HUNGAIRY

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HERMAN OTTÓ INTÉZET NONPROFIT KFT.

MOVING TOWARDS CLEAN AIR FOR EUROPE

9-10. 11. 2021.

INTERNATIONAL CONFERENCE ON AIR POLLUTION

INTERNATIONAL CONFERENCE ON AIR POLLUTION – MOVING TOWARDS CLEAN AIR FOR EUROPE

PROGRAMME

AND

BOOK OF ABSTRACTS

virtual conference

9-10 November 2021

Dear Participants,
Dear Colleagues,

We proudly announced the "International Conference on Air Pollution – Moving Towards Clean Air for Europe". This conference is organized in the framework of the HungAIRy LIFE integrated project coordinated by Herman Ottó Institute Nonprofit Ltd. Our aim is to bring together the experts, decision makers and other relevant stakeholders working in different regions across Europe to discuss many important air pollution issues. It is well known that air pollution poses the largest environmental health risk in Europe and has a significant impact on the climate of our planet. Several efforts have already been made to reduce the concentration of the key air pollutants in Europe; however, it is clear that the reduction of the emission of air pollutants in the different sectors is still needed to comply with the standards and guidelines. The international nature of the presenters (Bulgaria, Czech Republic, France, Germany, Hungary, Italy, Ireland, Poland, Portugal, Slovakia and Spain) and the wide range of participating institutions make this conference a truly international event, leading to an excellent opportunity for the participants to share their knowledge and get in contact with different ideas.

The topics to be discussed include, but are not limited to:

- air quality modelling,
- new technologies and networks in air quality monitoring,
- emission reduction strategies and practices in different sectors (e.g. residential, traffic, agriculture),
- monitoring the impact of activities,
- communication strategies and good practices,
- policy uptake,
- effects of air pollution on the health, climate and the built environment.

Presentations from both ongoing and recently completed projects, especially those are funded under the European Union's LIFE programme will be presented. Furthermore, experts presenting international projects funded under other programmes (e.g., Horizon 2020) will also be present at the conference.

We are looking forward to meeting you online on 9-10 November 2021!

The HungAIRy LIFE IP team

PROGRAMME

Day 1 – 9 November 2021 (Tuesday)

8:00-8:30	**Virtual welcome coffee/tea and connection checks**

8:30-9:00	**Opening** **Péter Bozzay**, Executive Director, Herman Ottó Institute Nonprofit Ltd., Hungary **Dr. Hunor Orbán**, Head of Department, Department of Environmental Preservation, Ministry of Agriculture, Hungary **Dr. Fabio Leone**, Head of Sector, Unit LIFE and Eco-Innovation, CINEA, European Commission **Guido de Wilt**, Policy Officer, European Commission

Plenary speaker	
9:00-9:30	**Guido de Wilt**, Policy Officer, European Commission **Clean Air: Policy developments in the EU**

Session I.	
9:30-9:50	**Adrianna Frankowska**, Tomasz Pietrusiak **LIFE Integrated Project "Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere"**
9:50-10:10	Violeta Hristova, **Dochka Velkova** **Towards cleaner air in Bulgaria with LIFE IP CLEAN AIR**
10:10-10:30	**Tamás Szigeti**, Nóra Koplányi, Viktória Doró-Laukó, Barbara Bezegh, Ildikó Babcsány, Orsolya Józsa, Dóra Simon **Introduction to the LIFE IP HungAIRy and the first achievements**
10:30-10:50	Marco Deserti, **Katia Raffaelli** **The project LIFE IP PREPAIR for the improvement of Air Quality in the Po Valley: main outcomes and results**
10:50-11:10	**Gabriel Adamek,** Zuzana Kopinová **Potentials and challenges of air quality improvement funding**

11:10-11:30	**Virtual coffee/tea break**

Session II.	
11:30-11:50	**Tymoteusz Sawiński**, Anetta Drzeniecka-Osiadacz, Magdalena Korzystka-Muskała, Marek Kowalczyk, Joanna Kubicka, Piotr Modzel, Arkadiusz Remut, Katarzyna Rutkowska **Integrated air quality information system as an educational tool supporting air quality improvement - experience from implementation of the LIFE-MAPPINGAIR/PL Project**

11:50-12:10	**Anetta Drzeniecka-Osiadacz**, Magdalena Korzystka-Muskała, Marek Kowalczyk, Piotr Modzel, Tymoteusz Sawiński **The effectiveness of UAV in Vertical profiling of PMx from residual heating - case study from Wrocław, SW Poland**
12:10-12:30	**Patrick Kenny** **LIFE Emerald**
12:30-12:50	**Csongor Báthory** **First operational experience of a high-resolution particulate matter monitoring system in Miskolc**
12:50-13:10	András Hoffer, Beatrix Jancsek-Turóczi, Ádám Tóth, Gyula Kiss, Anca Naghiu, Erika Andrea Levei, Luminita Marmureanu, Attila Machon, **András Gelencsér** **Emission factors for PM_{10} and polycyclic aromatic hydrocarbons (PAHs) from illegal burning of different types of municipal waste in households**

E-poster session	
13:10-13:15	**Boglárka Sára Balogh**, Zsófia Csákó, Zoltán Nyiri, Tamás Szigeti **Investigation of the effect of solid fuel burning on air quality and human health**
13:15-13:20	Emese Farkas, **Katalin Uramné Lantai** **Improvement of air quality in Miskolc by reducing the burning of green waste and by promoting local composting**
13:20-13:25	**Katalin Uramné Lantai** **Communication of the high-resolution particulate matter monitoring system in Miskolc**
13:25-13:30	Éva Borbála Anka, Mihály Fehérvári, Kinga Lőcsei-Tóth, Renáta Tusák, **Ákos Ulmer**, Gergő Vass **Introduction of a new loading area booking system in Budapest**

End of Day 1

Day 2 – 10 November 2021 (Wednesday)

8:00-8:30	**Virtual welcome coffee/tea and connection checks**

Plenary speaker	
8:30-9:00	**Roman Perez Velasco**, Technical Officer, WHO Regional Office for Europe **WHO Global Air Quality Guidelines 2021: Setting ambitious goals for air quality to protect public health**

Session III.	
9:00-9:20	**Susana Marta Almeida**, Vânia Martins, Tiago Faria, M. Dionisi, Nuno Canha, Evangelia Diapouli, Manousos-Ioannis Manousakas, Konstantinos Eleftheriadis, Ana Isabel Miranda, Joana Ferreira, Hélder Relvas, Antti Korhonen, Heli Lehtomäki, Otto Hänninen, Mihalis Lazaridis, Eleftheria Chalvatzaki **Implementation of the LIFE Index-Air Exposure - Dose Management Tool in 5 European Cities**
9:20-9:40	**Éva Csobod**, Péter Szuppinger **The ClairCity (Citizen-led air pollution reduction in cities) project - outcomes**
9:40-10:00	Guy Brasseur, **Bastien Caillard**, Cathy Li, Olivier Salvi **AQ-WATCH: "Air Quality: Worldwide Analysis and Forecasting of Atmospheric Composition for Health"**
10:00-10:20	**Pierre Sicard**, Fatimatou Coulibaly, Morgane Lameiro, Alessandra De Marco, Jacopo Manzini, Yasutomo Hoshika, Elena Paoletti, Antoine Nicault, Sébastien Berge-Lefranc **AIRFRESH: Air pollution removal by urban forests for a better human well-being**

10:20-10:40	**Virtual coffee/tea break**

Session IV.	
10:40-11:00	**Jens Hürdler** **What's about agricultural emissions?**
11:00-11:20	**Sergio Sanz-Bedate**, Dolores Hidalgo **Global system for Sustainable TRAffic management – LIFE GySTRA**
11:20-11:40	**Dolores Hidalgo**, Sergio Sanz-Bedate **Noise and Emissions Monitoring and radical mitigation – NEMO project**
11:40-12:00	**Jan Bruns** **Enabling SME forwarders to shift transports to sustainable rail**
12:00-12:20	**Gabriela Kalužová**, Kateřina Bonito **CLAIRO – Clear air and climate adaptation in Ostrava and other cities**
12:20-12:40	**József Lezsák** **LIFE-IP North-HU-Trans - North Hungary in Transition**

End of the Conference

Abstracts

LIFE Integrated Project "Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere"

Adrianna FRANKOWSKA, Tomasz PIETRUSIAK

the Marshal's Office of the Małopolska Region, Cracow, Poland

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Keywords: *air quality, LIFE integrated project, anti-smog resolutions, Malopolska Air Quality Plan, eco-managers*

Abstract:

Southern Poland is one of the regions in the EU with the highest air pollution levels. The Malopolska Region suffers from extremely poor air quality, especially during the winter months. Particulate matter and benzo(a)pyrene concentrations are extremely high throughout the region. In response to this situation, the Małopolska Air Quality Plan (MAQP) determines different tasks for local governments in order to change the status quo of air quality in the region, with a focus on household heating systems. However, the level of implementation of these actions determined by the Plan prepared in 2013 in the past was insufficient. In order to accelerate and smooth the way for improving air quality in the Region, the LIFE Integrated Project "Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere" assists in the effective use of available financial resources and legal tools. As one of the actions of the LIFE Integrated Project, a network of Eco-managers covering 62 beneficiary municipalities has been created. Eco-managers are responsible for the implementation of tasks arising from the Air Quality Plan at local level. In addition, at the regional level, the Excellence Centre was established within the Marshal's Office of the Małopolska Region to provide training and a knowledge base for all local authorities in order to assist municipalities in the implementation of their activities. The LIFE Integrated Project contributes to the implementation of local regulations introduced as a result of the Air Quality Plan for the Małopolska Region. For example, The Małopolska Regional Parliament passed Anti-smog resolutions for Kraków and Małopolska Region forced to eliminate old inefficient boilers and also a ban of the use of solid fuels in Kraków.

Towards cleaner air in Bulgaria with LIFE IP CLEAN AIR

Violeta HRISTOVA[1], Dochka VELKOVA[2]

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Keywords: *air pollution, domestic heating, replacement*

Abstract:

The oral presentation of the **LIFE IP CLEAN AIR with cover:**
Bulgarian Municipalities Working Together to Improve Air Quality - LIFE IP CLEAN AIR at a glance – budget, duration, coordinating and associated beneficiaries, main objectives
Preparatory activities and work done for designing the Scheme for replacement old heating devices with new alternatives - analyses, studies, surveys, consultations, outcomes. *The core of the IP is reduction of the PM_{10} and $PM_{2.5}$ pollution from household heating through replacement of old wood and coal burning devices of 10500 households in the 6 cities with environmentally-friendly alternatives (500 households in the pilot phase and 10000 in the main phase) within a developed Scheme for transition towards alternative forms of heating.*
Lessons learnt for the pilot testing the Scheme for replacement old heating devices – implementation process – application process, ranking, contracting households, tendering and procurement of new heating devices, assessment of the results via different channels and viewpoints, and outlining areas for implement of the implementation of the Scheme in the main phase; information dissemination and awareness raising.
We are not alone in our efforts for air pollution reduction - the complementary action
Challenges ahead – recruitment of applicants, COVID-19 crisis, cost increase.

Introduction to the LIFE IP HungAIRy and the first achievements

Tamás SZIGETI, Nóra KOPLÁNYI, Viktória DORÓ-LAUKÓ, Barbara BEZEGH, Ildikó BABCSÁNY, Orsolya JÓZSA, Dóra, SIMON

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Keywords: *air pollution, air quality plan, Hungary, emissions, air quality monitoring*

Abstract

The overall aim of the LIFE IP HungAIRy is to improve ambient air quality in 10 Hungarian municipalities (Békéscsaba, Budapest, Debrecen, Eger, Kaposvár, Karcag, Miskolc, Pécs, Szolnok, Tatabánya) across 8 of the country's regions. The project has officially started on 1st January 2019 and will run until the end of 2026. In the frame of the project, an eco-manager network has been established to increase the capacities at the participating municipalities. Tasks of the experts of the network include, among others, (i) organization of awareness raising campaigns, (ii) biannual revision of air quality plans, (iii) monitoring the funding programs and open calls. Regional and local emission databases have already been improved; however, further data collections will also be performed. A decision supporting tool for predicting the effect of different measures on air quality is under development. This tool will provide support to the partners during the revision of the air quality plans. Two new air quality monitoring stations are under construction in two cities that have not had monitoring stations yet. A particulate matter monitoring network including 60 low-cost sensors has started its operation in one of the partner cities. This network will be extended. Different pilot activities on the reduction of residential (e.g. regulation of burning of garden waste, promotion of district heating) and traffic emissions (e.g. development of a smart parking system, new mini public bicycle systems) are under development. The reduction of the agricultural emissions is targeted by a voluntary program. Different communication materials targeting adults and children have already been produced as well as several national awareness raising campaigns have been organized. The environmental, social and economic impact of the project activities are monitored in the project with the first assessments completed in 2020. Besides the project activities, several actions must be taken at national, regional, and local levels to considerably reduce air pollution, thus the partners of the LIFE IP Hungary are focusing on facilitating and integrating new proposals.

The project LIFE IP PREPAIR for the improvement of Air Quality in the Po Valley: main outcomes and results

Marco DESERTI[1], Katia RAFFAELLI[2]

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Keywords: *air quality, air pollution, Po Valley, integrated project*

Abstract

Introduction
The Po Valley represents an exceedance zone of the air quality limit values for PM, NO_2 and O_3. This area covers the territory of most Italian northern Regions and includes several urban agglomerates. Although all the Regions in the Po Valley have been implementing air quality plans (AQPs) over the last decades, such plans turned out not to be fully effective in achieving a sufficient reduction of pollutant levels below the EU limit values. Previous experience demonstrates that coordinated and large-scale actions are necessary in this area.

The project
The LIFE IP PREPAIR was financed in 2016 with the aim of improving air quality in the Po Valley. PREPAIR aims at implementing the measures foreseen in the regional air quality plans and in the Po Valley agreement at a larger scale. The actions are extended to Slovenia in order to assess and reduce pollutants transportation across the Adriatic Sea.
PREPAIR supports the implementation of 7 AQPs affecting the health and life quality of 28 million people living in a territory of 135,000 km2. It addresses six *thematic pillars*: Agriculture, Biomass, Transports, Energy, Air Quality, Emissions and special stations.

Main outcomes
The PREPAIR air quality monitoring and evaluation system allows to collect and share data necessary to evaluate the effectiveness of AQPs and the implementation of the measures. The emissions inventory identifies the main contributions to the emissions of particulate matter and its precursors. Future emission scenarios consider the AQPs, the agreements between national and regional administrations and the PREPAIR actions, in the context of the EU current legislation. The expected reductions should allow to achieve the EU PM10 limit value in the Po Valley by the year 2025.
After the COVID-19 pandemic, the effects of *lockdown* measures on air quality were evaluated. The results, once again, highlighted the complex dynamic of PM and the relationship between precursors and transport, diffusion and physic-chemical processes determining the formation of secondary PM, which constitutes a significant part (up to 70%) in the Po Valley. This dynamic is strongly influenced by weather conditions and can lead to exceedance episodes, although of lower intensity compared to that occurring in usual conditions.

Potentials and challenges of air quality improvement funding

Gabriel ADAMEK, Zuzana KOPINOVÁ

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Keywords: *air quality improvement, funding instruments*, *indicators of air quality improvement*

Abstract:

The European financial response to the COVID-19 pandemic and Green Deal goals has been unprecedented. Huge volumes of resources are being pledged, committed and mobilized from diverse organizations through diverse funding instruments; however, getting an accurate and comprehensive understanding of the extent and detail of the response is difficult. The ambient air quality in air quality management areas in Central and Eastern Europe can benefit from planned resources, however the fine-tuning of individual programs, projects and tools has to go in line with the proper set up of the indicators of air quality improvement.
This Paper indicates the potentials and highlights the challenges of actual and upcoming funding in order to reach the most efficient solutions.

Integrated air quality information system as an educational tool supporting air quality improvement - experience from implementation of the LIFE-MAPPINGAIR/PL Project

Tymoteusz SAWIŃSKI, Anetta DRZENIECKA-OSIADACZ, Magdalena KORZYSTKA-MUSKAŁA, Marek KOWALCZYK, Joanna KUBICKA, Piotr MODZEL, Arkadiusz REMUT, Katarzyna RUTKOWSKA

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Keywords: *air pollution, PMx, air quality forecasts, low-cost sensors, mobile measurements, education*

Abstract:

Poland is struggling with a significant problem of air pollution emitted from the household sector. High concentrations of PM and B(a)P are associated with the widespread use of solid fuels for heating purposes and a significant share of obsolete heating devices. Despite the introduction of local law - the so-called "anti-smog resolutions" and government and local programs supporting the replacement of obsolete heating systems - many Polish residents still do not fully accept the necessity of such activities. This indicates the need for educational and information actions aimed at increasing the awareness of residents about the air quality in their immediate vicinity. These challenges have been met by the LIFE-MAPPINGAIR/PL project implemented since 2019 by the University of Wrocław, Wrocław University of Technology, and the Municipality of Bydgoszcz in the area of two Polish cities - Wrocław and Bydgoszcz.
Within the Project, a platform was prepared consisting of a system that provides air quality forecasts (currently WRF-Chem model, ultimately also ensemble forecasts with EMEP model and high spatial resolution forecasts with uEMEP model), as well as a measurement network including 40 low-cost PM concentration sensors. The sensor's network was developed and prepared as part of the Project and located in the Wrocław and Bydgoszcz agglomerations. As a complementary information, we also use the results of mobile PM concentration measurements carried out in the Project area.
Obtained data are used in educational and information activities, including the publication of daily resume of forecasts, thematic educational articles on the current air quality (in social media and the Project website), as well as direct educational activities for children, youth, and adults (including seniors) as well as educators, NGOs, and local authorities. The advantage of this approach is the enhancement of the educational effect by linking the presented information with a place of residence of the message recipients.

The research was carried out under the Project "Do you know what you breathe?" – educational and information campaign for cleaner air LIFE-MAPPINGAIR/PL, financed by the European Union under the LIFE Financial Instrument and co-financed by the National Fund for Environmental Protection and Water Management.

The effectiveness of UAV in Vertical profiling of PMx from residual heating - case study from Wrocław, SW Poland

Anetta DRZENIECKA-OSIADACZ, Magdalena KORZYSTKA-MUSKAŁA, Marek KOWALCZYK, Piotr MODZEL, Tymoteusz SAWIŃSKI

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Keywords: *particulate matter, vertical profile of PMx, atmospheric boundary layer, UAV*

Abstract:

The air quality in Poland belongs to the worst across Europe. The main problem is the emission from residential heating sources during winter. In many places, the EU limit value in reference to PM_{10}, $PM_{2.5}$, and B(a)P has been exceeded for many years contributing to more than 40 000 premature death yearly in Poland.
This study presents the results of the vertical profile of PMx measurements involving Matrice 600 hexacopter equipped with a prototype environmental measurement head. The measurements have been carried out since 2017 in Wrocław, SW Poland. The main aim of the research was to analyse the variability of the concentration of particulate matter in the vertical profile up to 350 m a.g.l.
The UAV-based system enables us to measure the $PM_{2.5}$, PM_{10} concentration, as well as air temperature and relative humidity. Furthermore, all flight parameters are recorded. To ensure the highest precision of the measurements, an ascent speed of 1 m/s was assumed, and all data are gathered with 1 second, and about 1 m resolution. To characterize the meteorological conditions during the field experiments the basic meteorological data extended with acoustic sounding (by means SODAR) of the lower part of the atmosphere were used. All background data were provided by the Meteorological Observatory of the University of Wrocław.
The study focuses on the vertical distribution of PM depending on the structure of the atmospheric boundary layer and weather conditions. Analysis indicates the strong vertical variability of PM_x concentration due to temperature lapse rate and effective height of emission sources. Gathered data provide i.e., additional knowledge of the processes of accumulation and dispersion of pollutants within the urban atmospheric boundary layer, and can also be used as input or verification data in air quality modelling.

The research was carried out under the Project "Do you know what you breathe?" – educational and information campaign for cleaner air LIFE-MAPPINGAIR/PL, financed by the European Union under the LIFE Financial Instrument and co-financed by the National Fund for Environmental Protection and Water Management.

LIFE Emerald

Patrick KENNY

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Keywords: *LIFE, Emerald, air, modelling, forecast*

Abstract:

The LIFE Emerald project will strengthen air quality management in Ireland to ensure effective implementation of the EU Ambient Air Quality Directives.
The project partners are the Environmental Protection Agency (EPA), Department of the Environment, Climate and Communications (DECC), Health Service Executive (HSE), University College Cork (UCC), VITO NV, and the Asthma Society of Ireland. The confirmed stakeholders are the Department of Transport (DOT), Transport Infrastructure Ireland (TII), An Taisce, Central Statistics Office (CSO), Dublin City Council (DCC), Met Éireann, Scottish Environmental Protection Agency (SEPA), and the Irish Thoracic Society.
The key tasks/action of the project are:

1. Production of a **3-day national forecast** system that would also include high resolution elements for urban areas, linked to the Air Quality Index for Health (AQIH).
2. **Nowcast maps** providing estimates of air quality across the country between monitoring points, based on the existing monitoring network observations.
3. Production of **historical national and city level baseline maps**.
4. Development of an **air quality management dashboard** to predict, assess and plan air quality.
5. **Spatial representativeness study** of the Irish Monitoring Network.
6. Availability of the hourly modelled data for the **independent verification** of performance for EU policy verification purposes.
7. Development of the **National and EU reporting structures** for modelling.
8. **Emissions projects** on transport and residential combustion, building on experiences of previous projects such as the Curious Noses citizen science project.

First operational experience of a high-resolution particulate matter monitoring system in Miskolc

Csongor BÁTHORY

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Keywords: *particulate matter, monitoring, sensor*

Abstract:

Establishment of the particulate matter (PM_{10} and $PM_{2.5}$) monitoring system in Miskolc was made by installing 60 pieces of small air quality measurement devices, which distribution representing the whole area of the city in the framework of the LIFE IP HungAIRy. The university intends to use the monitoring system for research, and the municipality intends to use it to measure the impact of the measures to be taken.
The sensor-based measurement devices were designed to low cost and low energy consumption. The accuracy of the measured data is lower than instrument corresponding to the reference method but with adequate calibration they should provide data satisfactorily enough to explore local problems, inspect tendencies. Calibration was made in climate chamber with TSI DustTrak for all the measurement devices. Installation locations were designated to buildings of local government institutions, companies, and private persons houses, where power supply is continuously provided. The devices transmit their data through 2G network to the server of the university where data storage, and archiving are performed. To visualize and make public the date a website was developed under the address pmmonitoring.hu, where the actual and past pollution levels can be viewed on a map.
Evaluable measurements were stared in September of 2021. Despite the short period, we can already make some basic findings about the distribution of air pollution in the city.
The daily course of particulate matter well known in the literature can be detected at most measurement points. The heating season has just begun, but the higher air pollution in the typically solid-fired areas, as well as the effects of the city's valley location and the prevailing wind directions, can also be seen.

Emission factors for PM_{10} and polycyclic aromatic hydrocarbons (PAHs) from illegal burning of different types of municipal waste in households

András HOFFER[1], Beatrix JANCSEK-TURÓCZI[2], Ádám TÓTH[2], Gyula KISS[1,2], Anca NAGHIU[3], Erika Andrea LEVEI[3], Luminita MARMUREANU[4], Attila MACHON[5], András GELENCSÉR[1,2]

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Keywords: *illegal waste burning, laboratory test combustion, particulate emissions, PM_{10}, PAHs*

Abstract:

It is a common practice in the developing countries and in some regions of Europe that solid wastes generated in the households (e.g. plastic beverage packaging and other plastic wastes, textile wastes, fibreboards, furniture, tyres, and coloured paper waste) are burned in wood- or coal-fired stoves during the winter months. Even though particulate emissions from illegal waste burning pose significant hazard to human health due to the combination of excessive emission factors (EFs) and uncontrolled chemical composition, there is scarce information on the specific EFs for PM_{10} and polycyclic aromatic hydrocarbons (PAHs) in the scientific literature.

In this work, controlled combustion tests were performed with 12 different types of municipal solid waste and particulate emissions were measured and collected for chemical analysis. Absolute EFs for PM_{10} and PAHs as well as the benzo(a)pyrene toxicity equivalent of the latter are reported for the first time for the indoor combustion of 12 common types of municipal solid waste that are frequently burned in households worldwide.

It was found that the PM_{10} emission factors from the combustion of wood-based waste samples were about twice that of firewood, whereas EFs in the range of 11–82 mg g^{-1} (a factor of 5–40 times higher than that of dry firewood under the same conditions) were obtained for different types of plastic waste. The latter were also found to emit exceptionally high amounts of PAHs, by a factor of 50–750 more than upon the combustion of dry firewood under the same conditions. Since the more toxic 4–6 ring PAHs were predominant in the particulate emission from plastic waste burning, BaP equivalent toxicity was up to 4100 times higher than that from wood combustion.

Investigation of the effect of solid fuel burning on air quality and human health

Boglárka Sára BALOGH [1,2], Zsófia CSÁKÓ [1], Zoltán NYÍRI [1], Tamás SZIGETI [1]

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Keywords: *air pollution, biomass burning, environmental health, human biomonitoring, solid fuel burning*

Abstract:

A significant part of the Hungarian households still uses solid materials (e.g. wood, coal, household waste) for heating and - at a lesser extent - cooking purposes and as a disposal way for garbage. Gaseous and solid air pollutants released into the environment during residential solid fuel burning significantly contribute to air pollution.
The National Public Health Center has launched a survey to investigate the impact of residential solid fuel burning on air quality and to investigate the exposure through human biomonitoring studies. The detailed investigation of the air quality of two Hungarian settlements with different heating habits (Nógrádmegyer – frequent solid fuel burning, Esztergom – high percentage of households with district heating and gas heaters) was carried out in the heating and non-heating seasons in 2020. For human biomonitoring studies, urine samples were collected from volunteers during the campaigns.
In Nógrádmegyer, the mean $PM_{2.5}$ mass concentration during the heating period was 1.7 times higher compared to the result obtained for Esztergom. A significant correlation was observed between the biomass burning markers (levoglucosan, potassium, organic carbon in the $PM_{2.5}$) during the heating period. The 1,3,5-triphenylbenzene used as a universal waste burning marker was detected in Nógrádmegyer on each measurement day of the heating period, which indicates that the population is burning waste in the area. The concentration of levoglucosan in the urine samples was in the same order of magnitude during both seasons, while the same compound shower significant seasonal variation in the $PM_{2.5}$ samples. The results revealed that levoglucosan has limited use (considering other determinants) as a biomarker of air pollution from biomass burning.
The results highlighted the need for more efforts in national air quality programs, local and regional air quality plans to reduce the extent of residential solid fuel burning.

Improvement of air quality in Miskolc by reducing the burning of green waste and by promoting local composting

Emese FARKAS, Katalin URAMNÉ LANTAI

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Keywords: *green waste, burning, compost, composting, awareness raising*

Abstract:

Burning of green waste is a common phenomenon in Hungary and not only in rural areas but also in the suburbs. It produces a lot of air pollutants, which degrades the city's air quality and is detrimental to health. It is also a source of neighborhood conflicts. In order to improve air quality, it is necessary to limit this activity.
Reducing the extent of burning can only be effective if the related measures are applied in parallel. The activities carried out in Miskolc are the following:

- Continuous cooperation and consultation with authorities to implement regulations effectively. Strict control of outdoor burning (warnings and fines).
- Development of awareness programs on environmental and health hazards and on alternatives to garden waste burning (articles, comics, posters, videos).
- Supporting local composting activities by allocating 300 compost frames per year. The goal of the composting program is to offer a simple, environmentally friendly alternative to outdoor burning for local recovery of green waste. Residents of Miskolc participating in the program will receive a composting frame made of local wood free of charge. They take part in a short training, where they can acquire the basic knowledge needed for composting activities and ask for advice.
- Establishment of a community composting garden, in order to present the tools, raw materials and work process of composting.
- As a follow-up to the results of the action, annual review of the reported infringements with the help of local authorities. Registration of distributed composting frames, sometimes checking their use.
- During the program, Miskolc cooperates with other initiators and settlements participating in the LIFE IP HUNGAIRY project.

As a result of the project, it is expected to reduce the burning of garden waste in Miskolc. We also expect the reduction of PM_{10} levels, the reduction of complaints from the population and the increase of local utilization of green waste.

Communication of the high-resolution particulate matter monitoring system in Miskolc

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Keywords: *particulate matter, monitoring, sensor, awareness raising*

Abstract:

In winter, poor air quality caused by improper residential heating is a significant problem in Miskolc. Within the LIFE IP HungAIRy, the Municipality and the University of Miskolc are working together to draw people's attention to this problem and try to find solutions as well. We prepared a long-term communication strategy, and we are working on awareness-raising personally, online and offline at the same time.
Our most important tool is the **new, high-resolution, low-cost monitoring system** which consists of 60 measuring units, located all over the city. Its (almost) real-time information is available for anyone interested on https://pmmonitoring.hu website, where colors and emojis help to understand the actual air quality situation. The kick-off ceremony of the PM monitoring system took place on 02/09/2021. Around this event we built up a campaign online and in local media, too. A smartphone application is also under development.
The central character of our communication is **Dr. Sensor**. An animated figure, a kind but strict professor who provides explanations, health advice, general air quality knowledge and advice. Also, he explains, how to use the monitoring system.
We appear regularly in the **local media**: TV news, radio and newspapers. We try to draw attention to important events, write educational articles, create awareness-raising posters and games. We deliver information on the most popular **social media** (Facebook, Youtube) and plan to extend to other platforms.
The most effective way to change attitude is to meet **personally**. Therefore we are available for free consultation in the Ecomanager's Office in the downtown and with a tent in bigger city events, too. The tent is equipped with demonstration sensors (a real-time measurement, a disassembled, and one with LED lights), hit-the-sensor-spot game, and gifts like an eco-bag with a map of the system.

Introduction of a new loading area booking system in Budapest

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Keywords: *city logistics, transport, loading area, air pollution*

Abstract:

In the framework of the LIFE IP HungAIRy project, the Municipality of the City of Budapest is developing a new approach to its loading area booking system.
A pilot intervention in the field of "City logistics", which is being prepared within the framework of Action A.10 of the project, aims to reduce emissions of air pollutants from transport, including freight transport.
Studies on the subject and the basic principles of the logistics sector suggest that in the long-distance transport of goods the last stage of the journey ("the last mile" up to personal delivery, which is considered the least efficient part of the transporting supply chain) should be organised as efficiently as possible to shorten the time of transporting. By developing intelligent transport systems, it is possible to reduce the delivery time of parcels and goods and thus reduce road congestion as well.
As an initial step in Action A.10, we have assessed and involved the main players in the logistics sector in Budapest, both at the transport and regulatory level. A survey was carried out to get a clear picture of the real and current freight transport practices and on this basis the details of the action were jointly developed. Six workshops on the subject were held – partly in person and partly online – in view of the Covid-19 epidemic.
Based on a wide range of professional criteria, several sites were selected for the physical implementation of Action A.10. In addition, an external meeting was organised with the operator of a "smart parking system" which is not in the test phase but already fully operational in the capital. We also carried out market research at companies producing physical parking enforcement devices that can be integrated into the system, where we verified their operation in real-life conditions.

WHO Global Air Quality Guidelines 2021: Setting ambitious goals for air quality to protect public health.

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Keywords: *air pollution, environmental exposure, guideline, World Health Organization*

Abstract:

Air pollution is recognized as the single biggest environmental threat to human health, and its estimated burden is comparable to other major global health risks. Since 1987, WHO has periodically issued air quality guidelines (AQG) to assist governments and civil society to reduce human exposure to air pollution and its adverse effects.

The guidelines were developed according to a rigorous process, involving several groups of experts with well-defined roles. In particular, the different steps included scoping the guidelines, systematic review of evidence, assessment of certainty in the evidence, and formulation of AQG levels and other guidance.

The guidelines provide recommendations for protecting human health in the form of AQG levels for $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2 and CO. Additionally, the guidelines offer interim targets to guide reduction efforts towards the ultimate achievement of the AQG levels and good practice statements on certain types of PM. Key features of these guidelines are: the use of new methods for evidence synthesis and guideline development; higher certainty in the evidence of health effects occurring at lower levels than previously understood; new AQG levels (i.e. peak season O_3 and 24-hour NO_2 and CO) and interim targets; and new good practice statements on certain types of PM (i.e. black carbon/elemental carbon, ultrafine particles, and sand and dust storms).

While the guidelines are not legally-binding recommendations, they can be used as an evidence-informed tool to help decision-makers in setting standards and goals for air quality management at international, national and local level. Academic researchers and national and local authorities may also find them useful for planning and impact assessments, and they may stimulate further research and monitoring. They can also be used as an advocacy tool, for example by civil society and academic groups.

Implementation of the LIFE Index-Air Exposure - Dose Management Tool in 5 European Cities

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Keywords: *air quality, particles, exposure, health impacts, management tool*

Abstract:

Exposure to particulate matter (PM) has been associated with significant adverse health effects and to protect human health in European urban areas is essential to achieve not only the EU's air quality standards but also the WHO Air Quality Guidelines. The LIFE Index-Air Management Tool was developed in the framework of the LIFE Index-Air project, aiming to cover the gap between ambient air quality management and real-life exposure of urban populations and related health risks. It aspires to provide policy makers with the means to assess citizens' exposure to PM and related health effects, as well as to evaluate the effectiveness of selected air pollution mitigation measures with respect to ambient air quality, population exposure and the protection of public health. The tool also aims to enhance the knowledge of the general public on PM pollution, sources, means of exposure and health effects and to raise awareness regarding the adoption of sustainable and environmentally friendly practices in their everyday lives. The tool incorporates data on major source emissions, PM concentrations and characteristic, time-activity patterns of different population subgroups, as well as a number of specialised models. The objective of this presentation is to share the results of the implementation of the tool in five European cities: Lisbon and Porto (Portugal), Treviso (Italy), Athens (Greece) and Kuopio (Finland) where measures related with traffic (change in the number of vehicles and in the percentage of vehicles considering the fuel and vehicle emission standard), residential heating (change in the number and percentage of equipment) and number of cruise ships were assessed. The LIFE Index-Air Management Tool showed that the implementation of measures related with traffic and residential heating can promote the reduction of 13% in the DALY (Disability-Adjusted Life Year) and 7% in the costs, associated with the exposure to PM, in the selected cities.

ClairCity (Citizen-led air pollution reduction in cities) project - outcomes

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Keywords: *air quality, public health, cities, innovative measures for improvement*

Abstract:

Introduction
ClairCity engaged citizens across Europe (in 4 cities and 2 regions) to better understand their environmental behaviours in their local contexts. The project was curious to know how they travelled, how they heated their homes and their future aspirations. If citizens interested in adopting greener lifestyles, how would this affect carbon emissions and air pollution by 2030 and 2050? Importantly, would their involvement in decision making processes accelerate the transition to a clean air, zero carbon futures?
ClairCity is funded by the European Union.

Methods
The engagement process consisted of three parts. First, establish a baseline of behaviours in each of partner cities and regions and explore the policy and governance landscape to understand the impacts on citizens behaviours. Second, engage citizens in various creative ways and use cutting-edge modelling to understand what happens to air quality and carbon emissions when their suggestions are incorporated into decision making. Third, feed-loop this knowledge to policy makers, citizens and influential organisations in each city and region. The project produced a series of webinars on the ClairCity method.

Results
WP3 Behaviours
D3.1 Review of Social Science in Air Quality & Carbon Management
D3.2 Academic paper on the application of social science to air quality and carbon management
D3.4 Good practice guidelines D3.6 Environmental justice report
WP4 Engagement
D4.4 Pilot Cities DELPHI Evaluation Report
Task 4.4.2. School Competition Final Report
WP6 Policy
D6.3 Evaluation of Approaches Cities Take to Emission Footprints and City Carbon Initiatives
D6.4 Multilevel and SWOT analysis of air quality policies
WP7 Scenarios
D7.4 Final City Policy Package – First City and D7.5 Final City Policy Package – Last City
D7.6 Final Cross–City Policy Analysis Report

Conclusion
ClairCity was an innovative project involving thousands of people across Europe.
The project enabled us all to decide the best local options for a future with clean air and lower carbon emissions towards 2030 and 2050.

AQ-WATCH: "Air Quality: Worldwide Analysis and Forecasting of Atmospheric Composition for Health"

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Keywords: a*ir quality, monitoring, Copernicus, forecast, products*

Abstract:

The WHO states that 90% in the world do not breath clean air and that, each year, almost 8 million people die prematurely from indoor and outdoor air pollution. The problem is well understood, but actions to mitigate one of the deadliest environmental threats are lacking. Clearly, the priority is to develop effective solutions that are based on the most advanced science and involve the latest technologies.
The purpose of AQ-WATCH is precisely to develop tools that will help decision-makers in government, municipalities and in the private sector to address air pollution issues in the region of the world where they operate.
AQ-WATCH uses of satellite observations, in situ measurements and modelling products to produce several innovative products and services for improving air quality forecasts and for identifying the location and strength of the air pollution sources that are responsible for the degradation of the air quality.
These products and services are organized around 5 modules allowing users to access historical and air pollution data as well as air quality forecasts at a global and regional scale, to compare different air pollution reduction scenarios and to assess the effect of wildfires or fracking activities on air quality, and to derive the changes in solar irradiance due to the presence of dust in the atmosphere:

- Module 1: Global and regional air quality atlas
- Module 2: Air quality attribution & mitigation
- Module 3:Dust and fire forecasting system
- Module 4:Fracking analysis
- Module 5: Air quality forecast

These modules are being co-developed with potential users from different parts of the world. By bringing together partners from prestigious research organizations in Europe, North and South America and Asia, together with representatives of the private sector, AQ-WATCH creates new opportunities for the development and the widespread adoption of innovative environmental technologies.

AIRFRESH: Air pollution removal by urban forests for a better human well-being

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Keywords: *air pollution, measurement campaign, pilot testing, urban reforestation*

Abstract:

Urban reforestation, e.g., by increasing the tree density in cities, and peri-urban reforestation near densely populated cities where it is not easy to plant trees, can help improve air quality and meet clean air standards in cities. However, to efficiently reduce air pollution in cities, municipalities and city planners urgently need a quantitative and concrete assessment of the role of urban trees in affecting air quality and a suitable selection of tree species. We selected the front-runner cities Aix-en-Provence and Florence as living labs. In Aix-en-Provence in Southeastern France (143,000 inhabitants) and Florence in Italy (380,000 inhabitants), human exposure regularly exceeded the EU and WHO protection limits of particles (PM_{10}), nitrogen dioxide (NO_2) and tropospheric ozone (O_3) with increasing O_3 levels in cities over the time period 2009-2019. In 2019, a total of 73 and 167 premature deaths and 309 and 700 hospital admissions for cardiovascular and respiratory diseases are attributed to air pollution in Aix-en-Provence and Florence.
The project AIRFRESH (LIFE19 ENV/FR/00086) aims to: 1) provide a list of efficient tree species to maximize air quality in city; 2) estimate the air pollution removal capacity by a reforested test area in both cities; 3) estimate and quantify the environmental and health benefits provided by urban tree at city-scale; and 4) propose recommendations for reforestation policies (e.g., number and type of tree species to be planted) for attainment of the air quality standards in both cities.
As large-scale reforestation is not feasible within a project, 2 test areas will be implemented (planting end of 2021; 400 fast-growing trees, mix of species, > 2 m tall, 1ha). Measurements campaigns (winter-summer) of air pollution concentrations and air temperature/humidity will be carried out in and around the area, above and below the canopy, before (2021) and after tree planting (2023-2024). The environmental and socio-economic benefits will be estimated before (2021) and after reforestation (2023-2024, and 2030) through key indicators.

What's about agricultural emissions?

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Keywords: *clean air, agriculture, emissions, climate*

Abstract:

"Clean country air", "breathing fresh air", these are ideas that draw people who live and work in the city to the countryside. However, there is often a fallacy here. Animal husbandry in particular produces many air and climate pollutants. Ammonia emissions, which serve as a precursor to particulate matter ($PM_{2.5}$), are produced in Europe by more than 90 % in agriculture. The same applies to methane emissions (CH_4), more than 50 % of which come from agriculture in Europe. These highly potent climate-damaging emissions are at the same time precursors for ground-level ozone and thus additionally harmful to health and biodiversity. Since these pollutants can also be transported over long distances, $PM_{2.5}$ also reaches cities from rural areas. Thus, agricultural emissions also become an urban problem. Increased particulate matter pollution in large cities, such as Paris, can come largely from agricultural sources, especially in spring.
Therefore, the EU LIFE Clean Air Farming project works on raising awareness among climate and air pollution emissions from meat and dairy production. We like to involve civil society organisations across Europe in legislative processes and in the implementation of national air pollution control programmes as well try to reach future famers by improving the curriculum of agricultural vocational training and inform about their impact. By a broad public relations work we raise awareness about the reduction of food waste from meat and dairy products along the supply chain.
For this purpose, we are trying with our multinational project at the international, European and national level to encourage stakeholders from the agricultural sector to be part of the solution and to let agriculture make its necessary contribution to protecting the climate and air quality.

Global system for Sustainable TRAffic management – LIFE GySTRA

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Keywords: *remote sensing, real world emissions, exhaust emissions regulation*

Abstract:

Road transport is the largest source of pollution in cities, seriously affecting air quality and subsequently human health, climate and economy. Vehicles are becoming cleaner at the time of manufacture. However, due to misalignments, poor maintenance or malicious practices, a modern vehicle can be as polluting as an old one.
LIFE GySTRA project has developed a device (RSD+) based on remote sensing technology capable to measure the actual exhaust of road traffic in a non-intrusive cost-effective way. A robust methodology to identify high emitters has been created.
The technology has been demonstrated in Madrid and in Sofia in different kind of fleets. In Madrid, the devices have taken more than 1.2 million measurements in three years. Measurements demonstrated that between 3% -5% of the circulating fleet is responsible for up to 40% of total urban traffic emissions. The RSD+ has been also used to identify tampered trucks, more than 5,000 trucks have been monitored and around 1,100 were found using illegal devices. Other applications, such as private fleets monitoring or PTI collaboration. Finally, the project data has contributed to the definition of new local and national policies in Spain. Madrid City council has included remote sensing as a tool to be used in roadside inspection for all vehicle categories.
In Sofia, one RSD+ has been monitoring the urban bus fleet. The RSD+ has identified the most polluting vehicles and the municipality has repaired them. After reparations, the buses were measured again showing decreases in emissions up to 85% and 2% in fuel consumption. This is allowing to Sofia municipality to save up to 2 tons per year in pollutant emissions and 45k€ between externalities and fuel savings.

Noise and Emissions Monitoring and radical mitigation – NEMO project

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Keywords: *noise, exhaust emission, monitoring, real driving emissions, pollution mitigation*

Abstract:

Emissions and noise from transport affect seriously people's health and environmental ecosystems requiring the implementation of monitoring and mitigation measures to achieve a real reduction in all transport modes. According to the EC, the fast development of technologies that facilitate connectivity of innovative sensors, both on-board and on the side of the infrastructure, could allow real-time monitoring and control of transport emissions and noise.
Current applications of different mobile systems and measurement methodologies in transport management make comparison of data rather difficult. According to the EC, the development of harmonized measurement methodologies will increase the reliability of collected data and the credibility of the consequent awareness/mitigation procedures. Systems embedded in the transport infrastructure can help in identifying vehicles not respecting prescribed limits. This approach would either allow the operator to be informed swiftly of the environmental deficiencies of the vehicle, or would enable authorities to identify and prevent polluting vehicles from entering, hindering their access to specified low-emission zones, thus mitigating the effects of the non-respect of tolerance limits. Furthermore, and also according to the EC, the integration in the infrastructure of absorbing materials and the utilization of negative-emissions solutions can also contribute to the reduction of the negative effects of exhaust emissions, microplastics from tyres and noise.
In order to meet the requirements of the EC, NEMO project seeks to create the most advanced and purely European solution to reduce emissions and noise from transport, by empirically measuring individual vehicles to apply personalized tariffs to the most emitting vehicles or preventing their access to sensitive zones. The whole NEMO concept is focused on the development (hardware, infrastructure and software) of a reliable novel Remote Sensing system to measure traffic emissions and noise. The system will be integrated into existing road, rail, maritime and IT infrastructures to make it standardized, more user-friendly and able to operate continuously without human supervision for continuous monitoring.
The new measurement systems, together with the implementation of new mitigation solutions, will form a global and scalable solution to improve air quality and reduce noise impact in European cities.

Enabling SME forwarders to shift transports to sustainable rail

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Keywords: *modal shift, intermodal transports, reduction of air pollution in transport sector*

Abstract:

The transport sector is one of the fastest growing and most dynamic industries. More than 72% of all traffic is cargo traffic. The transport sector is responsible for the release of several million tons of gases into the atmosphere each year, leading to air pollution, human health impairment and climate change. Intermodal rail freight reduces the transport-related air pollution by two thirds compared to a road-only transport. Most companies in the transport sector are SME, who are currently not participating in intermodal rail freight traffics due to several entry barriers like missing network, easy access to operators for booking and equipment.

Rail-Flow GmbH as a Freight-Tech start-up improves the cooperation, accessibility, and efficiency of European rail freight transport. Its key product is a digital ecosystem for railway undertakings, shippers, intermodal operators and forwarders.

Rail-Flow GmbH is the coordinating beneficiary of the LIFE funded project FIT ("Facilitating Intermodal Transportation"). The focus of FIT is to support SME freight forwarder in accessing intermodal transportation by providing an innovative and integrated platform solution. The Intermodal Capacity Broker (ICB) gives easy access to numerous train routes and transport partners throughout Europe - and the security of reliable service provision by verified partners.

By shifting 15.000 transports form road to rail, Rai-Flow GmbH aims to save of 17,6 million road km and reduce air pollutants by 9,9t VOC, 14,7t NOx, 3,5t SO_2 until the project end of FIT in 2024.

The productive piloting phase of the ICB starts on 01st December 2021. First results will be available in mid-2022.

CLAIRO – Clear air and climate adaptation in Ostrava and other cities

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Keywords: *air quality, urban greenery, climate adaptation, plants, public survey*

Abstract:

CLAIRO is a pilot research project (co-financed by the European Regional Development Fund through the Urban Innovative Actions Initiative) whose main objective is to systematically reduce air pollution through comprehensive planning and greenery planting with a positive impact on air quality. The project is being implemented by the City of Ostrava in cooperation with other project partners.
The key project activities can be divided into three steps. In the first step of the research, measurements was carried out, which enabled to acquire important data about the concentrations of atmospheric pollutants in the selected area. The collection and analysis of data, run during all seasons and under different climatic conditions, was essential for the second part of the project – the creation of structure and composition of new greenery. An accurate measurement will help to select plants that are more resistant and would be able to capture more dust particles in the long term. Moreover, the watering of plants by a new special greenery care shall strengthen the plant resistance and absorption capacity.
If the positive impact of planted greenery on air quality is confirmed, the same approach will be applied to other areas within Moravian-Silesian Region. The share of knowledge and experience through the developed methodology and other information tools will help cities to decide what types of plants to choose for planting, not only in Ostrava neighborhood but also in other European cities.
In addition, public surveys on air quality of urban greenery, together with the behavioral study on public willingness to change their lifestyle in favour of improved air quality have been realized during the project and will be shared with other cities.

LIFE-IP North-HU-Trans - North Hungary in Transition

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Keywords: just transition, lignite phase-out, decarbonisation, energy poverty

Abstract:

The LIFE-IP North-HU-Trans "Secure and start implement an effective roadmap for the low-carbon transition of the single largest coal-region in Hungary" project is based in the Northern Hungary region. It runs from 01/09/2020 until 31/10/2029 with a budget of 14.878.324 EUR. Its goal is to facilitate the implementation of Hungary's National Energy and climate Plan and the sustainable and just decarbonisation and transition of Hungary's largest lignite-fired power plant (and its region).

Objectives of the project:

- Climate change mitigation, decarbonisation, coal phase-out
- Develop, test and evaluate renewable-based and innovative flexibility solutions at the post-minig sites.
- Capacity-building
- Sustainable and just transition for lignite-sector employees.
- Recultivation of post-mining sites.
- Mobilization of complementary funds
- Assessment and removal of legal barriers
- Economic diversification in the post-coal region.
- Reduction of energy poverty in the (low-income) households using lignite for heating.
- Greening public transport in the region and preparing for nation-wide replication.
- Dissemination of results, awareness-raising and knowledge sharing.

Expected results:

- Decarbonisation
    - 6.5 million tonnes CO_2 emission reduction
    - 5 innovative prototypes to replace coal-fired technology;
    - 1 toolkit of innovative technologies for the protection of weather-dependent renewable infrastructures;
    - 1 innovative prototype of combined energy community and households' energy efficiency to replace residential lignite use and reduce energy poverty;
- Just Transition
    - Establishment and operation of a national Coal Commission;
    - Development and implementation of „Territorial Just Transition Plans" for Heves és B-A-Z counties
    - Trainings and knowledge sharing for 500 workers and miners of the MPP;
    - 250 companies among the 951 affiliated and supply chain companies of MPP will enter new markets and supply chains and find new clients and customers.