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Building A Software Model to Estimate the Emission of Carbon Footprints

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***Abstract*— Considering the transportation sector alone, wecome across various kinds of emissions which in turn affectsthe environmental climate. Hence, we need systems that givean estimate of such pollution to control it and also prevent iteventually .**

INTRODUCTION

TIER 2: This level, like TIER 1, employs gasoline as the prima activity metre and correlates a specified estimate of emission and vehicular data using the same NFR codes. The vehicle typesdisallowed by the NFR codes, on the other hand, are larger and require more information. Simultaneously, the factors of varioussuch gases are connected to one price.

In most nations, the National Emissions Inventories (NEIs) are theprimary tool for estimating emissions. In the case of road traffic emissions, the NEIs provide complete statistics at the national level, taking into account GHG emissions from gasoline. Furthermore, this data is not grouped by road, which would allowfor the analysis of various emission reduction options.

The following databases are required for estimating NEI road emissions: Vehicle fleet data that determines the distribution of the operational vehicle fleet. (2) Data on vehicle traffic, which determines the number of cars on the road. The NEIs employed several approaches to convert records into GHG values.

The COPERT IV software was created in collaboration with the European Environment Agency (EEA) [13]. This method relates an average speed with a pollutant's emission factor or GHGs withthe distance travelled by a particular vehicle. The EEA has established three levels (or tiers) of complexity for this instrumentto estimate vehicle traffic emissions. These thresholds are determined by quantity of data accessable through traffic list. Those are:

TIER 1 : We use the fuel connected with the vehicle type as an activity indication linked to a specified emission factor. This level characterizes the vehicular fleet inventory according to the code, shortcoming of this technique is that it presumes an average paceand a standard vehicle fleet.

TIER 3 : This necessitates far more data. However, one significantmatter about the vehicle's fuel attributes, taking into account the amount of emissions at different temperatures that have varied properties throughout. Kotrikla et al. [18] issued a thorough investigation in field of particulate matter estimated emission on the spatial distribution in the city of Mytilene, Greece, using certain polluting concentration values, and Alam et al. [19] researched Ireland's road topology and decided that earlier emitting inventories undermined the impact of Particulate Matteron estimations.

The records of networked traffic throughout a nation and vehicular fleet were wide and contain a huge amount of data,making it difficult to efficiently prioritize this analogy insidea familiar environment that promotes the linkage of these national data and emission estimation methods. Data abundance can be as difficult as data scarcity, and engineersmust find ways to use it intelligently and practically to make judgements.

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II. EXISTING METHODS

The methods and techniques required to construct the put forth platform that estimates the rate of emission are discussed in this section. These two methods are required for this platform. (1) Datasets that capture information about road traffic and vehicular data in a certain country. These datasets include the data required to compute estimated emissions for particular roadways. (2) A BIM model that prioritizes different data from datasets and computes an estimated rate of emission related to TIER 1 level.

The platform is need of various fields: (1) topological maps, thatcaptures road traffic data with the help of ESRI's ArcMap model[43], (2) BIM software that is required to procure an estimated model of emission [44], BIM Plugin, like the DYNAMO visual model, that enables to integrate datasets with the BIM model.

A. DATASETS OF VEHICULAR FLEET & ROAD TRAFFIC

The tools and techniques required to develop the proposed platform's road traffic and a fleet of vehicular datasets are discussed in this section. Because the information which is provided by the first tier supports only certain fuels, and different categories of cars in the datasets.

Most government bodies in charge of national road networkadministration and management have developed digital technology orpublic records that indicate the data which showcase the entire congestion of traffic. The US Federal Highway Administration is one of the organizations, and it provides thorough information on traffic onmany types of highways.

TABLE 2. Road traffic database.

Road name	Length [km]	Province	Total travel value [veh-km]	Travel value heavy vehicles [veh-km]	Travel value light vehicles [veh-km]
A-23	7.27	Zaragoza	27,246,648	7,666,105	19,580,543
A-23	5.65	Zaragoza	22,864,165	6,628,071	16,236,094
A-23	16.85	Zaragoza	69,756,133	20,012,913	49,743,220
A-23	7.77	Zaragoza	24,846,633	6,571,127	18,275,506
A-23	5.46	Zaragoza	24,799,645	5,185,525	19,614,120
A-23	9.67	Zaragoza	43,921,718	9,183,889	34,737,829
A-23	7.49	Zaragoza	40,655,081	7,168,154	33,486,927
A-23	7.13	Zaragoza	50,875,293	7,466,429	43,408,864
AP-2	24.58	Zaragoza	145,756,616	31,494,005	114,262,611
AP-2	23.91	Zaragoza	137,201,837	25,826,884	111,374,953
AP-2	3.73	Zaragoza	19,354,727	3,960,961	15,393,766
AP-68	12.30	Zaragoza	48,725,732	4,580,960	44,144,772
AP-68	23.17	Zaragoza	123,745,798	11,166,454	112,579,344
AP-68	1.83	Zaragoza	8,958,048	795,106	8,162,942
AP-68	17.50	Zaragoza	104,973,870	8,114,503	96,859,367

B. THE GENERATION OF VARIOUS NODESTHAT ARE USED IN DYNAMO

TABLE 3. Vehicle fleet distribution database.

Autonomous community	Province	% Cargo Truck up to 3,5 T-Diesel	% Cargo Truck Over 3,5 T - Diesel	% Van-Diesel	% Industrial Tractor-Diesel	% Bus - Diesel	% Bus - CNG	% Cars - Diesel	% Cars - LPG
Andalucia	Almeria	13.97%	48.13%	10.44%	47.33%	4.54%	0.00%	75.47%	0.12%
Andalucia	Cádiz	10.93%	57.27%	7.50%	32.32%	10.32%	0.09%	81.46%	0.11%
Andalucia	Cordova	10.24%	60.88%	13.47%	32.62%	6.10%	0.41%	76.17%	0.12%
Andalucia	Granada	11.75%	55.35%	12.81%	35.14%	9.51%	0.00%	75.33%	0.12%
Andalucia	Huelva	12.97%	51.57%	8.17%	38.55%	9.88%	0.00%	78.77%	0.09%
Andalucia	Jaen	12.59%	56.96%	18.96%	36.92%	6.13%	0.00%	68.35%	0.10%
Andalucia	Malaga	11.53%	59.71%	12.11%	30.31%	9.95%	0.03%	76.11%	0.25%
Andalucia	Sevilla	10.79%	52.37%	6.89%	39.10%	7.22%	1.32%	82.15%	0.17%
Aragón	Huesca	16.07%	50.44%	14.28%	42.44%	7.12%	0.00%	69.54%	0.10%
Aragón	Teruel	14.93%	46.18%	15.28%	51.40%	2.41%	0.00%	69.73%	0.06%
Aragón	Zaragoza	10.88%	47.27%	11.77%	44.81%	7.92%	0.00%	77.02%	0.33%
Asturias	Asturias	8.17%	57.31%	10.39%	31.97%	10.61%	0.11%	81.26%	0.18%
Balcares	Islas Balcares	19.35%	63.32%	11.60%	16.85%	19.21%	0.62%	68.85%	0.19%
Canarias	Palmas	34.54%	62.84%	19.82%	17.09%	20.07%	0.00%	45.16%	0.48%
Canarias	Santa Cruz	35.53%	62.67%	21.72%	15.95%	21.38%	0.00%	42.49%	0.26%

These links among data through various traffic congestion was created using DYNAMO nodes. These nodes are specific functions that organize the information from a certain algorithm.

C. APPROXIMATION OF EMISSION RATES USING THEBIM MODEL

The BIM model contains two key components for calculating GHG and pollutant emissions. The initial part of BIM, that sorts different vehicles from a particular nation and incorporate that tothe BIM model as parametric groups [60] with precise data on thetype of fuel and emission [61], [62], including various attributes. The quantity tables are the second component. Based upon these data collected through DYNAMO nodes and other parameters from every group, the BIM model estimates the amount of carbonemitted.

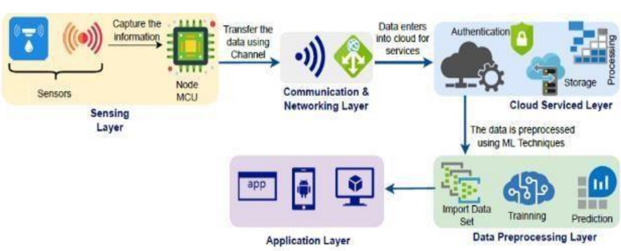
D. RELATED WORK

TABLE 1. Featured studies on the use of BIM in estimating the emissions of AEC projects.

Project type	Estimation method	BIM software used	Emission estimation software	Aim	Reference
Infrastructure Project	Emission factors	Autodesk Revit	COPERT 4	Calculation of the incorporated emissions from bridge projects	[27]
Road project	Life cycle analysis	Autodesk Revit	Athena impactor estimator/COPERT	Calculation of the carbon footprint of road construction projects	[29]
Bridge structural assembly	Life cycle analysis	Autodesk Revit	ISO 14040	Emissions estimation of structural pieces assembly	[30]
Tunnel project	Life cycle analysis	Autodesk Revit	Designer Builder	Design method of acoustic barrier tunnels by reusing steel beams	[31]
Building project	Emission factors	Autodesk Revit	Athena impactor estimator	Emissions estimation of the construction phase	[32]
Building project	Life cycle analysis	Autodesk Revit	Design Builder	Emission management system information model	[33]
School project	Life cycle analysis	Autodesk Revit/DYNAMO	RS Means Database	Calculation of the emissions from the assembly processes of structural systems	[34]
Building project	Life cycle analysis	Autodesk Revit	Autodesk insight	Calculation of the carbon footprint during the material fabrication stage	[35]
Housing complex projects	Life cycle analysis/Emission factors	Autodesk Revit	Green building studio	Estimation of the carbon footprint during the life cycle of materials manufacturing	[36]

III. METHODOLOGICAL FRAMEWORK

The below fig. depicts the tiered representation of IoT based air pollution estimator. This is divided into its various layer as showcased below.



(2)

Figure 2. Layered architecture of IoT-based air-quality monitoring system for agricultural community.

A SDS021 and DTH11 are among the sensing units included inthe physical sensor layer. The SDS021 is used to detect particles of dust in the environment, like PM2.5 and PM10.

The cloud services layer is in charge of storing different pollutantdata , such as PM2.5, PM10, temperature, and humidity. This layeris also in charge of sending the collected data to cloud, and simultaneously in charge of ensuring confidentiality through third-party services.

Because our research is focused with developing a software modelto estimate carbon footprint emissions, we do not focus on the physical sensor layer, data and network layer, or cloud computinglayer, which are the platform's first three levels. Our attention is restricted to the platform's last two layers, the data processing layer and the application layer.

Air Quality Index is a vital indicator that is utilised by many nations. This metric is widely used across the world to assess pollution levels at a specific time and place. In the trials, the categorization risk metric is used to calculate the AQI of a specificpollutant such as PM2.5 and PM10. The risk categorization of pollution circumstances is expressed in many classification groups, as illustrated in Table 2. There are five categories: excellent, moderate, unhealthy, very unhealthy, and dangerous.

Risk Classification	AQI Values	Color-Coding
Good	0–50	Green
Moderate	51–100	Yellow
Unhealthy for Sensitive Groups	101–150	Orange
Unhealthy	151–200	Red
Very Unhealthy	201–300	Purple
Hazardous	300 and above	Brown

$$\text{AQI coefficient of a particular pollutant} = \left[\frac{(APP_{obs} - APP_{min}(PAQL_{max} - PAQI_{min})}{POLL_{max} - POLL_{min}}\right] \quad (1)$$

The conversion coefficient of molecule is given by,

IV. LIMITATIONS AND FUTUREWORK

The highlighted drawback of this study circles back to the datasets that were used which in fact were incorrect and outdated,since it focuses on the most recent edition of the topological traffic dated 2018. To overcome this constraint, the traffic datasetwill be revised as soon as this information becomes available in the near future.

Another drawback of this technique is that it solely addresses exhaust pollutants. As a result, future research aims to expand the functionality of the suggested platform to include emissionsof new kinds, that necessitate the inclusion of more extensive BIM family properties.

V. CONCLUSION

This paper presents a framework for calculating working emission of exhausts from different types of vehicle on various highways in a given nation. The model merges official data froma BIM information model on road traffic and vehicular fleet. Thesoftware is capable of bringing the complex estimation and observational methodologies worked on motorways in order to estimate their emission.

Since traffic datasets has to be physically entered into COPERT,this suggested platform decreases the effort required to estimatethese kind of carbon footprint that are usually needed by softwares that follow the EMEP/EEA standards.

The BIM technique consolidates data on traffic, vehicle fleet, and motorways of country to a centralized data centre. These new improvement simplifies the interplay of data from many national statistics datasets into a single calculating engine. This proposed application, BIM, broadens the method's application to different sorts of projects and demonstrates that it is not limited to construction projects.

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VI. REFERENCES

[1] US Enviromental Protection Agency. (2016). Climate ChangeIndica-tors: Weather and Climate. Accessed: Mar. 3, 2020. [Online]. Available :https://www.epa.gov/climate-indicators/weather-climate

United Nations Climate Change. (2020). The Doha Amendment. Accessed: Dec. 3, 2020. [Online].Available: https://unfccc.int/process/thekyoto-protocol/the-doha- amendment.

[2] Ministry for Ecological Transition and Demographic Challenge of Spain. (2020). Kyoto Protocol. Accessed: Apr. 13,2020. [Online].Available:https://www.miteco.gob.es/es/cambio-climatico/temas/elproceso-internacional-de-lucha-contra-el- cambio-climatico/nacionesunidas/protocolo-kioto.aspx

[3] Ministry of Ecological Transition and the DemographicChallenge of Spain. (2020). Greenhouse Gas Emission Reduction Targets. Accessed: Aug. 7, 2020.[Online].Available:https://www.miteco.gob.es/es/cambiocl imatico/temas/mitigacion-politicas-ymedidas/objetivos.aspx

[4] Barcelona Town Hall. (2020). Pollution: Daily and Episodes.Accessed: May, 26, 2020. [Online]. Available:https://ajuntament.barcelona.cat/qualitataire/en/la- contaminacio/pollution-daily-andepisodes

[6]J. S. Riechi and B. Tormos. (2018). Development of a Model for the Optimization of Vehicle Replacement for an Urban Passenger Transport Fleet. Polytechnic University of Valencia, Valencia, Spain. Accessed: May, 26, 2020. [Online].Available:https://riunet.upv.es/bitstream/handle/10251/ 99567/S%C3%81%20%20Desarrollo%20de%20un%20modelo %20para%20la%20optimizaci%C3%B3n%20del%20reemplazo %20de%20veh%C3%ADculos%20para%20una%20ota%20de% 20tr.pdf?sequence=1

[7]Urban Development Agency of Barcelona. (2020). Report on the Results of the Emissions balance and the Air Quality Modelling Of the LBZ (Low Emission Zone) of Barcelona and Nearby Municipalities. Barcelona. Accessed: May, 26, 2020. [Online]. Available: https://urbanaccessregulations.eu/

[5]