Local Governments for Sustainability
EUROPE

IN PARTNERSHIP WITH Google

How Google's Environmental Insights Explorer (EIE) is supporting Athens to assess their transportation emissions

TECHNICAL CASE STUDY

SUMMARY

This case study sets a founding example for cities on how to move from a top-down to a bottom-up transport emissions calculation approach, using Google's EIE data as a basis. EIE is a tool utilising various data sources and modelling capabilities to assist cities in assessing emissions sources, conducting analyses, and formulating strategies for impactful actions. Athens has used the tool to obtain more accurate data on the distance travelled by private transport in the city, and based on this, correct their yearly emissions inventories from 2014 to present.

AIMS / OBJECTIVES

1. *Adopting EIE Transportation Emissions data as one of the main data sources for assessing cities on-road transport emissions from private vehicles in their GHG Emissions Inventory.*
2. *Gain a more accurate picture of on-road Transportation Emissions by recalculating data for private vehicles in the city. This will inform the official GHG Emissions Inventory and recalculate accordingly for the previous years (2014-2017) based on the petroleum consumption annual data for transport.*
3. *Informing the city's next Climate Action Plan with the new emission values to identify potential emissions reduction opportunities.*

OUTCOMES

1. *New and more accurate trips and emissions data for on-road transport for private vehicles in Athens.*
2. *Updated and higher quality of GHG Emissions Inventory.*
3. *Identification of GHG emissions reduction opportunities in the transportation sector in Athens.*

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TABLE OF CONTENT

INTRODUCTION

The City of Athens is the capital of Greece with 3,638,281 inhabitants in 2021[1] within the Greater Athens area, and a territory of 39 km^2. The municipality of Athens forms the central part of a connected metropolitan area with many transboundary movements and radial routes from the surrounding areas into Athens itself. This results in traffic as a major issue in the city, causing a large part of its greenhouse gas (GHG) emissions. The city is located in the Attica basin, and this topography worsens the air pollution situation.

Digital tools can play an important role in local climate action, helping cities understand the current situation and plan future measures based on data. Athens and ICLEI Europe have been working together on EIE since 2021, analysing the value that this tool can bring to the city. The tool was found useful for the city especially for its Transportation Emissions calculations, as the bottom-up approach taken by the tool to measure private vehicle trips proved very accurate compared to the top-down approach of the city.

The city is at a stage where they have already used Google's EIE data for their official transportation emissions inventory. They have a deep understanding of the tool data and methodologies and now it is one of their official data sources.

ATHENS CLIMATE ACTION STRATEGY

Athens City Council approved a new Climate Action Plan in 2022 with the goal of a **61% reduction of greenhouse gas emissions by 2030** compared to 2018. The CO_2 emissions in Athens in 2018 were 3,270,875 tn CO_2e, and with a business as usual scenario the CO_2 emissions in 2050 would be 12,732,358 tn CO_2e.

One of the lines of action is to accelerate the transition to sustainable and smart mobility. GHG emissions related transport in Athens accounts for 28% of the total, calculated in 2018. The Plan aims to free up and integrate public spaces for 70% of the population to have access within 15 minutes, on foot to a green space while also making neighbourhoods more friendly to active forms of transport. Specific objectives in the modal share of Athens include increasing pedestrian travel to 14.5% of the trips and increasing the use of public transport to 4.5 % in the next 10 years.

In 2021, the City of Athens approved their Sustainable Urban Mobility Plan (SUMP), with a vision until 2030. The plan will produce a framework of strategic measures and policies for the optimum use of the city's infrastructure and services related to the mobility within Athens. The SUMP sets 10 priorities for optimal urban mobility planning including the reduction of fossil fuel based mobility, the promotion of active mobility and limiting private car travel.

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1 www.statistics.gr/en/2021-census-pop-hous

GOOGLE'S EIE DATA FOR ATHENS

The City of Athens has officially used EIE Transportation Emissions data to obtain more accurate data on the distance travelled by private transport (km) both in-boundary and transboundary (according to the GPC Protocol transboundary is the sum of inbound and outbound trips) as well as the average vehicle efficiency (13.01km/lt for automobiles and 24.39km/lt for motorcycles). EIE is able to provide data for Athens from the years 2018 to 2022.

The data extracted from the tool for the inventory calculations corresponds to the distance travelled by automobile and motorcycle, both in-boundary and transboundary, for the years 2018, 2019 and 2020, as depicted in the following table.

TRANSPORTATION EMISSIONS DATA ANALYSIS

Automobiles (including cars, taxis, trucks etc.) in Athens use mostly gasoline, LPG and diesel oil. With the new EIE data, they were able to correct the emissions derived from these vehicles in already existing emissions inventories and as well as future inventories.

EIE provides data for all automobile trips without any separation of the type of vehicles by fuel consumption, so the city has derived data on the overall consumption of these petroleum products at prefecture level from the Statistic Authority of Greece[2].

2 www.statistics.gr/en/statistics/-/publication/SDE15/

Table 1: Distances travelled by automobile and motorcycle in Athens

	2018	2019	2020
Automobile in-boundary	424,902,305	394,503,417	257,245,285
Automobile transboundary	3,168,296,175	3,191,509,721	2,011,016,815
Motorcycle in-boundary	152,952,089	139,952,159	103,518,743
Motorcycle transboundary	425,104,363	438,644,132	317,423,469

In order to estimate the energy consumed by automobiles that use the petroleum products

j Su($E_{automobile\_j}$, in TJ),

having the above mentioned EIE data, the city used the following formula:

$E_{automobile\_j} = (D_{automobile} / F_{automobile}) \times P_j \times C_j$

Being:

- $D_{automobile}$ = the distance travelled by automobiles according to EIE [km]
- $F_{automobile}$ = average automobile efficiency [km/m^3]
- P_j = the fraction of the use of petroleum product j at prefecture level of the total use of petroleum products for automobiles.
- C_j =petroleum product j's calorific value [TJ/m^3]

Similarly, for motorcycles using gasoline, the following formula is used:

$E_{motorbike\_gasoline} = (D_{motorbike} / F_{motorbike}) \times C_{gasoline}$

Once we have the energy consumed by automobiles and motorcycles each year, the CO_2 emissions are obtained by applying the emissions factors used by the city.

EIE has no data available for the years previous to 2018, but the inventories of these years should be accordingly adapted for reasons of consistency. Therefore, a correlation factor was obtained with the 2018 data correction, based on the petroleum consumption data at prefecture level:

$E_{v,j,t} = E_{v,j,2018} \times CF_{j,t}$

Where:

- $E_{v,j,2018}$ = the energy consumed in 2018 by vehicle type v and petroleum product j [TJ]
- $E_{v,j,t}$ = the energy consumed in year t [where 2014≤ t <2018] by vehicle type v and petroleum product j [TJ]
- $CF_{j,t}$ = the fraction of the consumed petroleum product j, in year t, in relation to the consumption of petroleum product j in 2018

Previous existing data in the City of Athens

The City of Athens has been using a top-down fuel sales approach to estimate on-road transport GHG emissions in the past. This means they were extrapolating from regional to municipal data.

Public transport on-road emissions had been calculated based on real fuel consumption data at prefecture level, downscaled at city level. For private vehicles on the other hand, estimations took the TREMOVE[3] model as reference, which provides input of fleet distribution and fuel consumption per type of vehicle. Fleet distribution and fuel consumption data are obtained from regional government data derived from national statistics.

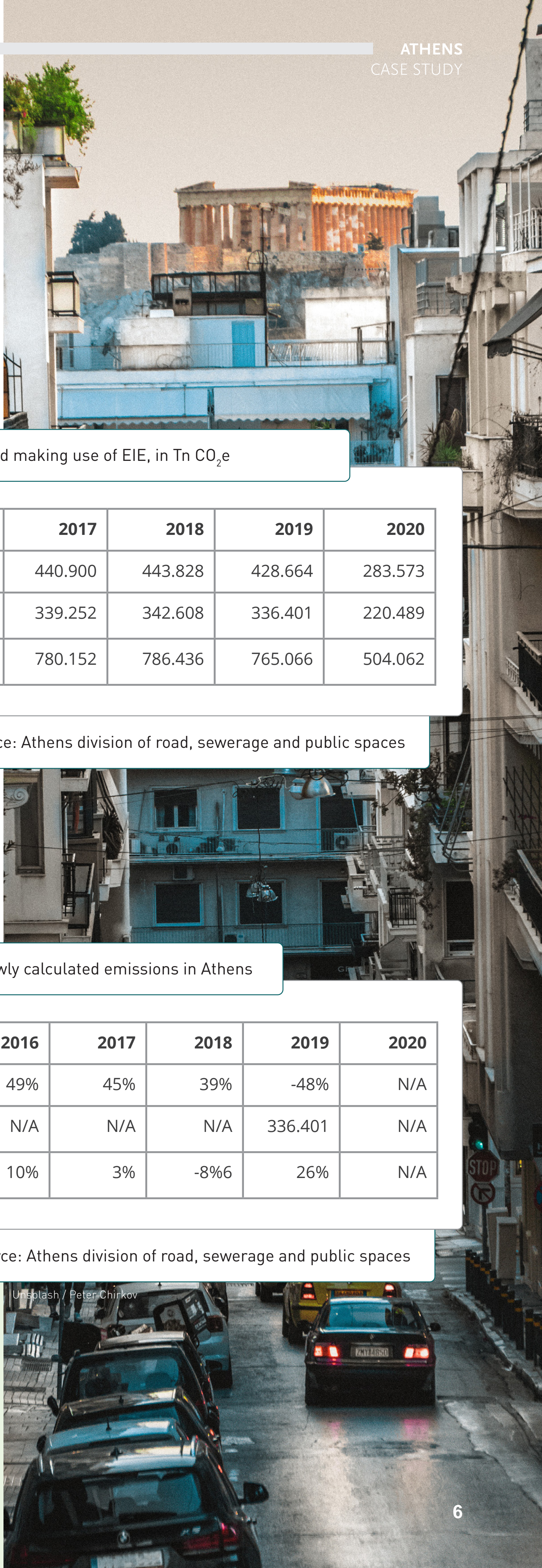
The City of Athens estimated transportation emissions annually from 2014 to 2019 before using EIE, having the following results:

Table 2: Transport emissions in the City of Athens estimated previous to the use of EIE, in Tn CO_2e

	2014	2015	2016	2017	2018	2019	2020
Inboundary	725.801	853.675	874.223	802.604	727.391	290.589	
Outboundary						739.217	
Total	725.801	853.675	874.223	802.604	727.391	1.029.806	

Source: Athens division of road, sewerage and public spaces

3 TREMOVE is a policy assessment model designed to study the effects of different transport and environment policies on the transport sector. (Transport and Mobility Leuven, n.d.)


Unsplash / Peter Chirkov

New transport emissions inventory

As explained in the methodology section, Athens was able to improve their transport emissions inventory using EIE on distance travelled by mode. Applying the methodology described for the years 2018 to 2020 and correcting the previous years accordingly, these are the new official transportation emissions in the city of Athens:

Table 3: Transport emissions in the City of Athens estimated making use of EIE, in Tn CO_2e

	2014	2015	2016	2017	2018	2019	2020
Inboundary	432.781	437.960	446.868	440.900	443.828	428.664	283.573
Outboundary	332.176	336.577	343.807	339.252	342.608	336.401	220.489
Total	764.957	774.537	790.675	780.152	786.436	765.066	504.062

Source: Athens division of road, sewerage and public spaces

Below we can see the differences between the emissions in the former inventories in Athens and the newly calculated transport emissions based on EIE:

Table 4: Difference percentage between the former and newly calculated emissions in Athens

	2014	2015	2016	2017	2018	2019	2020
Difference in-boundary	40%	49%	49%	45%	39%	-48%	N/A
Difference outboundary	N/A	N/A	N/A	N/A	N/A	336.401	N/A
Difference total	-5%	9%	10%	3%	-8%6	26%	N/A

Source: Athens division of road, sewerage and public spaces

OUTCOMES AND IMPACT OF THE STUDY

Using EIE transport data, the city developed a further analysis to evaluate local travelling habits and on-road transport GHG emissions. Fuel consumption from private vehicles, for example, had been overestimated, while active mobility had been underestimated. In the city's 2018 GHG emissions inventory, the energy consumption considered by thermal vehicles was 67% higher than the one estimated by EIE.

Working with ICLEI Europe on the 2019 transportation GHG emissions, the city's team was able to recalculate GHG transportation emissions for on-road private transport based on the distance travelled provided by EIE. In the same way, they recalculated all time series from 2014 onwards, applying correction factors to the years Google's data was not available (previous to 2018). This data quality improvement also contributed to Athens achieving the "A" list in the CDP-ICLEI Track for the 5th consecutive year in 2022.

The updated and improved GHG Emissions Inventories help identify GHG emissions reduction opportunities in the transportation sector in Athens. Having a clear picture of the current situation allows planning measures to be more effective and efficient. Regarding the time and cost savings associated with using this new data set, Dr Eleftheria Alexandri, Civil Engineer from the City of Athens notes, "*We now have a more robust methodology for calculating GHG emissions from private vehicles. Now that the methodology has been set, it will be just a one to two days routine to estimate GHG emissions from private transport, while before it would take a couple of weeks to set up the assumptions and estimations to end up with less precise results.*"

Cities like Athens taking the lead and implementing changes where they see the opportunity clears the path for the ones that will follow. Their experience and successful methodology used for correcting their transportation emissions based on EIE will help and inspire other cities to take action and improve their emissions accounting methodologies.


Unsplash / Victor Malyushev

Interview with **Dr Eleftheria Alexandri**, **Civil Engineer**, City of Athens

VALUE TO CITIES

What value did you personally find in Google's EIE data?

For cities to have accurate data on modal share, based on a bottom-up data collection approach that captures precise street level movement data, is very important, not only for the estimation and mitigation of greenhouse gases, but also for the improvement of commuting, which is also vital for the quality of life within cities.

What do you think the value of Google's EIE data is to your city?

Regarding transport, the tool provides data on modal share, on which we do not have any data, apart from some surveys. For the city to have access to annual modal share activities is a gift from heaven.

OPERATIONAL IMPACT

How do you think Google's EIE data will support your city or local government's operations?

Google EIE data has huge potential. Especially if data is provided in more spatial and temporal detail, the municipality will be able to comprehend whether a project that has to do with lowering private transport (e.g. pedestrianisation, cycling lanes, zero carbon neighbourhoods) has been successful or not; if people continue to visit the specific space (especially if visitability has increased), which periods of the year, day etc.

What have been the estimated time and cost savings of using Google's EIE data

We now have a more robust methodology for calculating GHG emissions from private vehicles. Now that the methodology has been set, it will be just a one to two days routine to estimate GHG emissions from private transport, while before it would take a couple of weeks to set up the assumptions and estimations to end up with less precise results.

GLOBAL IMPACT

What do you see will be the impact for all cities?

Replicate the method for other cities, moving from top-down to bottom-up approaches. Obtain more detailed data on trips by mode in the city.

More comparable data, regarding GHG emissions, if all cities applied the same methodology.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OUTLOOK

This case study can inspire other cities to take action and improve their emissions accounting processes, as it sets the basis for a methodological approach to assess Transportation Emissions based on EIE that could be adopted by other cities. If the same methodology is applied, more comparable data will be produced, making the comparison among cities more reliable. In addition, this experience could inform methodological updates and developments on cities' emissions accounting processes on a national, EU and global level.

The results and experience from this case study could set a pathway to align climate actions in the transport sector with sustainable urban mobility strategies on a local level. This integrated approach could foster the identification of new low-carbon and sustainable mobility actions (i.e. new pedestrian zones, low emissions areas, etc.) that could be implemented and monitored annually based on annual EIE data availability.

EIE is a new source of information that is helping cities to assess their emissions better. In addition to this, further spatial/granular data EIE could support the design of new low-carbon mobility projects in specific neighbourhoods, areas, etc.

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Talks with the division of road, sewerage and public spaces of the City of Athens.

Talks with the EIE team.

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ICLEI Europe

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