Effects on air quality of semi-volatile engine emissions

EASVOLEE

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Special Interest Articles

About EASVOLEE

The research project "**Effects on Air quality of Semi-VOLatile Engine Emissions** (EASVOLEE) GA-101095457 — EASVOLEE — HORIZON-CL5-2022-D5-01 / HORIZON-CL5-2022-D5-01-07" is implemented under the EU- Horizon Europe Research and Innovation Action (2021-2027).

The primary objectives of EASVOLEE are to: i) Quantify the contributions of secondary PM formation from transport engines to air quality problems in Europe, ii) Develop and identify health-related metrics, mitigation strategies, and policies to improve air quality limiting the concentrations of aerosol (organic, inorganic, nanoparticles, primary and secondary) due to vehicle exhaust. EASVOLEE will improve our understanding of organic emissions from vehicle exhaust including low-volatility (LVOCs), semi-volatile (SVOCs), intermediate volatility (IVOCs) and volatile organic compounds (VOCs). It will elucidate the corresponding secondary aerosol formation (both organic and inorganic) and characterize the health effects of these primary and secondary particles.

EASVOLEE Kick Off Meeting

The 2-day EASVOLEE project Kick-Off meeting held in February 22-23, 2023 in Patras, Greece.

With 25 participants, representing 6 beneficiaries and 2 associated partners, the project Kick-Off meeting proved very fruitful for the initiation of the project. The Kick-Off meeting allowed the review of the scope and structure of the project, its overall management concepts, and the detailed work plans of the individual work packages.

Sessions for the six WPs focused on better shaping the workflows and initiated successfully the EASVOLEE. Meeting breaks were also used for informal discussions and preparations of the next steps.

The EASVOLEE Kick-Off meeting served successfully all its purposes based on its designed and served as a promising start of the project.

Figure 1. EASVOLEE group photo of the Kick Off Meeting

Figure 2. Impression from the KoM Room

EASVOLEE has received funding from the European Union's Horizon Europe (2021-2027) research and innovation programme under grant agreement No 101095457.

Consortium

The EASVOLEE consortium (8 partners from 6 countries) mobilizes the diverse interdisciplinary knowledge needed to match the projects' objectives; complementary expertise is brought in within each discipline. The consortium is using state-of-the-art infrastructure, performs ground-breaking research adopting open science practices and has strong experience in transforming scientific results in support of technology development and policy relevant information for societal and economic benefit.

EASVOLEE state-of-the-art techniques

EASVOLEE will characterize engine exhaust emissions and their effects on air quality and public health using state-of-the-art measurement and modelling techniques.

- Measurement of emissions:
  - under real driving conditions

Figure 3. CRMT installations for RDE emission measurements of: (a) bus; (b) car; (c) street sweeper; (d) flow measurement in a truck; (e) PEMS and FTIR.

  - under simulated driving conditions on a dynamometer
  - in a parking structure

Figure 4. A parking structure that SOA formation experiments can be performed

  - in a traffic tunnel

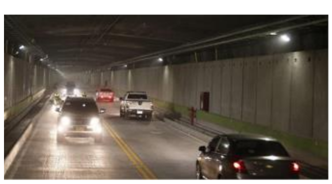

Figure 5. A traffic tunnel that SOA formation experiments can be performed

- Measurement of all organic pollutants that are relevant to aerosol formation (volatile, intermediate volatility, semivolatile, low-volatility organic compounds)
- Quantification of atmospheric processing using oxidation flow reactors and mobile atmospheric simulation chambers.

Figure 6. The FORTH mobile laboratory with the mobile smog chamber facility.

- Oxidative potential measurements
- Mechanistic understanding of biological effects using cells
- Development of a new state-of-the-art European emission inventory
- Creation of new emission indexes

"A powerful analytical approach to the characterization of the emissions and the products of their processing is one of the major strengths of EASVOLEE."

Overall structure of the work plan

"EASVOLEE will create high-quality new knowledge on vehicle exhaust emissions accounting for the combined effects of solid particles emissions and the formation of secondary organic and inorganic aerosol as well as the toxicity of these pollutants"

Emissions of organic pollutants of all volatilities (VOCs, IVOCs, SVOCs, and LVOCs), size-dependent particle emissions (including semivolatile material), ammonia, black carbon, and standard pollutants (NOx, SO_2, etc.) will be measured in WP1. Measurements will cover a variety of vehicles and will be performed under real and simulated driving conditions leading to a new pan-European emission inventory for engine exhaust emissions.

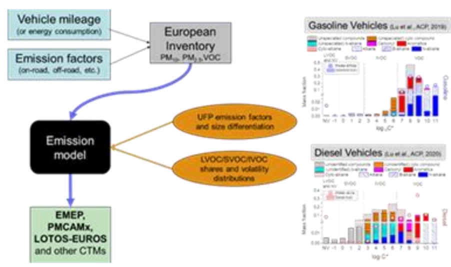

Figure 7: Proposed emission modelling system for the EASVOLEE inventory.

The atmospheric processing of these emissions will be quantified in the same campaigns using both oxidation flow reactors and atmospheric simulation chambers (WP2). The toxicity of both the fresh and the processed emissions will be quantified in WP3.

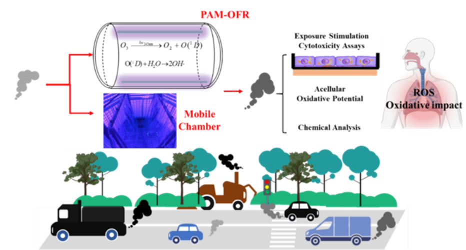

Figure 8. Schematic of the EASVOLEE health-related measurements

We will extend and evaluate the three EASVOLEE families of chemical transport models using the results of our measurements (WP4). The models will be used to quantify the role of exhaust emissions in current air quality and to investigate the effectiveness of different policies for their control (WP5).

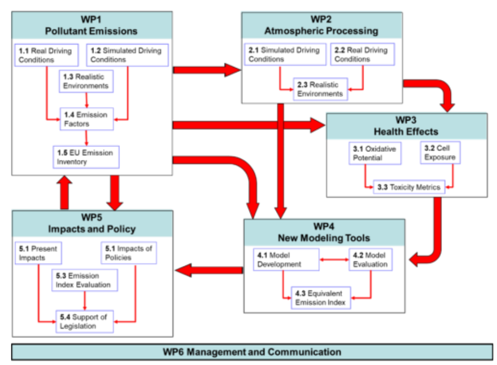

Figure 9. Graphical presentation of EASVOLEE components and their inter-relations.

Expected Impacts/Outcomes

Outcome 1: Achieve better understanding of (semi)volatiles particles and secondary aerosol formation as well as their effects on health, air quality (in particular during winter season) and climate.

Outcome 2: Assess the contribution to $PM_{2.5}$ of precursors present in exhaust from transport through the formation of secondary aerosol.

Outcome 3: Find ways in which scientific evidence of the role of emissions in atmospheric processes could be an input to develop policies and mitigate SOA formation in urban areas of EU.

Outcome 4: Improved quantification of transport externalities.

Outcome 5: Support of future emissions legislation and "polluter pays" legislation.

ZERO POLLUTION AMBITION

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EASVOLEE target groups

A. Research/scientific communities

Higher education institutions; Atmospheric scientists; Epidemiologists; Air quality engineers; Automotive experts.

B. Public authorities and Government

The European Commission, European Governments (e.g., Ministries of Transport and Environment), other public institutions (e.g., cities).

C. International bodies

International bodies on air quality and climate change, (UNECE, UNFCCC, GEIA) and health (WHO).

D. Private sector/Industries

The EU automotive industry (design, development, production of engines and control technologies through ACEA (15 largest car makers), businesses in the environmental sector, and instrument development companies.

E. General public and society

Citizens (health and air quality awareness), NGOs, consumer protection entities, health authorities, civic society organizations (regional, international with health and climate change foci), regional and international media.

About FORTH/ICE-HT

The Institute of Chemical Engineering Sciences (ICE-HT) was established and began operating at Rio-Patras in 1984 as an independent academic institute. In 1987 ICE-HT was incorporated into the structure of the Foundation of Research and Technology-Hellas (FORTH). This comprises of a network of eight institutes that report directly to the General Secretariat of Research and Technology of the Ministry of Development and Investments. In addition to fundamental research, the FORTH/ICE-HT currently conducts applied and technological research in a great variety of fields and provides specialized services to industry. The Center of Studies on Air quality and Climate Change (C-STACC) is part of the FORTH/ICE-HT. It aims to understand how atmospheric processes impact climate, health and ecosystems through a combination of theory, measurements and simulations.

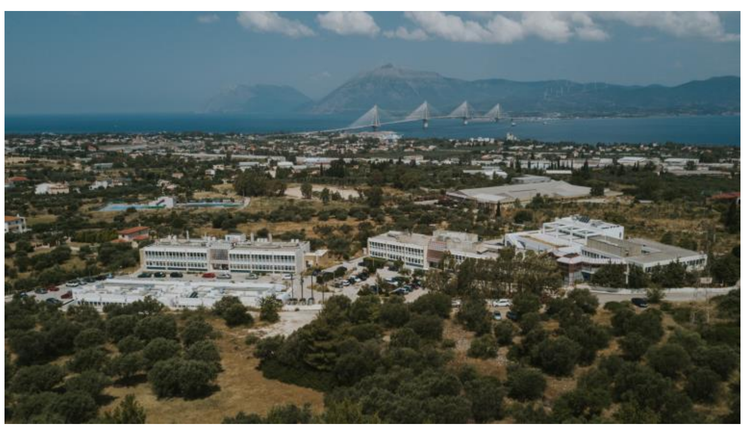

Figure 10. A view of the FORTH/ICE-HT buildings