	6	7	8	9
1	Organization of the council, and technical seminars						
2	Participation in EXCO meeting and preparation of analysis report						
3	Collection and dissemination of domestic and foreign technical information						
4	Preparation of annual report						
5	Preparation of report and next year plan establishment						



➤ Effect of IEA-AMT Activity as Member

- Participation Effect
 - Possible to cope rapidly for the technical changing on AMT
 - Strengthen the international network on the Automotive Materials & Technologies
 - Possible to exchange the new technical information on the automobile
 - Possible to take part in the New Annex planning & project collaboration
 - Reduction of technical and trade barrier to deployment of new materials
 - Greenhouse gas emission reducing & fuel efficiency rising
 - Preoccupation of technology by presenting and participating in Annex led by Korea
 - Expanding the composition of domestic consultative for presenting and participating in new Annex
 - Possible to draw international cooperation projects to share the technologies of IEA-AMT TCP participating countries



➤ Effect of IEA-AMT Activity as Member

- Application
 - Offer the technical information to the Auto companies
 - Lead the promotion on the AMT technologies of our companies
 - Announce our technologies to world wide