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Research paper

Guidelines for Accounting Melaka Mobile Units Greenhouse Gas (GHG) Emissions

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Abstract

Having a clear picture of greenhouse gas (GHG) emission is essential to understand the spatial emission status and make international comparisons. This study gave an overview on how GHG from the mobile units was measured to produce a pioneer report for Melaka. Global Protocols for Community-Scale Greenhouse Gas Emission (GPC), harmonized emission analysis tool plus (HEAT+) and greenhouse gas (GHG) emission inventory were utilized to produce the mobile units' energy profile and carbon emission in Melaka. Data was collected from federal government agencies and private sectors. The results showed that on-road transportations contributed to the largest GHG (99.51%), followed by railway (0.38%) and lastly aviation (0.03%). Melaka has embarked on a path towards green city by the year 2020 and has to reach the target of reducing carbon emissions up to 40% by the year 2020. These findings are important to assist the local government to define mitigation programs and refine policies to enhance liveability in Melaka by having low carbon resident in future.

Keywords: Greenhouse gas (GHG) emission; mobile units; *Global Protocol for Community-Scale Greenhouse Gas Emission* (GPC); *geographical boundaries*; *top-down approach.*

1. Introduction

Melaka is a growing state with the vision to become a Green Technology City State by the year 2020 [1]. Over the past 10 years, Melaka has achieved remarkable economic growth which has brought about exponential population growth in addition to the high influx of foreign workers. Melaka was projected as 881,400 in year 2014, 895,100 in year 2015 and 908,300 in year [2]. Subsequently, Melaka is projected to grow its population more than 120,000 in between 2011 to 2020 [3]. At the same time, Melaka has received a large number of tourist arrivals which is 15.4 million people in 2014 [4], 15.7 million and 16.3 million in 2015 and 2016 respectively [5]. The rise in population and increasing of tourists, boosts the demand for mobile units. Mobile units consist of road transportation, railway, aviation, water-borne and off-road transportation mode [6]. On-road transportation, railway and aviation (landing and take-off) are considered as mobile units in this study is based on the Melaka state greenhouse gas emission inventory report 2013 [7]. The rise of mobile units is influenced by better income, greater distances, lack of public transportation choices and pattern of land use [3]. Mobile units sector grows rapidly due to fast access to any geographical location in the world [8].

Nevertheless, increasing demand of mobile units also brings calamities such as noise pollutions [9-10], congestions and pollutant emissions such as carbon dioxide, known as the main greenhouse gas emission that may cause global warming [11-13]. Carbon dioxide (CO_2), carbon monoxide (CO), methane (CH4), nitrous oxide (N_2O) and oxides of nitrogen (NOx) are the examples of the greenhouse gas. Mobile units usage contributes towards increasing the source of greenhouse gas emission such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) [14] as well as ozone precursor gases such as carbon monoxide (CO), oxides of nitrogen (NOx) and non-methane volatile organic carbon (NMVOC) [15-17]. Fossil fuel burnt from mobile units produces carbon dioxide [18]. Due to its abundance, carbon dioxide is known as the most critical greenhouse gas emission [19] and considered as the fundamental greenhouse gas (GHG) in Malaysia for any studies related to GHG emissions, following other countries' consideration [20]. The main objective of this study is to determine the amount of the GHG emissions that contributed by the on-road transportation in Melaka. This study gives an overview on how the GHG emission from on-road transportation were measured and to produce a pioneer results reporting of GHG emission. This study enhanced the knowledge of accounting emissions from on-road mobile units sources by providing the guidelines that need to be followed for reliable results. Reliable results lead to better action plans development to address serious global warming problems.

2. Methodology

Three processes and guidelines have been applied to measure the greenhouse gas emission based on the Melaka state greenhouse gas emission inventory report 2013 [4]. The first process is to follow the global protocols and principles, next is accounting the emissions by using the Harmonized Emission Analysis Tool Plus (HEAT +) for calculation purposes and finally, to use the variables in the greenhouse gas emission inventory as targeted variables to be measured. These processes are vital in accounting for mobile units' emissions, providing guidelines for other countries especially developing countries which still have an infancy knowledge about accounting the mobile units' emissions. *Perbadanan Teknologi Hijau* Melaka (PTHM) is the responsible agency that provides fuel sold data based on the year 2013 for accounting mobile units' GHG emissions, while the guidelines have been developed by Local Governments for Sustainability (ICLEI) or formerly known as International Council for Local Environmental Initiatives in collaboration with World Resource Institute (WRI) and C40 Cities Climate Leadership Group supported by the World Bank group, UN-Habitat and UNEP. The guideline is known as Global Protocol for Community-Scale Greenhouse Gas Emission (GPC). Melaka, Malaysia is a pioneer in Southeast Asia that uses this guideline in accounting for mobile units' emissions, aiding any country on accounting for mobile units' emissions which lead to uniformity of the data for benchmarking purposes.

2.1. Protocols and Principles

The GHG inventory must comply with the approved principles of the Global Protocol for Community-Scale Greenhouse Gas Emission (GPC). It provides methodologies to aid the local governments in accounting for the GHG emission and limits within the geographical boundaries. The GPC has been developed by Local Governments for Sustainability (ICLEI) or formerly known as International Council for Local Environmental Initiatives in collaboration with World Resource Institute (WRI) and C40 Cities Climate Leadership Group supported by the World Bank group, UN-Habitat and UNEP. The GPC is an international protocol that is formalized for the international standard of reporting for the sub-national governments across the world. The GPC measures emissions at the community level which has different needs and abilities in compiling inventories from national level [21].

The emissions in this study were calculated according to scopes, which is covered GHG emissions from mobile units occur within community boundary and produced through fuel combustion. 3 scopes covered in this study included scope 1, scope 2 and scope 3. The significance of has the "scopes" framework by disaggregated emissions into Scope 1, Scope 2 and Scope 3 are to include all GHG emissions related activities. It also eliminates possibilities of "double counting" of the emissions within the same inventory. Using the "scopes" framework will aid the researchers to deliver a comprehensive study that includes each emission from multiple sub-sector emissions.

Scope 1 included GHG emissions from mobile units within community boundary and it must be produced through the combustion of fuel. Scope 2 covered GHG emissions that came from the grid-supplied electricity used for mobile units. Scope 3 included GHG emissions occurred outside community boundary [3]. The GPC reporting was also providing another solution for accounting emissions from mobile units by determining the initial and end point of the journey, which is also known as origin and destination of journey. For the journey which either begin and end outside the community boundary, 50% of the emissions must be included in the community reporting and also be reported under Scope 3. This divide emissions was not applicable for road transportation but has been applied by water-borne emissions [22]. Scope 2 emissions were also excluded from this study. This study only covered emissions from fuel based mobile units, which excluded electrified mobile units. This study used Scope 1 to cover all mobile units' emissions in Melaka, emissions that occur inside community boundary and used fuel as energy source.

To calculate the mobile units's emissions, there are two usual approaches for accounting the mobile units emissions which are top-down approach and bottom-up approach [6, 23]. Top-down approach based on fuel consumption as a proxy for journey behaviour. Overall emissions of mobile units were calculated by multiplying GHG emissions factor of fuel (e.g.: petrol, diesel or NGV) with the total fuel sold in a year [6]. For bottom-up approach, ASIF framework was used to calculate emissions from mobile units. It used journey activity, mode share, intensity energy of every mode, vehicle type, fuel and every fuel carbon content as variables to calculate the GHG emissions of mobile units [6, 24].

Top-down approach was chosen in this study to measure emissions because this approach was the most preferred by communities as the starter choice [6]. It had shorter time to conduct, did not require high technical expertise to conduct, was cheaper compared to the bottom-up approach, in line with national inventory and aggregation with other communities inventories was applicable. Hence, it was easier for benchmarking among the communities because the majority of the cities conducted emissions studies using top-down approach, advance towards more complicated and detailed bottom-up approach later [6]. Top-down approach for accounting emissions is also preferred in reviewing Urban GHG Inventory in China [25].

2.2. Harmonized Emission Analysis Tool + (HEAT +)

HEAT + is a software package that uses a country-specific emissions coefficient data sets. It also aids the local governments to develop the GHG emission inventory, forecast growth of these emissions for coming year, evaluate GHG emissions reduction policies and ensure the action plan to reduce the GHG emission is ready. HEAT + provides an exceptional software environment to prepare a specific GHG inventories for a city in evaluating the benefits of policies for establishing the comprehensive action plans, which can encounter greenhouse gas (GHG) emissions issues more specifically and accurately.

2.3. GHG Inventory

Carbon dioxide (CO_2), methane (CH_4) and nitrogen oxide (N_2O) are used in this GHG inventory. These gases contribute nearly 99% of the world GHG emissions. The GHG inventory has been set up in terms of every Individual GHG emissions and the total carbon dioxide equivalent (CO_2e) emissions. To arrive at the CO_2e, the global warming potential (GWP) of every gas involved for a 100 year timeline is factored. GWP refers to a relative measure of the heat amount can be trapped by a GHG in atmosphere. It compares the heat amount trapped by particular type of GHG mass to the carbon dioxide with the same mass. The ability of a GHG can trap more heat in atmosphere depends greatly on the GWP value. Higher GWP value corresponds to more heat amount can be trapped by a particular GHG which increases the temperature at the atmosphere, leading to global warming.

Methane has 12 years of lifetime and has 25 GWP for 100 years. Nitrous oxide has 114 years of lifetime and has 298 GWP for 100 years. Table 1 shows the GWP according to the IPCC's 4th Assessment Report.

Table 1: 100 year GWPs of the GHGs with respect to carbon dioxide (CO_2)

Type of Gases	Lifetime (Years)	GWP for 100 Years
Methane (CH_4)	12	25
Nitrous Oxide (N_2O)	114	298

Emission factor refers to the mass of GHG emissions per unit of activity data. For the emission factor, it depends greatly on the type of fuel used. NGV, petrol and diesel have various emission factor value. For emission factors that are shown in Table 2, the value depends on the type of fuel used.

Table 2: Emission factor of each fuel

Road Transportation Fuel	Emission Factor		
	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)
	tC/TJ	tC/TJ	tC/TJ
Natural Gas (NGV)	15.3	50	0.1
Petrol (Gasoline)	18.9	20	0.6
Diesel	20.2	5	0.6

Activity data refer to the amount of energy already used such as liters of petrol consumed or total diesel sold. It depends on how much the fuel sold on that particular year to generate the total fuel sold. It can be represented as TJ (Terajoule) or MJ (Megajoule). In order to estimate the GHG emissions, emission factor and relevant activity data are required. General formula for accounting the GHG emissions by multiplying the emission factor with the relevant activity data to determine the overall GHG emissions. For mobile units, emissions of each gas such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are required as these gases are considered in accounting for mobile units' emissions. Carbon dioxide was used as the reference gas in calculating emissions. Methane and nitrous oxide emissions value must be converted into carbon dioxide equivalent (CO_2e) emissions using GWP. After emission of each gas which was already generated by multiplying activity data with emission factor, it must be multiplied with GWP to determine the value of each gas in CO_2e emissions form. After CO_2e emission of each gas was determined, the total GHG of mobile units were summed up. The formula for accounting mobile unitss GHG emissions [17-20] is shown as follows:

$$GHG_a = D_a xEF_a xGWP \quad (1)$$

where GHG_a is the greenhouse gas (GHG) emission resulting from the activity a, D_a is the data for the activity a, EF_a is the emission factor for the activity a and GWP is global warming potential.

3. Results and Discussion

Table 3 shows the total fuel sold and the total GHG emissions of mobile units in Melaka for 2013. The total fuel sold was 479,613.08 Kiloliters. Petrol (on-road) dominates the energy mix with 297,980.59 Kiloliters sold to communities, followed by diesel (on-road) with 166,962.28 Kiloliters. NGV (on-road) amounted at 10,402.29 Kiloliters. Diesel (public bus service) amounted at 2,720.14 Kiloliters while the diesel (rail) being the least fuel used with 1,547.78 Kiloliters. For aviation, it depends on landing and taking-off (LTO) for calculating GHG emissions. In 2013, aviation had 580 landing and taking-off (LTO) occurred in Melaka. The total GHG emissions were 1,172,703 tonnes of CO_2e (tCO_2e). Petrol (on-road) contributed the largest amount of GHG emissions with 684,331 tonnes of CO_2e (tCO_2e), closely followed by diesel (on-road) with 475, 953 tonnes of CO_2e (tCO_2e). NGV (on-road) being the least GHG emissions contributor among mobile units in Melaka with 46 tonnes of CO_2e (tCO_2e). Diesel (public bus service) and diesel (rail) contributed 7,616 and 4,412 tonnes of CO_2e (tCO_2e) respectively. Lastly, aviation contributed to 363 tonnes of CO_2e (tCO_2e). According to percentage, petrol (on-road) and diesel (on-road) were the major GHG emissions contributor in Melaka with the share of 58.36% and 40.58% respectively. Both transportation modes contributed nearly 99% of GHG emissions among mobile units in Melaka while NGV (on-road), diesel (public bus service), diesel (rail) and aviation contributed almost negligible amount of GHG emissions in Melaka. The finding results of this research are in line with the Melaka state greenhouse gas emission inventory report 2013 [7-25], which also used the top-down approach in their research for calculating the emission and inventory studies. By being the tiny portion of GHG emissions lead to less concern to take the action on these modes of transportation by local government in reducing the GHG emissions from mobile units in Melaka. Hence, the local government can turn-on the focus on petrol (on-road) and diesel (on-road) in quest of reducing the GHG emissions from mobile units in Melaka significantly.

Table 3: GHG emission from mobile units (fuel) combustion in transportation sector 2013

Emission Source	Total Fuel Sold (Kiloliters) Except Aviation	GHG (tCO_2)	Emission Share (%)
Petrol (on-road)	297,980.59	684,331	58.36%
Diesel (on-road)	166,962.28	475,935	40.58%
CNG/ NGV (on-road)	10,402.29	46	0.00%
Diesel (Public Bus Service)	2,720.14	7,616	0.65%
Diesel (Rail)	1,547.78	4,412	0.38%
Aviation (Landing and take-off) (LTO)	-	363	0.03%
Total	479,613.08	1,172,703	100.00%

The results clearly showed that petrol (on-road) and diesel (on-road) were the main contributors for GHG emissions in Melaka, which is a big concern for local government to focus on how to reduce the massive GHG emissions coming from these two fuel types. By focusing on reducing the GHG emissions from these fuel types will give significant results in reducing GHG emissions from mobile units in Melaka. These results also show that on-road transportation such as motorcycle and car are the dominant transportation used by communities in Melaka due to its characteristics, as mostly people have them and they are the most convenient vehicles to use from home. The public transportation in Melaka such as buses contribute to tiny scale of GHG emissions compared to on-road transportation. The results could be influenced by lack of public transportation choice, lack of coverage area, worse scheduling arrangement which lead to late arriving time on destination, public transportations which are not properly maintained and the community habit which prefer using own vehicles such as motorcycle and car rather than public transportations. This transportation area should be the main concern to local government for improving the services, lead to the better public transportation usage and less dependency on own vehicle in future. Less dependency on the own vehicle leads to lower carbon emissions. It is in line with Melaka's ambition to be a sustainable city in the future by reducing its carbon emissions and enhancing liveability among

communities by having low carbon resident. Low carbon resident means better air quality, leading to a healthy life and prolonged human lifespan.
The scope of this study is focused on the GHG emissions from the on-road transportation only. The area that is needed to be focused only in Melaka geographical boundary covering all the districts in Melaka which are Jasin District (Melaka-Jasin), Central Melaka (Melaka-Tengah) and Alor Gajah District (Melaka-Alor Gajah).
The limitations of this study were this to determine the on-road transportation GHG emissions on the common mode of transportation, which are the emissions in general from the personal vehicle such as cars and motorcycles and also public transport such as buses. Unfortunately, this study cannot determine specifically which the on-road transportation mode contributes to the largest GHG emissions due to it only focused on the fuel sold by the oil companies in order to determine the amount of the GHG emissions. The fuel sold are based on 3 types of fuel sold in Malaysia which are petrol, diesel and natural gas or also known as CNG or NGV.
Another limitation in this study is it is based on the top-down approaches in order to measure the GHG emissions from the on-road transportation, which is based on the total fuel sold by the oil companies and in order to calculate the emissions, the top-down approach using the basic formula by multiplying the emission factor with the activity data to get the total amount of the emissions from the on-road transportation. For example, the emission factor of petrol multiply with the activity data which is the petrol fuel sold so the researcher can get the total amount of the on-road transportation emissions. Different types of the fuel such as petrol, diesel and natural gas will give different value of the emission factor. So, due to this kind of measuring method nature, it cannot calculate the emissions based on the specific measures such as emission factor that coming from various engines technology, engines capacity, driving style, traffic patterns and fuel characteristics in terms of mixing of the fuel content due to the different formula. For example, Petronas has different fuel formula compared to Shell, Petron, BHP and Caltex or also known as Chevron. This study only provide the readers about the general emissions that are coming from the on-road transportation based on the fuel sold method.
Another limitation in this study is it does not included the emission factor based on the different level of the petrol fuel, which refers to the fuel quality and performance rating. In Malaysia, there are three different level of the petrol fuel which are RON 95, RON 97 and RON 100. RON actually stands for Research Octane Number that determine the fuel quality and the performance rating of the petrol fuel itself. So, different RON number basically has different emission factor due to the different in terms of the fuel quality and performance rating. But, for this study, the researcher only focus on the common petrol fuel sold which include all the RON 95, RON 97 and RON 100 into the same category of the petrol fuel sold due to the amount of the emission factor between the different RON number are negligible. In order to get a better emissions results from the on-road transportation in the future, the RON number emission factor should be include in the study in order to compare the results and at the same time to see if there any minor or major differences between the amount of the emissions from the on-road transportation using the common petrol fuel sold which include all the RON 95, RON 97 and RON 100 into the same category with the petrol fuel sold that are segregated all RON into different fuel level individually which are RON 95, RON 97 and RON 100 in order to provide a clearer picture on whether the emission factor of the petrol fuel sold that are segregated all RON into different fuel level individually should be include in the future study or should be ignored in order to reduce the complexity of the study.
The key assumptions that can be made from this study is personal vehicle could be the largest GHG emissions contributor compared to the public transport. This is due to the tendency of the Melaka communities owning more than one car or motorcycle at a time and the public transportation in Melaka is not covering every route, especially in the rural areas and also the inefficiency of the public transportation systems itself such as delay in schedule that cause longer waiting time, not having enough bus to cover every route in Melaka, not having enough workers, small demand from the local communities in the certain areas and breakdown of the bus due to bad service maintenance which cause delay in time to reach destination.
Next key assumption that can be made in this study is the petrol fuel could become the main contributor to the GHG emissions from the on-road transportation in Melaka due to the people tendency to use private transportation rather than public transportation which is due to the convenience of the private transportation that can be used directly from home to desire destination for example going to work place such as office. This statement also supported by [29] which stated that fuel consumptions and emissions per km travelled are higher for the on-road transportation mode compare to the other transportation mode due to its characteristics as a convenient transportation mode for our daily life due to its ability to become a direct transportation that can be easily use from home to desire place. Most of the on-road transportation in Melaka use petrol fuel rather than diesel fuel due to the domination of the car and motorcycle on road in Melaka compare to the lorries and buses that use diesel fuel and only a few of the taxies and rental car use natural gas or also known as CNG or NGV based fuel.
Another key assumption in this study is the on-road transportation could be the largest contributor of the GHG emissions compared to the other transportation mode such as railway, aviation, waterborne and off-road transportation mode due to its popularity and its convenient to be used as a direct transportation from our home and becoming our daily transportation, make it valuable to study the emissions came from this mode of transportation.

4. Conclusion

In conclusion, the results showed that on-road transportations contributed to the largest GHG, followed by railway and lastly aviation. These findings are important to assist the local government to define mitigation programs and create policies to enhance liveability in Melaka by having low carbon resident in future. Furthermore, this research has reported the pioneer GHG results from Mobile units in Melaka. Melaka has already embarked on a path towards green city by the year 2020 and has to reach the target of reducing carbon emissions up to 40% by the year 2020. Hence, these findings are important to produce the Melaka mobile units' GHG profile. Subsequently, this information can assist the local government to identify the relevant strategies and define mitigation programs as well as refine policies to enhance liveability in Melaka by having low carbon resident and becoming sustainable city in the future. Low carbon resident means better air quality, leading to a healthy life and prolonged human lifespan. This project supports the data revolution across the 17 Sustainable Development Goals (SDGs) set by the United Nations in the UNESCO moving forward the 2030 agenda for sustainable development [30]. This research along with the second author's previous studies in new technology management in overcome municipal solid waste disposal problem in Melaka [31] are part of the works contribute to addressing sustainable cities and communities (SDG 11), as well as on reduce inequalities (SDG 10) by narrowing socioeconomic gap within and among the administrative districts in Peninsular Malaysia [32-36].

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References

[1] Astro Awani (2017). Cooperate to make Melaka green technology state by 2020 – CM. http://english.astroawani.com/malaysia-news/cooperate-make-melaka-green-technology-state-2020-cm-154562.

[2] Department of Statistics Malaysia, "Population Projection (revised), Malaysia, 2010-2040", 2016.

[3] S Fam, A.A. Jaafar, A.J. Johanna, A.M. Din, H. Musa and M.H. Mustaffa, "Developing Melaka mobile units greenhouse gas (GHG) emission profile", *Proceedings of Mechanical Engineering Research Day 2017*, pp. 282-284, 2017.

[4] Utusan (2015). Jumlah pelancong ke Melaka meningkat 5.03 peratus http://www.utusan.com.my/gaya-hidup/pelancongan/jumlah-pelancong-ke-melaka-meningkat-5-03-peratus-1.69196.

[5] S.F.Fam, M.T. Dora, N.A. Othman, F.R. Azmi, H. Musa, A.M.M. Azim, H. Norman, M.F.I.A. Shuib. Why Tourists Visit Melaka? Proceedings of 2017 China Marketing International Conference, Marketing Strategy in the Sharing Economy: Localization and Globalization, 2017, pp. 785-807.

[6] WRI, C40 and ICLEI, "Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities", pp. 1–176, 2014.

[7] PTHM-Melaka Green Technology Corporation, "Melaka state greenhouse gas (GHG) emission inventory report 2013", Melaka Green Technology Corporation, ICLEI-Local Government for Sustainability, and South Asia, ICLEI-Local Government for Sustainability, Southeast Asia, pp. 1-21, 2015.

[8] H.C Ong, T.M.I Mahlia and H.H Masjuki, "A review on emissions and mitigation strategies for road transport in Malaysia", *Renewable and Sustainable Energy Reviews*, vol. *15, no. 8,* 3516-3522, 2011.

[9] M. Tobollik, M. Keuken, C. Sabel, K. Cowie, L. Tuomisto, D. Sarigiannis, N. Kunzli, L. Perez and P. Mudu, "Health impact assessment of transport policies in Rotterdam: Decrease of total traffic and increase of electric car use", *Environmental Research*, vo. 146, 350-358, 2016.

[10] L. Perez, S. Trueb, H. Cowie, M.P. Keuken, P. Mudu, M.S. Ragettli, D.A. Sarigiannis, M. Tobollik, J. Tuomisto, D. Vienneau, C. Sabel and N. Kunzli, "Transport-related measures to mitigate climate change in Basel, Switzerland: A health-effectiveness comparison study", *Environmental Research*, vol. 85, 111-119, 2015.

[11] R. Cervero and A. Golub, "Informal transport: A global perspective", *Transport policy*, vol. 14, no. 6, 445-457, 2007.

[12] D.A Hensher, "Climate change, enhanced greenhouse gas emissions and passenger transport–What can we do to make a difference", *Transportation Research Part D: Transport and Environment*, vol. *13, no*. 2, 95-111, 2008.

[13] B. Lin and N.I. Benjamin, "Influencing factors on carbon emissions in China transport industry. A new evidence from quantile regression analysis", *Journal of Cleaner Production*, vol. 150, 175-187, 2017.

[14] D.O. Clark and T. Pauly, "An Approach to Controlling N2O Emission on HDD On-Road Applications", *SAE International Journal of Engine*, vol. 9, no. 3, 2016.

[15] D.J.M. Flower and J.G. Sanjayan, "Greenhouse gas emissions due to concrete manufacture", *International Journal of Life Cycle Assessment*, vol. 12, no. 5, pp. 282-288, 2007.

[16] D. Majumdar and D.G. Gajghate, "Sectoral CO 2, CH 4, N 2O and SO 2 emissions from fossil fuel consumption in Nagpur City of Central India", *Atmospheric Environment*, vol. 45, 4170-4179, 2011.

[17] A. Singh, S. Gangopadhyay, P.K. Nanda, S. Bhattacharya, C. Sharma and C. Bhan, "Trends of greenhouse gas emissions from the road transport sector in India", *Science of the Total Environment*, vol. *390, no*. 1, 124-131, 2008.

[18] A. Torok, "Greenhouse gas emission of Hungarian transport sector", *Periodica Polytechnica, Transportation Engineering*, vol. 37, no. 2, 65, 2009.

[19] S. Sim, J. Oh and B. Jeong, "Measuring greenhouse gas emissions for the transportation sector in Korea", *Annals of Operations Research*, vol. *230, no*. 1, 129-151, 2015.

[20] S. Shahid, A. Minhans and O.C. Puan, "Assessment of greenhouse gas emission reduction measures in transportation sector of Malaysia", *Jurnal teknologi*, vol. *70, no*. 4, 1-8, 2014.

[21] J.L. Richter, "Counting in Cities: City-Scale Greenhouse Gas Inventory Standards and Indirect Emissions", pp. 1-43, 2012.

[22] M. Brander, S. Carstairs and C.F. Topp, "Global protocol for community scale greenhouse gas emissions: a trial application in the West Highlands of Scotland", *Greenhouse Gas Measurement and Management*, pp. 1– 17, 2014.

[23] W.G. Bai, G.Y Zhuang and S.X. Zhu, "Progresses and Prospects of Municipal Greenhouse Gas Inventory Research in China", *China Population Resources and Environment*, vol. 1, 63-68, 2013.

[24] L. Schipper, J. Leather and H. Fabian, "Transport and carbon dioxide emissions: forecasts, options analysis, and evaluation", Asian Development Bank, 2009.

[25] F. Yang, Y. Li and J. Xu, "Review on Urban GHG Inventory in China", *International review for spatial planning and sustainable development*, vol. 4, no. 2, 46-59, 2016.

[26] IPCC/IGES, "*IPCC Guidelines for National Greenhouse Gas Inventories",* Institute for Global Environmental Strategies, Geneva, 2006.

[27] M. Wattenbach, R. Redweik, S. Lüdtke, B. Kuster, L. Ross, A. Barker and C. Nagel, "Uncertainties in city greenhouse gas inventories", *Energy Procedia*, vol. *76*, 388-397, 2015.

[28] R. Zhao and Y. Li, "Greenhouse Gas Inventory Accounting for Chinese Cities: A Preliminary Study", *International Review for Spatial Planning and Sustainable Development*, vol. 4, no. 4, 88-104, 2016.

[29] S. Soylu, "Estimation of Turkish road transport emissions", *Energy Policy*, vol. 35, no. 8, 4088-4094, 2007

[30] United Nations Educational, Scientific and Cultural Organization, "UNESCO moving forward the 2030 Agenda for Sustainable Development", pp. 1-22, 2017. http://unesdoc.unesco.org/images/0024/002477/247785e.pdf.

[31] S. Fam, A.F. Ismail, S.I. Wahjono, M.A.A.M. Khairuddin and M.H. Mustaffa, "New technology management to overcome municipal solid waste disposal problems in Melaka", *Proceeding of Mechanical Engineering Research Day 2017*, pp. 265-266, 2017.

[32] S.F. Fam, A.J. Abdullah, M.F. Kamarudin,Z.L. Chuan, I. Jantan and A, Marina, "Determining Spillover Effect of Tourism Hot Spots through OSS: A Case Study in Masjid Tanah Melaka", Poster Presentation in the 5th Malaysia Statistics Conference, MyStats 2017 -From Data to Knowledge: The Journey, Bank Negara Malaysia, Kuala Lumpur, 2017.

[33] S.F. Fam, N. Ismail and A.A. Jemain, "Geographical and Socio-Economic Analysis in Peninsular Malaysia", The Social Sciences, vol. 12, no. 9, 1695-1704. 2017.

[34] S.F. Fam, N. Ismail and A.A. Jemain, "Where Are Peninsular Malaysia's Most Deprived Areas", *Proceeding International Statistical Institute Regional Statistics Conference 2014*, IS33- ID54, ISI RSC 2014, Bank Negara Malaysia, Kuala Lumpur, 2014.

[35] S.F. Fam, A.A. Jemain and W.Z.W. Zin, "Spatial Analysis of Socioeconomic Deprivation in Peninsular Malaysia", *International Journal of Arts and Sciences*, vol. 4, no. 17, 241-255, 2011.

[36] S.F. Fam, A.A. Jemain and K. Ibrahim, "The Association between Material Deprivation and Relative Risk of Infant Mortality in Peninsular Malaysia", *International Journal of Arts and Sciences*, vol. 4, no. 17, 257-269, 2011.

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