Virtual Conference Industrial Air Pollution Ukraine 2020. What can we do together
Session: 15.12 Kharkiv - Clean air for Ukraine: How can we achieve it?

Climate Change, Waste Management and Air Pollution: A holistic approach through the Project "Approximation to Environmental Acquis 3 (APENA 3)" and synergies with the project "Clean Air for Ukraine"

CONSORTIUM: ENVIROPLAN S.A. (GR), Egis International (FR), Egis Structures & Environment (FR) & CRES (GR)

Christos Tsompanidis

Team Leader - Approximation to Environmental Acquis 3 – APENA3

December 15, 2020

ENVIROPLAN S.A.
Consultants & Engineers

"Strengthening the capacity of regional and local administrations for implementation and enforcement of EU environmental and climate change legislation and development of infrastructure projects" (Approximation to Environmental Acquis 3 – APENA3)
is a EU Project, designed by the Directorate-General (DG) Development and Cooperation.

The Contacting Authority is the **Delegation of European Union to Ukraine**

The project was awarded to the **Consortium**:

ENVIROPLAN S.A. (GR) – Leader
Egis International (FR)
Egis Structures & Environment (FR)
Centre for Renewable Energy Sources and Saving (CRES) (GR)

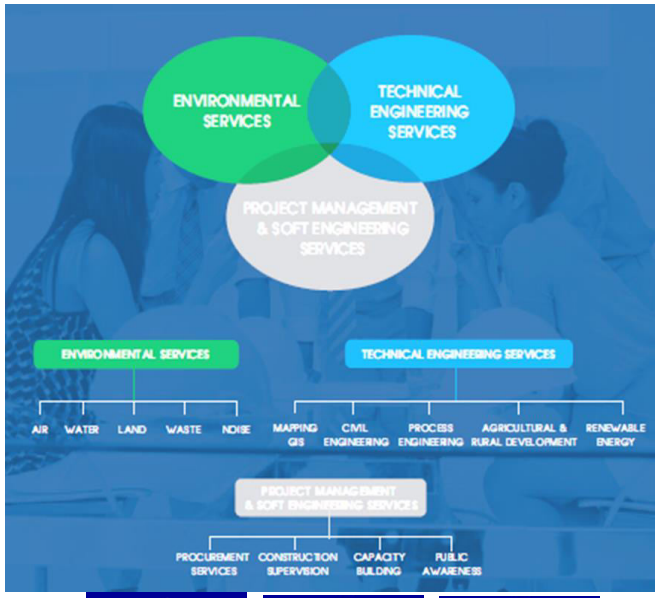
ENVIROPLAN S.A.
Consultants & Engineers

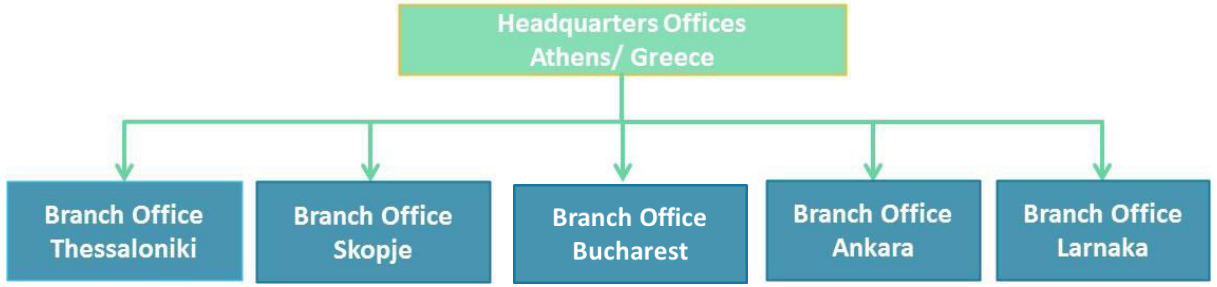
Virtual Conference Industrial Air Pollution Ukraine 2020. What can we do together
Session: 15.12 Kharkiv - Clean air for Ukraine: How can we achieve it?

ENVIROPLAN S.A.
Consultants & Engineers

ENVIROPLAN S.A. provides comprehensive services in the field of waste management, energy, technical engineering and project management, starting from initial procedure planning, up to construction, supervision and client's training for project operation.

Since the philosophy of the company is the multidisciplinary approach of the technical and environmental subjects, more than 60 scientists and engineers from various disciplines are occupied in ENVIROPLAN.





EURO CERT

CERTIFIED M.S. ISO 9001:2015 1076/Δ

EURO CERT

CERTIFIED M.S. ISO 14001:2015 160/Π

EURO CERT

CERTIFIED M.S. ΕΛΟΤ 1801:2008/ OHSAS 18001:2007 115/Α

ENVIROPLAN S.A. is currently active in many international environmental projects at Western Balkans, Eastern partnership countries and MENA region and more specific at *Cyprus, Turkey, Romania, Croatia, Serbia, Bulgaria, North Macedonia, Azerbaijan, Armenia, Ukraine, Kyrgyz Republic, Lebanon, Lithuania, Oman, Palestine*

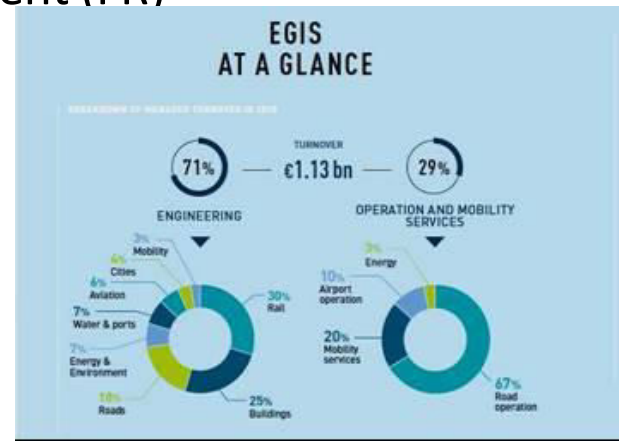
ENVIROPLAN S.A. clients are many international financing institutions and organizations as well as public governmental bodies such as:

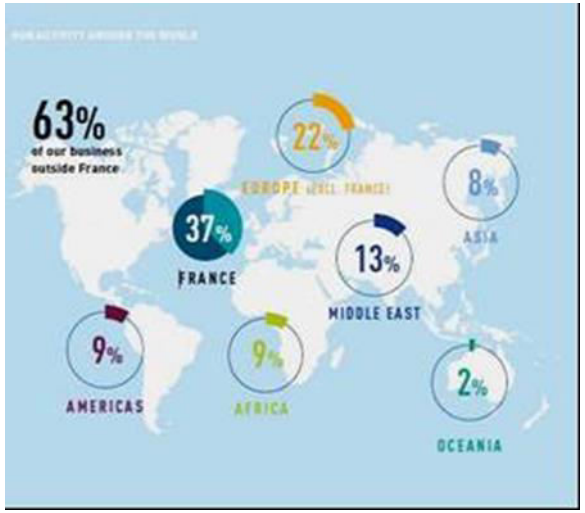
European Commission (EU), European Investment Bank (E.I.B.), European Bank for Reconstruction and Development (E.B.R.D.), World Bank (W.B.), KfW, Local authorities/Ministries, Waste Management Organizations- Public Utility Companies, Private sector

Virtual Conference Industrial Air Pollution Ukraine 2020. What can we do together
Session: 15.12 Kharkiv - Clean air for Ukraine: How can we achieve it?

egis

Egis International (FR) & Egis Structures & Environment (FR)





➢**EGIS** is a global consulting and engineering group working in transport infrastructure, urban development, building, industry, water, waste, environment and energy and training for over 70 years. EGIS is present in over 100 countries.

➢The range of activities covers all common engineering and consulting services, in each and every known industrial domain: EPCM Engineering (project management, preliminary and basic design studies, permitting, engineering procurement, detail design studies, construction project management, works supervision); Consulting (advisory services, feasibility studies, project management, programming, planning & landscaping).

➢EGIS Group companies have a triple ISO certification: Quality (ISO 9001), Health and Safety (OHSAS 18001), Environment (ISO 14001). Egis Experience in Ukraine Egis has been present in Ukraine since 1993 and it is one of the leaders of the consulting and engineering services market in Ukraine.

➢It carries out projects in various sectors such as: water, environment and waste management; energy; roads and highways; urban public transport, urban planning and development; regional and local development; ports and inland waterways; aviation. Egis uses the best European practices and European standards of engineering and consulting services in its work.

Virtual Conference Industrial Air Pollution Ukraine 2020. What can we do together
Session: 15.12 Kharkiv - Clean air for Ukraine: How can we achieve it?

Centre for Renewable Energy Sources and Saving (CRES) (GR)

CRES (Centre for Renewable Energy Sources and Saving), is the Greek organisation for Renewable Energy Sources (RES), Rational Use of Energy (RUE) and Energy Saving (ES).

CRES was founded in September 1987 by Presidential Decree 375/87.

It is a public entity, supervised by the Ministry of Environment and Energy and has financial and administrative independence.

Its main goal is the research and promotion of RES/RUE/ES applications at a national and international level, as well as the support of related activities, taking into consideration the principles of sustainable development.

CRES has a scientific staff highly qualified and experienced multidisciplinary scientists and engineers.

Project Information:

Project information	
Country	Ukraine
Contracting Authority	Delegation of the European Union to Ukraine
Project Beneficiaries	Ministry of Ecology and Natural Resources of Ukraine as project beneficiary. Ministry of Community and Territorial Development of Ukraine as project beneficiary regarding Components 4 and 5.
Project duration	36 months from the starting date
Target Groups	✓ Regional Oblast Administrations and local-self government authorities in Ukraine as the project recipients ✓ Ministry of Ecology and Natural Resources as the main project beneficiary ✓ Ministry of Community and Territorial Development of Ukraine as project beneficiary regarding Components 4 and 5 ✓ Other important stakeholders (other state and non-governmental organizations, scientific community, business associations, civil society organizations, donor organizations)

Project objectives:

❑**Overall objective**: Effectively raise Ukrainian public authorities capacities at local and regional level in designing and implementing key reforms stemming from the Association Agreement, including capacity to carry out legal approximation process with the EU.

❑**Specific objectives**

- To **reinforce Ukraine-EU cooperation** by addressing the priorities of the **Ukraine-EU Association Agreement** as to enhance regulatory convergence in the areas of **environment assessment, waste management and climate change**;
-Strengthen the capacity of regional authorities to develop and implement **regional climate adaptation policies**;
-Strengthen the capacity of local and regional administrations to implement new **EU compliant Ukrainian legislation in the area of environmental impact assessments, waste management and climate change**;
-To support and **train business and civil society** at local and regional level to deal with new environmental legislation in the above areas;
-To support local and regional authorities as well as business to prepare **bankable infrastructure projects**, including in the area of waste**, in line with EU environmental standards and existing Ukrainian legislation**, which is in line with EU standards;
-To support **local civil society in increasing awareness** in the population on waste issues, promote circular economy principles, EIA, SEA, and resilience to climate change challenges.

Expected project results:

- Further **implementation of the Association Agreement** and other relevant international obligations of Ukraine in environment and climate change sector;
- **Institutional capacity** of regional and local authorities improvement for better implementation and enforcement of the new legislation aligned with the EU legislation in the areas of EIA, SEA and waste management;
- The **respective know-how and European best practice** introduction and implementation in Ukrainian institutions to improve their performance, taking into account the **organisational, managerial, technical and other** issues relevant to the sector performance;
- Public relations, **communication** and advocacy capacity improvement;
- **Civil society and business stakeholders involvement** in the implementation of new legislation aligned with the EU legislation in the areas of EIA, SEA and waste management, and in the development of climate adaptation plans, in particular through visible and effective public consultation mechanisms;
- **3 Regional waste management plans with SEA**;
- **3 mature waste management investment projects with EIA**;
- **3 regional climate adaptation strategies**.

Scope of work:

- **Inception Phase**
- **Implementation Phase**
  - **Component 1:** Assistance the strengthening of the administrative capacity for implementation and enforcement of new legislation aligned with the EU legislation in the areas of EIA, SEA on regional and local level in Ukraine
  - **Component 2:** Support local civil society and business in increasing awareness for implementation of the legislation aligned with the EU legislation
  - **Component 3:** Development of regional climate adaptation strategies with implementation plans
  - **Component 4:** Development of Regional Waste Management Plans in 3 pilot regions
  - **Component 5:** Development of priority waste management investment projects' preparation in 3 pilot regions
  - **Component 6:** Design and implementation of stakeholder involvement and communication awareness plan
- **Final Phase**

Component 1: Assistance the strengthening of the administrative capacity for implementation and enforcement of new legislation aligned with the EU legislation in the areas of EIA, SEA on regional and local level in Ukraine

Central Level:

- **Task 1.1** – Assistance for drafting, approval, training of the regulations, guidelines and the methodologies for SEA and EIA
- **Task 1.2** – Support for the development of EIA and SEA Registries

Regional and Local levels:

- **Task 1.3** – Development and approval of capacity building plans for EIA and SEA
- **Task 1.4** – Implementation of the priority measures of the capacity building plans
- **Task 1.5** – Assistance for the improvement in the coordination between the competent authorities

Component 2: Support local civil society and business in increasing awareness for implementation of the legislation aligned with the EU legislation

- **Task 2.1 -** Assessment of the coordination between the competent authorities at all levels and other stakeholders in the areas of EIA, SEA, climate change and waste management
- **Task 2.2 -** Development of an action plan to establish a sustainable mechanism to improve the coordination and continue the dialogue with the interested parties in the areas of EIA, SEA, climate change and waste management
- **Task 2.3 -** Performing stakeholder analyses and developed stakeholders' involvement guide
- **Task 2.4 –** Preparation of training plan, training curricula and delivering trainings for the local civil society and business for implementation of the legislation aligned with the EU legislation in the areas of EIA, SEA, climate change and waste management

Component 3: Development of regional climate adaptation strategies with implementation plans

- **Task 3.1 -** Preparation of climate adaptation **strategies** for three (3) pilot regions, including climate vulnerability assessment and resilience measures and adaptation costs
- **Task 3.2 -** Preparation of climate adaptation implementation **plans** for three (3) pilot regions
- **Task 3.3 -** Assistance in the approval process and public consultations on pilot strategies and plans
- **Task 3.4 -** Preparation of communication plans for three (3) pilot regions

This component will be implemented in close coordination with the EU4Climate Initiative.

Component 4: Development of Regional Waste Management Plans in 3 pilot regions

- **Task 4.1 -** Selection of the 3 pilot regions
- **Task 4.2 -** Strengthening the administrative capacity for implementation and enforcement of new waste management legislation aligned with the EU legislation at regional and local level in the 3 pilot regions
- **Task 4.3 -** Development of Regional Waste Management Plans
- **Task 4.4 -** Development of local waste management plans in 3 pilot amalgamated communities
- **Task 4.5 -** Development of SEAs for the plans
- **Task 4.6 -** Assistance for establishment and development of inter-municipal cooperation agreements
- **Task 4.7 -** Assistance for public consultations and approval process of SEA and the plans

Component 5: Development of priority waste management investment projects' preparation in 3 pilot regions

- **Task 5.1 –** Investment Projects' identification
- **Task 5.2 –** Development of Waste Management Concept
- **Task 5.3 –** Feasibility Stage
- **Task 5.4 –** Environmental Impact Assessment
- **Task 5.5 –** Assistance for public consultation and approval process
- **Task 5.6 –** Assistance for finding donor/investor for the implementation of investment project

Component 6: Design and implementation of stakeholder involvement and communication awareness plan

- **Task 6.1 -** Performing stakeholder analysis and development and implementation of Stakeholders Involvement Plan
- **Task 6.2 -** Development and implementation of Dissemination and Visibility Plan
- **Task 6.3 -** Development and implementation of Communication and Public Awareness Plan

Potential links between the project "APENA 3" and "Clean Air for Ukraine" project

- **Task 1.1 -** Assistance for drafting, approval, training of the regulations, guidelines and the methodologies for SEA and EIA / Methodology
  - Methodological recommendations for assessing the **cumulative effect of activities in various industries**;
  - Methodological recommendations for the **assessment of physical factors of impact on planned activities (emissions)**;
  - Methodological recommendations for the development of the EIA reports and **calculations of likely impacts on environment of infrastructure projects**;
  - Discussion with the national authorities, stakeholders, etc.
- **Task 1.5 -** Assistance for the improvement in the coordination between the competent authorities
  - Strengthening capacity of competent authorities for carrying out **post-project analysis and monitoring**
- **Task 2.2 -** Development of an action plan to establish **a sustainable mechanism to improve the coordination and continue the dialogue with the interested parties** in the areas of EIA, SEA, climate change and waste management

ENVIROPLAN S.A.
Consultants & Engineers

Potential links between the project "APENA 3" and "Clean Air for Ukraine" project

- **Task 2.3 -** Performing stakeholder analyses and developed **stakeholders' involvement guide**
- **Task 3.1 -** Preparation of **climate adaptation strategies for three (3) pilot regions**, including climate vulnerability assessment and resilience measures and adaptation costs
  - Step 1: Preparation of the ground of the adaptation
  - Step 2: Assessment of the risks and vulnerabilities to climate change
  - Step 3: Identification of adaptation options
  - Step 4: Assessment of adaptation options
  - Step 5: Implementation
  - Step 6: Monitoring and evaluation
- **Task 3.2 -** Preparation of **climate adaptation implementation plans for three (3) pilot regio**ns
  - Linking of climate adaptation with the promotion of a sustainable development model;
  - Promotion of adaption actions and policies in the sectors of the natural and anthropogenic environment, which are more vulnerable
- **Task 5.3 -** Feasibility Stage
  - Sub-task 5.3.3 - **GHG Assessment and Resource Use**
- **Task 5.4 – Environmental Impact Assessment**
- **Task 6.1 -** Performing stakeholder analysis and development and implementation of **Stakeholders Involvement Plan**

ENVIROPLAN S.A.
Consultants & Engineers

Air pollution and climate change

- **Air pollution and climate change are closely related**
- **Many air pollutants contribute to climate change** by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere, with some pollutants warming and others cooling the Earth
- Short-lived climate-forcing pollutants (SLCPs) include **methane, black carbon, ground-level ozone, and sulfate aerosols**
- They have significant impacts on the climate: black carbon and methane in particular are among the top contributors to global warming after CO_2

- **Black carbon (BC)**, is a component of fine particulate matter (PM2.5). Particulate matter is the air pollutant that is most harmful to human health and the primary driver of air pollutant-induced mortality
- Methane (CH_4) does not have any direct human health effects in the sense that inhaling typical ambient concentrations of methane is not harmful to human health. However, **methane has a very important indirect human health impact, because it is a precursor to ground-level ozone (O_3, also known as tropospheric ozone)**, which causes asthma and other respiratory diseases and contributes to air pollution-related premature deaths.

Air pollution and climate change

- ✓ To reach the Paris Agreement goal of limiting warming to 1.5 (or even 2) degrees Celsius, **rapid reduction of CO_2 emissions is absolutely necessary**, but will not in itself be sufficient

- ✓ The IPCC special report on the impacts of global warming of 1.5 °C stresses that **deep reductions in emissions of non-CO_2 climate forcers, particularly the air pollutants methane and black carbon**, are also crucial

- ✓ And while the decarbonisation of the economy will generally reduce emissions of both CO_2 and air pollutants, **pursuing the phase out of fossil fuels is not enough – for either air quality or climate**

- ✓ If we are to achieve the goals of the Paris Agreement, then emissions of **other climate drivers such as methane, black carbon, and ground-level ozone must be reduced alongside carbon dioxide**. These reductions would **benefit the climate** and foster sustainable development by **delivering better health** outcomes through improved air quality, preventing crop losses, and ensuring that we avoid climate tipping points that would exacerbate long-term impacts and impede efforts to adapt to climate change.

Role of cities in air pollution and climate change

- Cities are major contributors to climate change. According to UN Habitat, **cities consume 78 per cent of the world's energy and produce more than 60 per cent of greenhouse gas emissions**. Yet, they account for less than 2 per cent of the Earth's surface.

- The sheer density of people relying on fossil fuels makes urban populations highly vulnerable to the effects of climate change. Fewer green spaces exacerbate the problem. According to the IPCC report, **limiting global warming to 1.5 degrees Celsius would "require rapid and far-reaching transitions in uses of energy, land, urban and infrastructure (including transport and buildings), and industrial systems.**"

- The effects of **climate change are worse among poor and low-income communities**, in part because many live on the margins of society, in unstable structures, and in areas more susceptible to flooding, landslides, earthquakes, but also because of inadequate capacities, inadequate resources and reduced access to emergency response systems. **This is even more pronounced in developing countries**.

- Pollution, mostly associated as a by-product of urban landscapes, is also linked with climate change. **Both climate change and air pollution are exacerbated by the burning of fossil fuels**, which increase CO_2 emissions, the cause of global warming.

Sources and Concentrations of Major Greenhouse Gases

Greenhouse gas	Major sources	Pre-industrial concentration (ppb)	2011 concentration (ppb)
Carbon Dioxide	Fossil fuel combustion; Deforestation; Cement production	278,000	390,000 (in 2011)
Methane	Fossil fuel production; Agriculture; Landfills	722	1,803 (in 2011)
Nitrous Oxide	Fertilizer application; Fossil fuel and biomass combustion; Industrial processes	271	324 (in 2011)
Chlorofluorocarbon-12 (CFC-12)	Refrigerants	0	0.527
Hydrofluorocarbon-23 (HFC-23)	Refrigerants	0	0.024
Sulfur Hexafluoride	Electricity transmission	0	0.0073
Nitrogen Trifluoride	Semiconductor manufacturing	0	0.00086

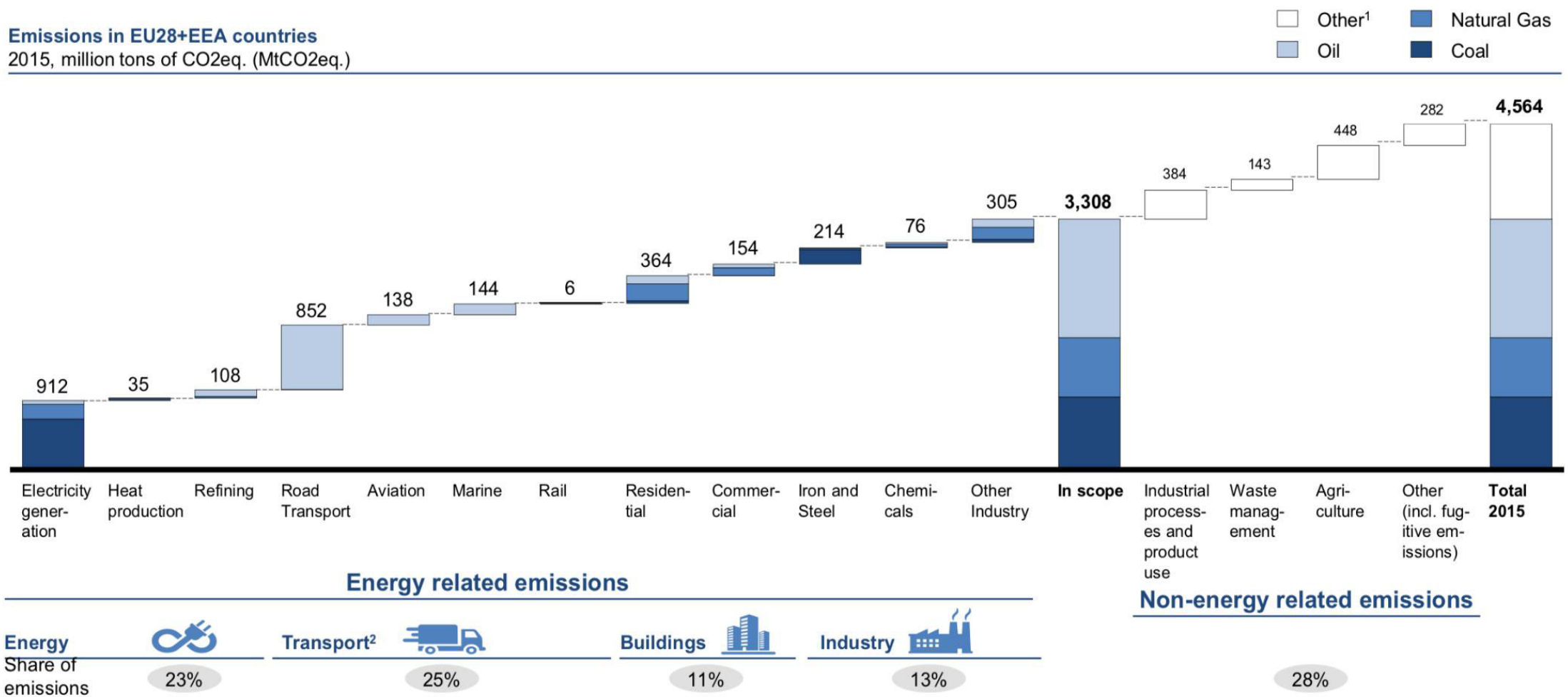
Source: 5th IPCC Assessment Report (2014)

ENVIROPLAN S.A.
Consultants & Engineers

Impacts of climate change on future air quality and human health

- More intense extreme events are projected under future climate change
- Changes in the chemical composition of the atmosphere, which have resulted from **massive industrialization, intensive agriculture and urbanization, as well as road, maritime and air traffic, have led directly and indirectly to enhanced radiative forcing** with, as a result, future changes in the Earth's temperatures and hydrological cycles
- However, the impacts of climate extremes on future air quality and associated health implications are not well recognized and are rarely quantified
- **Future climate change is likely to exacerbate air pollution mortality**, largely influenced by the more intense extreme events such as stagnation events and heat waves

Emissions in Europe (in CO_2-eq)



ENVIROPLAN S.A.
Consultants & Engineers

Emissions in Europe

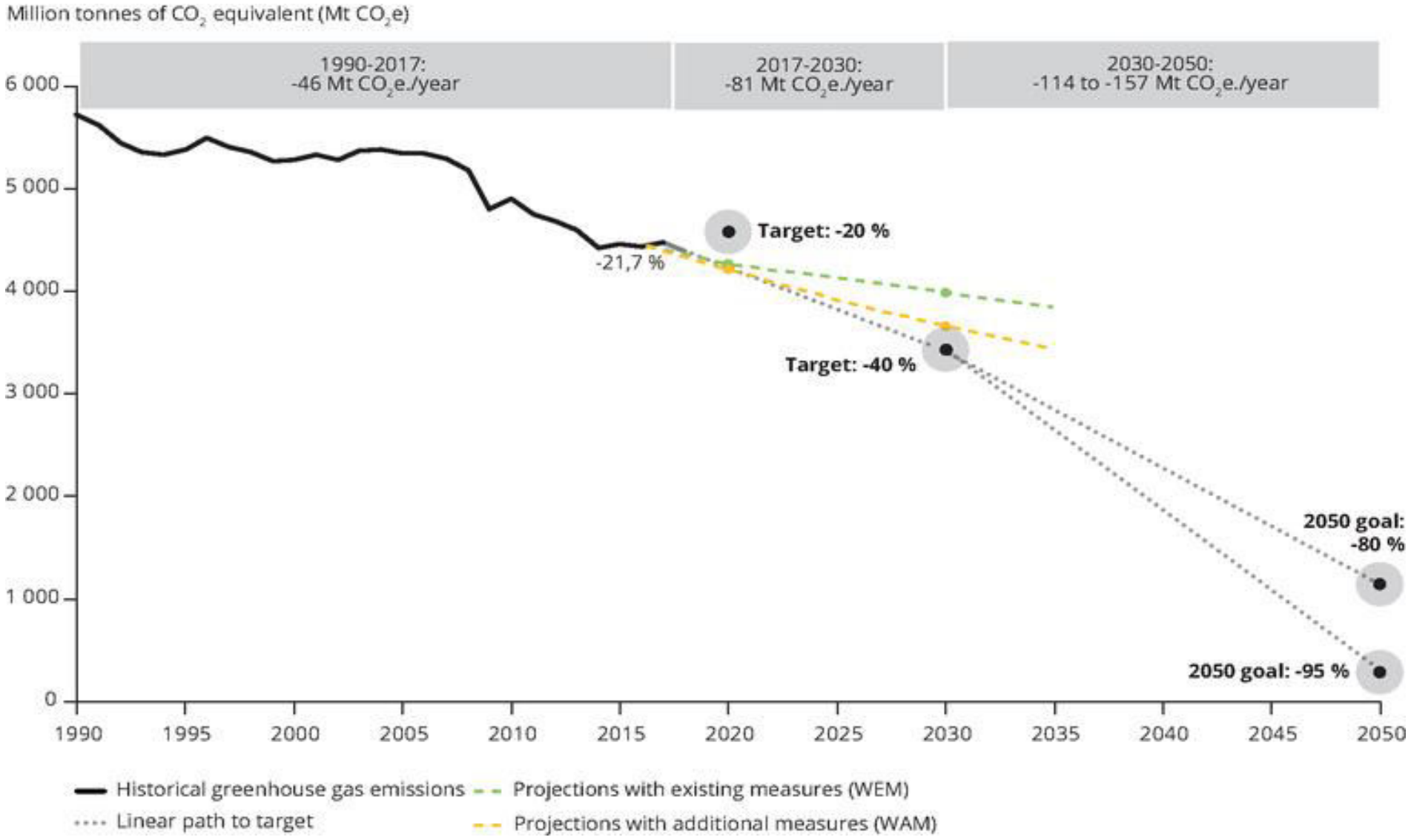
- According to EEA, EU greenhouse gas emissions decreased by 2 % in 2018, following a 0.6 % increase in 2017.

- These 2018 levels correspond to **a 23 % reduction from 1990 levels**, which is more than the EU reduction target of 20 % by 2020.

- Together, Member States project that **current policies and measures can deliver a 30 % reduction by 2030**, while the **reported additional policies and measures** they intend to launch in the coming years **can deliver a 36 % reduction by 2030**.

- While this presents a more positive outlook compared with projections from 2018**, these projections fall short of the 40% target for 2030**.

Greenhouse gas emission trend projections and target



ENVIROPLAN S.A.
Consultants & Engineers

Waste management practices and Air - emissions

Waste management operations:

- Collection of waste (mixed waste, recyclable etc)
- Transportation to treatment plants or landfills
- Open dumping
- Sanitary landfilling
- Mechanical and biological treatment
- Anaerobic digestion
- Incineration without energy recovery
- Waste to energy (Thermal Treatment with energy recovery)
- Recycling
- Composting

Emissions in waste management

- **Uncontrolled dumping or non-engineered landfilling as well as open burning of waste in developing countries is a significant local source of air pollution, constituting a health risk for nearby communities beside the strong contribution to GHG emissions**
- For landfill **CH_4 emissions**, the largest GHG emission from the waste sector, **continue several decades after waste disposal**
- Methane is also emitted during wastewater transport, sewage treatment processes and leakages from anaerobic digestion of waste or wastewater sludges
- The major sources of **N_2O are human sewage and wastewater treatment**
- The IPCC 2006 Guidelines provide methodologies for CO_2, CH_4 and N_2O emissions from open burning of waste and for CH_4 and N_2O emissions from composting and anaerobic digestion of biowaste
- **Composting and other biological treatments emit very small quantities of GHGs**
- The CO_2 from the **non-biomass portion of Thermal Treatment (incineration) of waste is a small source of GHG emissions**

Trends for GHG emissions from waste

Source	1990	1995	2000	2005	2010	2015	2020	2030	2050
Landfill CH_4[a]	760	770	730	750	760	790	820		
Landfill CH_4[b]	340	400	450	520	640	800	1000	1500	2900
Landfill CH_4 (average of [a] and [b])	550	585	590	635	700	795	910		
Wastewater CH_4[a]	450	490	520	590	600	630	670		
Wastewater N_2O[a]	80	90	90	100	100	100	100		
Incineration CO_2[b]	40	40	50	50	60	60	60	70	80
Total GHG emissions	1120	1205	1250	1345	1460	1585	1740		

Notes: Emissions estimates and projections as follows:
[a] Based on reported emissions from national inventories and national communications, and (for non-reporting countries) on 1996 inventory guidelines and extrapolations (US EPA, 2006).
[b] Based on 2006 inventory guidelines and BAU projection (Monni et al., 2006).
Total includes landfill CH_4 (average), wastewater CH_4, wastewater N_2O and incineration CO_2.

Collection and transportation of waste

- Collection is the first step of the waste cycle. It aims at gathering waste before treatment and recovery.

- No source is attributed to the waste itself. Emitted GHG comes from fuel used for transport. Fuel change can result in GHG emissions reduction.

Landfill

- **Landfill CH_4 has historically been the largest source of GHG emissions from the waste sector**.

- The growth in landfill emissions **has diminished during the last 20 years** due to:
  - increased rates of **landfill CH_4 recovery** in many countries and
  - **decreased rates of landfilling** in the EU.

- **The recovery and utilization of landfill CH_4 as a source of renewable energy** was first commercialized in 1975 and is now being implemented at a very significant number of plants worldwide with respective emission reductions.

GHG mitigation technologies

- A wide range of mature technologies is available to mitigate GHG emissions from waste.
- These technologies include landfilling with **landfill gas recovery** (reduces CH_4 emissions), **post-consumer recycling** (avoids waste generation), **composting of selected waste fractions** (avoids GHG generation), **and processes that reduce GHG generation compared to landfilling** (thermal processes including incineration and industrial co- combustion, Mechanical – Biological Treatment with landfilling of residuals, and anaerobic digestion).
- Therefore, the mitigation of GHG emissions from waste relies on multiple technologies whose application depends on local, regional and national drivers for both waste management and GHG mitigation.
- At the 'high technology' end, there are also advanced thermal processes for waste such as pyrolysis and gasification, which are beginning to be applied in the EU, Japan and elsewhere. Because of variable feedstocks and high unit costs, these processes have not been routinely applied to mixed municipal waste at large scale so far. However they significantly decrease the air emissions.

Biological treatment

- Many developed and developing countries practise **composting and anaerobic digestion of mixed waste or biodegradable waste fractions** (kitchen or restaurant wastes, garden waste, sewage sludge). **Both processes are best applied to source-separated waste fractions**: anaerobic digestion is particularly appropriate for wet wastes, while composting is often appropriate for drier feedstocks.
- Composting decomposes waste aerobically into CO_2, water and a humic fraction; some carbon storage also occurs in the residual compost.
- In this regard the production of **the significant GHG CH_4 and N_2O is avoided or drastically decreased**.
- Moreover, **the generation of malodorous and/or corrosive air emissions**, such as H2S, NH3 etc is **efficiently avoided**.

Anaerobic digestion

- Anaerobic digestion produces biogas (CH_4 + CO_2 + other gaseous compounds) and biosolids.

- Minor quantities of CH_4 can be vented from digesters during start-ups, shutdowns and malfunctions. However, the **GHG emissions from controlled biological treatment are very small in comparison to uncontrolled CH_4 emissions from landfills without gas recovery and even to the controlled CH_4 emissions from landfills with gas recovery**

Mechanical Biological Treatment (MBT)

- Mechanical biological treatment (MBT) of waste is being widely implemented worldwide. Mixed waste is subjected to a series of mechanical and biological operations to reduce volume and achieve partial stabilization of the organic carbon.
- Typically, mechanical operations (sorting, shredding, crushing) first produce a series of waste fractions for recycling or for subsequent treatment (including combustion or secondary biological processes).
- **The biological steps consist of either aerobic composting or anaerobic digestion**.
- Composting can occur either in open windrows or in closed buildings with gas collection and treatment.
- In-vessel anaerobic digestion of selected organic fractions produces biogas for energy use.
- Compost products and digestion residuals can have potential horticultural or agricultural applications; some MBT residuals are landfilled, or soil-like residuals can be used as landfill cover.
- Under landfill conditions, residual materials retain some potential for CH_4 generation.
- **Reductions of as much as 40–60% of the original organic carbon are possible with MBT.**
- Compared with landfilling, **MBT can theoretically reduce CH_4 generation by as much as 90%.** In practice, reductions are smaller and dependent on the specific MBT processes employed, but in any case they are quite significant.

ENVIROPLAN S.A.
Consultants & Engineers

Waste to Energy and emissions

- WtE plants produce oxidised air products, mainly CO2. However, **through generation of CO2, the generation of highly harmful air pollutants, such as CO, CH4, H2S etc. is avoided**.

- WtE plants are equipped with **sophisticated Air Pollution Control (APC) systems in order to minimize emissions which are strictly monitored**.

- Modern well managed WtE plants make only a small contribution to local concentration of air pollutants.

- Dioxin emissions of USA WtE industry have been reduced to 0.54% of all controlled sources and 0.09% of both controlled and uncontrolled sources (Dwyer and Themelis, 2015)

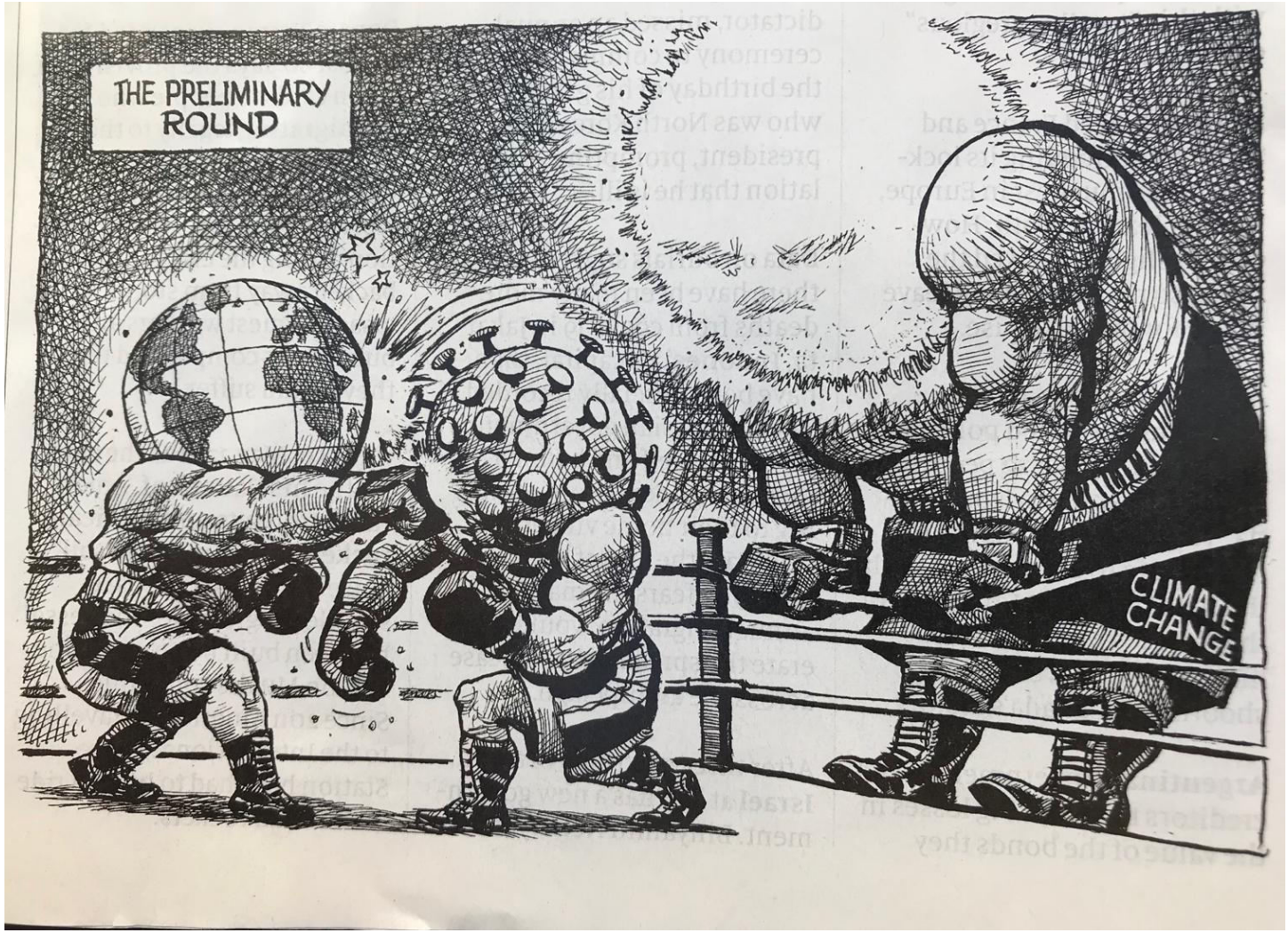
Waste to Energy and emissions

- **CO_2**: The incineration of 1 Mg of municipal waste in MSW incinerators is associated with the production/release of about 0.7 to 1.2 Mg of carbon dioxide CO_2.
- **N_2O:** As well as the above nitrogen oxide compounds NO and NO2, nitrous oxide N2O is of relevance from a climate perspective. Emission levels of 1 to 12 mg/m^3 have been determined in individual measurements at MSW incineration plants, **with an average of 1 - 2 mg/m^3**.
- **CH_4:** It can be assumed that under the oxidative combustion prevailing in waste incineration in MSW incinerators, **methane is not present in the waste gas and consequently is not emitted**

- **CO:** During the incineration of municipal waste in MSW incinerators carbon monoxide is formed as the product of incomplete combustion. CO is an indicator substance for the combustion process and an important quality criterion for the level of combustion of the gases. As a rule, CO is measured continuously in the plants. **Average CO emissions, as daily means, are below 50 mg/ m . Plants reflecting BAT (Best Available Techniques) have daily means in the range of <10 mg/ m^3**
- **NOx:** In the incineration of municipal waste in MSW incinerators nitrogen oxides NOx (NO, NO2) arise, which are formed essentially from the nitrogen contained in the waste, from the combustion process itself and from spontaneous reaction (so-called prompt NOx). As a rule, nitrogen oxide concentrations in waste gas are measured continuously at these plants. **If no measures were performed at MSW incinerators for nitrogen removal, the emissions would be between 350 and 400 mg/m^3**
- **NH_3:** In MSW combustion, emissions of ammonia NH3 arise in particular from the use of ammonia (and also ammonia water) as an additive in waste gas treatment measures for nitrogen removal (SNCR, SCR). As a rule, emissions (determined in individual measurements) are in the range of 1-10 mg/m ; **the average is assumed to be 4 mg NH^3/m** .
- **NMVOCs:** Organic compounds (organic C) in the waste gas of MSW incineration plants are measured continuously as sum parameter Total Carbon. This parameter constitutes an indicator of the level of combustion achieved in an incineration process. **The emissions are subject to a limit of 10 mg/ m^3 , but BAT plants attain, as a rule, emission levels of 1 mg/ m^3**.

ENVIROPLAN S.A.
Consultants & Engineers

Thank you for your attention!



Follow-up on:

ct@enviroplan.gr

info@enviroplan.gr

www.enviroplan.gr

23 Perikleous & Iras Str., 15344, Gerakas, Athens

Landline: +30 2106105127/8 –

+30 2106017386

Fax: +30 2106105138

ENVIROPLAN S.A.
Consultants & Engineers