

PIARC DATABOOK OF ROADS AND ROAD TRANSPORT 2020-2023

ROAD STATISTICS COMMITTEE



STATEMENTS

The World Road Association (PIARC) is a nonprofit organization established in 1909 to improve international co-operation and to foster progress in the field of roads and road transport.

The study that is the subject of this report was defined in the PIARC Strategic Plan 2020– 2023 and approved by the Council of the World Road Association, whose members are representatives of the member national governments. The members of the Technical Committee responsible for this report were nominated by the member national governments for their special competences.

Any opinions, findings, conclusions and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of their parent organizations or agencies.

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ROAD TRANSPORT 2020-2023**
ROAD STATISTICS COMMITTEE

AUTHORS/ ACKNOWLEDGEMENTS

This report was produced by the following active members of “Road Statistics Committee” of PIARC. All of them have made outstanding contributions to the provision of the latest road related statistics ensuing from PIARC Databook of Roads and Road Transport 2014-2018 which explicitly defined with accuracy, reliability, and an in-depth analysis two types of data: length of motorways and number of vehicles. In this report some more items of data focused on 10 indicators for 7 areas of interest were compiled and analyzed with careful data definition and scrutiny in order to see the whole pictures of roads and road transport of the member countries.

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Also we give special thanks to the members of General Secretariat who kindly offered the capability to translate this report originally drafted in English into French and Spanish.

PIARC DATABOOK OF ROADS AND ROAD TRANSPORT 2020-2023

Under the adverse circumstances of COVID-19 spreading across the world, many road administrations have to take further austerity measures while investing in construction of road network, maintaining/rehabilitating existing aged roads, ensuring increased traffic safety and so on. Then they are requested to adequately assess the importance of political measures to be taken and implement them effectively. Also they should not fail to review the current situation of roads and road transport in an objective manner. Therefore, it is critical for road experts to collect and analyze the road statistics, in some cases, which should be internationally comparable so that we can accurately gauge the maturity level of our own countries' roads and road transport in the international community.

In fact, however, it is not easy to collect various items of data related to roads and road transport which are internationally comparable with their accuracy and consistency ensured. Generally, each country has its own definitions regarding some sets of data which may be different from those of the other countries. In this case, it becomes necessary to closely examine the data with its definition and possibly correct/interpret it so that it can comply with the internationally reasonable standard of meaning. Anyway, it would be senseless to compare a certain piece of data with another one unless each definition were identical or reciprocally arranged in quality and condition.

In the overall context of the above and other cases this report has focused on the data definition with reliability which enables internationally meaningful comparison of data among 29 member countries including LMICs, and 10 items of data along 7 domains which seem to interest PIARC member countries are carefully selected and collected/examined to visualize how roads and road transport serve in their territories. Also the result of the data synthesis of roads/road transport and some kinds of basic data is graphically represented and must be informative for PIARC members. For example, road length divided by square root of population multiplied by surface area, which is called academically Land Characteristics Index, can be suggestive and thought-provoking in terms of fair international comparison of more practical maturity level of road development among the member countries. The report addresses the qualitative indicator such as road policies of a country. Probably there have never existed any road statistics focusing on the data from that angle. The obtained and collected information about road policies is transformed into quantitative data and made comparable, which is also a breakthrough of our activities. Of course we have managed to compile more comprehensive quantitative data in this report than that of the last version which was produced on a voluntary basis and released in 2019 while conducting a comparative analysis of some datasets examined by our survey. Interesting and key findings with analytical results relative to each indicator are given in detail in the chapter 6, and the overall summary of our work is presented in the chapter 7 as conclusions.

There are some examples of our discoveries reported as follows:

- It is inferred that the more developed motorway's network of a country is, the wealthier the country is, and vice versa.
- Regarding length of Bridges and Tunnels, we find it difficult to propose a clear and satisfactory definition because their respective definitions vary from country to country.
- The number of Vehicles in Use statistically correlates with the level of economic development as well as maturity level of the network of Motorways.
- We should notice that the data provided by many countries concerns 2020 or 2021 when COVID-19 rampant across the world should cause Annual Total Driving Distance of Vehicles to become smaller than normal by widespread hesitation and restriction of travel and drive. This trend also emerges when road fatalities and fuel consumption of vehicles are considered.
- It is necessary to pay attention to fatality rate rather than just fatalities, and as for fatalities for all roads per 1,000 population the highest is the United States, followed by New Zealand, Indonesia, Tunisia and so on, and the lowest is Portugal.
- In many countries, Investment exceeds Maintenance. However, Investment aimed at upgrade, structural reform, etc. of existing roads, instead of newly constructed roads might be interpreted as Maintenance. Then it would be necessary to distinguish Investment for new roads from that for existing roads which could be regarded as Maintenance.
- In many European countries, Diesel/Light oil is more dominant, and the United States, Canada and Japan consume more Gasoline/Petrol.
- Road Policies are normally composed of some key components which are itemized, we have proposed 14 probable items for each country to choose 5 preferential ones out of 14. The preferential one common to the most countries is « Road Safety », and the 2nd most is « Maintenance/Repairs » and « New Technology », followed by « Construction », « Multi-Modal and Modal shifts », and « Environment ».

Although there is still room for improvement because our work has been done by only a small number of active Committee members, the report produced as "PIARC Databook of Roads and Road Transport 2020-2023" must be of great use, and hopefully it will be periodically prepared with more sophistication in a sustainable manner. In that sense, PIARC will make efforts to maintain Road Statistics Committee standing as well as cross-cutting in the following working cycles. Also our activities must be separated from the commercial objective, and the knowledge and intelligence we have gained from the past in terms of data examination and analytical skills should be carefully preserved without being easily incorporated into the other road statistics.

August 2023

Hirofumi OHNISHI

Chair of Road Statistics Committee

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1. INTRODUCTION

In this report, we focus on the methodology of our data collection as well as the output of our dedicated work in this 4-year cycle from 2020 to 2023. Since the data definition with reliability and accuracy is the gist of our road statistics, we find it essential to clarify how to select, define and obtain the data of indicators from the PIARC member countries.

Then the main objectives of this report are, as articulated in the work program, to:

- Enable an international comparison of road statistics among the countries on the same definition and requirements, thereby allowing us to accurately gauge maturity of roads and road transport of each country, and
- Provide statistical data as well as the outcome of their analysis for road administrations of member countries who conduct quantitative research on and make an objective assessment of actions based on such data analysis when formulating the road policies and measures.

Also, our important issue is to upgrade and update the PIARC Databook of Roads and Road Transport 2014-2018. There are some key aspects to be noticed:

- Selection and analysis of data items which really suits the needs of the member countries and can offer enough comparability, in addition to those determined and specified in the past Databook,
- Clarification of data definition, which is linked with data comparability and consistency, alongside each data source located,
- Comprehensive and comparative analyses of roads and road transport data combined with some kinds of primary data in each member country: population, surface area, GNI, etc.,
- Liaison with Technical Committees of PIARC to collect and analyze more data of wider technical areas with valuable information stored in their archives,
- Maintenance and upgrade of outputs in the following working cycles, and
- Possibility of collaboration with the other international road statistics if needed.

In the following chapters of this report, the process of selection/definition of data items to be finally regarded as our indicators for survey and analysis is spelled out at first. Then we move on to the design of our survey which seems classic, structured by a series of spreadsheets, and we synthesize/interpret the obtained data. In total 10 indicators for 7 categories are carefully analyzed in combination with some basic country figures such as population, surface area, GDP per capita and so on. One of the obtained data is related to road policies which are qualitative, not quantitative by itself, and the approach to interpretation of such a non-numerical data should be unique, different from the past and the existing international road statistics generally available in the market. In conclusion some important findings as well as issues to be solved in the next cycle are summarized, and key figures which must be often referred to are tabulated so that data users can easily employ them on their purpose.

2. SELECTION OF DATA ITEMS FOR A DETAILED SURVEY

In the beginning we have deliberated on the list of possible data items which were prepared in advance by Japan, Austria and Germany in order to assess the feasibility of our project based on the ensuing full survey. You can refer to the sample check sheet of Figure 1 by which we will be able to successfully identify the data items to be selected.

Country	Japan					
Data source	Road Databook 2019 published by Japan Road Association (available by hard copy only)					
Data item		Quantitative or Qualitative	Definition	Comparability	Consistency	Remarks
Large classification	Small classification					
Road infrastructure	Length of motorway network	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Length of ordinary national road network	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Length of prefectural road network	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
Vehicle	Number of vehicles	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Number of drivers' license holders	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Average mileage	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
Transportation	Total vehicle-kilometers	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Total passenger-kilometers by vehicle	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Total freight ton-kilometers by vehicle	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Share of each transportation mode	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
Traffic Accident	Fatalities	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Injuries	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Number of traffic accidents	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
Budget	Investment in road construction	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Investment in road maintenance/repair	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Investment in road rehabilitation	1.Quantitative	1.Clearly defined	1.Comparable internationally	1.Updated at periodic intervals	
	Yearly volume of use of deicing salt	1.Quantitative	2. Defined but not clear	1.Comparable internationally	1.Updated at periodic intervals	referred in the Snow and Ice Databook of PIARC for some countries
Winter road service						
Road Development/Planning Policy (Government)	Important key measures	2.Qualitative	2. Defined but not clear	1.Comparable internationally	2.Updated at irregular intervals	stated in the mid-term road development plan and the annual road budget report by Ministry of Land, Infrastructure, Transport and Tourism

1.Quantitative 1.Clearly defined 1.Comparable internationally 1.Updated at periodic intervals
 2.Qualitative 2. Defined but not clear 2. Not comparable internationally 2.Updated at irregular intervals

Figure 1: Check sheet for selection of possible data items (Japan's case)

In general it does not seem difficult for the three countries (Japan, Austria and Germany) to collect some useful indicators regarding high-standard roads with clear definition and reasonable accuracy. It may be wiser to focus on only "Motorways" for selection of some prospective indicators, but we find it necessary to consider those related to the other category of roads except "Motorways" because we cannot ignore some developing countries which have yet to fully build up the motorway network. Therefore, as is articulated later, "Primary Arterial Roads" as well as "Other Roads", whose road standard is lower than "Motorways", are taken into account for our road statistics.

Also it is suggested that our road statistics cover seven important aspects of roads and road transport: "Infrastructure", "Vehicle", "Safety (in place of Traffic Accident)", "Performance (in place of Transportation)", "Budget", "Energy/Environment" (rather than "Winter road service") and "Policy". We have agreed its suggestion and select the indicators relevant to the above seven aspects. In order to see the whole pictures of roads and road transport of member countries we have also found the seven aspects and the further ten indicators from the aspects are vital at the first stage of preparing PIARC Road Databook. As for the three countries, each country regularly publishes the databook which can highlight many kinds of indicators whose definition is clear with sufficient accuracy. In that sense it seems reasonable to select a variety of data items for production of our road statistics, but we have to balance the risk of increased workload against the benefits of more indicators selected. Since our committee is a small group, it becomes realistic to narrow down the indicators to be finally selected from the perspective of a shortage of our manpower.

Also the definition of our prospective indicators is equivalent to that of the other organizations such as the United Nations and OECD. In that case we can respect the existing available dataset which will be just customized to our road statistics and comply with the principle of using the data as it is hopefully without any extra conversion and calculation for our work efficiency. On the other hand, needless to say, it is crucial to give a clear definition for our indicators, which may result in the necessity of additional data interpretation and processing.

Out of the seven aspects, “Policy” is suggested by a qualitative indicator which can arouse a great curiosity of road experts. Austria and Germany indicate that only main road agencies operating relatively high-standard roads such as “Motorways” and “Primary Arterial Roads” can introduce and present their road policies while Japan says that the ministry of the central government can formulate and announce the overall road policies and measures covering all kinds of road-related departments and agencies in the country, and we may not be able to know the overall road policy at a national level even for some countries when we conduct a survey. Therefore, we are required to clarify which organization has developed the road policy in the country.

Based on the preparatory work of active members and the in-depth discussion at the Committee meetings, 20 plausible indicators are proposed (refer to Figure 2). However, we may well focus on fewer indicators whose selection will become feasible within our limited working capacity due to a small number of active members, so 10 indicators have been finally selected on the basis of chair’s proposal considering the preparatory work and the Committee’s discussions.

No.	Scope of indicators	Indicator	Remarks
1	Infrastructure	Length of motorway network	
2	Infrastructure	Length of primary arterial network	National highways (JP)
3	Infrastructure	Number (or length or area) of bridges of motorways	
4	Infrastructure	Number (tube) of tunnels of motorways	
5	Vehicle	Number of vehicles	
6	Infrastructure	Number of rest areas of motorways	
7	Infrastructure	Number of interchanges of motorways	
8	Safety	Speed limit for motorways	Upper (lower)
9	Safety	Speed limit for normal roads	Upper (lower)
10	Transport	Modal split of freight	
11	Transport	Road transport performance (vehicles km)	
12	Safety	Road fatalities	
13	Safety	Road injuries	
14	Safety	Number of traffic accidents	
15	Budget	Annual investment for roads (maintenance, construction, rehabilitation)	
16	Winter service	Annual volume of deicing agents for motorways	
17	Policy	Road key policies	
18	Budget	Toll rate	Limited to inter-urban motorways
19	Vehicle	Number of driver’s license holders	
20	Energy & Environment	Fuel consumption of road sector	

- Blue & bold indicators are prioritized on the basis of chair’s proposal
- Red indicators are optional

Figure 2: Final selection of data items (except for red indicators in gray-colored cells)

3. CLEAR DEFINITION OF SELECTIVE DATA ITEMS REGARDED AS OUR “INDICATORS”

3.1. DESIGNING A DRAFT QUESTIONNAIRE FOR FINALLY SELECTED 10 INDICATORS

We have managed to narrow down 10 indicators which are suitable for data collection in a realistic manner. Then a draft questionnaire regarding such 10 indicators focused is designed and circulated among the Committee members.

When we develop a questionnaire to collect data and information for the selected ten indicators from the member countries, we can make the best use of the past experience we underwent during the last and its previous cycles to collect the data by some spreadsheets. The procedure of our data collection seems classic and may need reviewing. In the next cycle it would be further streamlined and standardized if some innovative software tools were normally used without any inconvenience for each respondent. Although we recognize that there are already Microsoft Forms and Google Forms made available for free, we have somehow chosen the conventional method of collecting data and information for the 10 indicators on this occasion.

While preparing each questionnaire for the 10 indicators we have selected, we check some points so that we can propose clear and satisfactory data definition. You can refer to Table 1 to make sure what to do for this sake.

Table 1: Check Point for each Question of an Indicator

Question/Indicator	Check Point	What to do
Q1 Road Length (Motorway)	Which structural conditions to be proposed	Confirm no. of lanes if any and who road operator is
Q2 Road Length (Primary Arterial Roads)	Which structural conditions to be proposed	Confirm if any and who road operator is
Q2-1 Road Length (Other Roads)	Other roads except for the above high-spec roads to be questioned	Collect data without any uniform definition arranged
Q3 Bridge Length	Physical length or other measurements to be questioned	Collect data based on physical length and other measurements if any
Q4 Tunnel Length	Physical length or other measurements to be questioned	Collect data based on physical length and other measurements if any
Q5 Vehicles in use	Trailer itself to be included	Exclude no. of trailers
Q6 Road Transport Performance	Annual Total Driving Distance of Vehicles to be divided	Divide into Passenger and Freight Vehicles
Q7 Road Fatalities	Other definition than UN to be confirmed	Confirm if any
Q8 Budget	OECD definition based with what else	Focus only domestic investment and maintenance

Question/Indicator	Check Point	What to do
Q9 Fuel Consumption	Other fuels than gasoline, diesel oil and gas to be questioned	Collect data of electric power, biomass energy and others if any
Q10 Road Policy	More policy areas of interest to be proposed according to suggestion of members	List 14 areas of interest for road policies with top 5 to be selected

3.2. GIVING A CLEAR DEFINITION OF FINALLY SELECTED 10 INDICATORS

Before we are ready for finalizing a questionnaire by which we can conduct a comprehensive survey for our road statistics, we have to give a clear definition for each indicator. Based on a full discussion among active Committee members as well as the past knowledge we have acquired, each indicator is defined as articulated in Table 2.

Table 2: Definition of each indicator

Category	Name of Indicator	Definition	Remarks
Infrastructure	Road Length (Motorways)	Roads primarily intended to provide interurban long distance/express transport. In principle, "Motorways" meet the following 3 structural conditions: 1) have limited access, 2) are divided to two different directions, and 3) have grade separation with other roads, railways, etc.	At least 2 structural conditions must be satisfied. The following 2 more questions are asked: Who is the road operator, and Minimum number of lanes for Motorways is defined or not
Infrastructure	Road Length (Primary Arterial Roads)	Except for "Motorways" as defined above, "Primary Arterial Roads" are equivalent to high-standard roads and national highways primarily intended to provide interurban long distance transport. In principle, "Primary Arterial Roads" meet the following 3 categorial conditions: 1) exclude "Motorways" defined above, 2) exclude urban roads, provincial (regional) roads and other lower-standard roads, and 3) be largely consistent with national trunk roads	At least 2 structural conditions must be satisfied. The following 2 more questions are asked: Who is the road operator, and Minimum number of lanes for Motorways is defined or not

Category	Name of Indicator	Definition	Remarks
Infrastructure	Bridge Length	The definition of "Bridges" varies from country to country, and it depends on the definition of each member country. Culverts may constitute part of "Bridges" unless culverts are defined differently from "Bridges", and even 1m long bridges may be counted as "Bridges". Therefore, we provide a broad definition for "Bridges", aligned with that of each member country.	Physical length of Bridges is required. Physical length: it adds up each length of a bridge. When each north-and south-bound road has one bridge (ex. 100m long) separately in the same section, its physical length of bridges is 200m. Meanwhile, network length of the case is 100m without double-counted for each direction.
Infrastructure	Tunnel Length	The definition of "Tunnels" varies from country to country, and it depends on the definition of each member country. At OECD conference in 1970, underground structures whose cross section is over 2 square meters was defined as "Tunnels". Also CEDR defines "Tunnels" whose length is over 300m. Therefore, we provide a broad definition for "Tunnels", aligned with that of each member country.	Physical length of Tunnels is required. Physical length: it adds up each length of a tunnel. When each north-and south-bound road has one tunnel (ex. 100m long) separately in the same section, its physical length of tunnels is 200m. Meanwhile, network length of the case is 100m without double-counted for each direction.
Vehicle	Number of Vehicles in use	Passenger cars: Vehicles carrying passengers - can be classified as passenger cars and buses	Passenger cars and busses can be split up to the definition of each country
		Freight vehicles: Vehicles carrying goods - can be classified as with light goods and heavy ones	Light and Heavy Freight vehicles can be split up to the definition of each country
		Motorcycles or Tricycles: Vehicles with less than four wheels	
		Others: Agricultural and forestry tractors and their trailers, special vehicles, etc.	
		Environmentally good (Eco-friendly) cars	Hybrid, Plug-in Hybrid, Electric, Fuel cell, LPG or CNG powered,

Category	Name of Indicator	Definition	Remarks
			Methanol powered, and Others
Performance	Annual Total Driving Distance of Vehicles (Vehicle-kilometer)	Unit of measurement representing the movement of a road vehicle over one kilometer in one year	Split for Road type and Vehicle type
Safety	Road Fatalities	< Following Definition by the United Nations > Person killed: any person killed immediately or dying within 30 days as a result of an injury accident, excluding suicides, due to road traffic accidents.	Split for Road type
Budget	Investment	< Basically Following Definition by ITF (OECD) > The total gross investment expenditure on your country's roads (by both government and private investment): New construction, extension, reconstruction and major repairs spent for roads If an international road project has been funded by several countries, each country should indicate only their own contribution.	Currency is up to each country (can be converted into US dollars for international comparability)
	Maintenance	< Basically Following Definition by ITF (OECD) > Maintenance expenditure on your country's roads financed by both government and private sector: Routine maintenance undertaken to maintain roads in good condition including surface maintenance and minor repairs, cleaning, sweeping, and clearing snow.	Currency is up to each country (can be converted into US dollars for international comparability)
Energy	Fuel Consumption	Not specifically defined: Gasoline/Petrol, Diesel/Light oil, LPG (Liquefied Petroleum Gas), CNG (Compressed Natural Gas), Electric Power, and Biomass	Each volume of consumption is collected by unit of kilo-tone, kwh, and others
Road Policies	Road Policies	"Road Policies", unlike the other quantitative indicators inquired in this survey, represent in a qualitative manner the official policy or the overall strategy of road	Each country's Road Policies is spelled out. Five preferential treatments are chosen by each country out of

Category	Name of Indicator	Definition	Remarks
		development formulated by the Ministry or Road agencies of each country. Perhaps "Road Policies" are composed of some key components which are itemized, and each component may be detailed with some specific goals. "Road Policies" may be, for instance, stated in an annual road budgetary report, or a mid-term business plan formulated by road administration.	14+1 options: Construction Maintenance, Rehabilitation, New Technology, Road Safety, Multi-Modal, Tolling, Winter service, Usability, Security, Environment, Climate Change, Disaster Management, Law Enforcement, and Others

4. DESIGNING SURVEY SHEETS FOCUSED ON FINALLY SELECTED 10 INDICATORS

4.1. FORMAT OF SURVEY QUESTIONNAIRE SHEET

Based on the definition of 10 indicators articulated in this section, we have designed their respective survey questionnaire sheets by Microsoft Excel so that we can collect and synthesize the data and information in a relatively systematic manner while carrying out some kinds of computational functions. Using Excel spreadsheets fully for this survey seems classic and possibly old-fashioned because Microsoft forms and Google forms, which are innovative tools to create on-line surveys with multiple questions, are already made available for free. Thinking of our comprehensive and detailed survey in this case, however, Excel spreadsheet will make it easier for each member country to answer 10 separate questionnaires by sharing the workload among some professionals. Anyway how to improve the work efficiency in answering questionnaires for each country's persons in charge is a critical issue for our committee in terms of increasing/maintaining a response rate for the survey. It will be discussed in the later chapters and taken over to the next working cycle of this committee.

You can refer to the below sample questionnaire sheet of "Road Length (Primary Arterial Roads)". Also, a sheet of "Introduction" has been prepared so that each respondent can understand the objective and overview of our survey at a glance. Needless to say, each questionnaire including introduction has been developed in three languages; English, French and Spanish, with kind support of General Secretariat of PIARC. Figure 3 - Figure 8 are as follows.

Question 2 Primary Arterial Roads

The objective of this survey is to study the length and definition of "Primary Arterial Roads" in member countries. We have defined "Primary Arterial Roads" as follows, and please fill out the below form of cells coloured in blue.

	Definition
Primary Arterial Roads	Except for "Motorways" as defined in Question1, "Primary Arterial Roads" are equivalent to high-standard roads and national highways primarily intended to provide interurban long distance transport. In principle, "Primary Arterial Roads" meet the following 3 structural conditions: 1) exclude "Motorways" defined in Question1, 2) exclude urban roads, provincial (regional) roads and other lower-standard roads, and 3) be largely consistent with national trunk roads

Q.2-1 Please present the official name and the latest length of "Primary Arterial Roads" of your country that fits into our definition. If there are more than one type of roads applicable to "Primary Arterial Roads" in your country, please provide their information in separate cells.

Year with the latest statistics	Primary Arterial Roads (km)			Total
				0

Note:
Please present the official name of "Primary Arterial Roads" that fits into our definition.

If any, you can add some footnotes to the above figures in the box (any kinds of relevant information except for the below questions)

Q.2-2 To check the equivalence of your "Primary Arterial Roads" to our definition, please answer the following three questions in terms of structural characteristics by a pull-down menu.

	Name of road	1) minimum number of lane (Yes / No)	2) exclusion of urban, provincial(regional),and other lower-standard roads (Yes / No)	3) largely consistent with national trunk roads (Yes / No)
Primary Arterial Roads				

Q.2-2-1 We would like to know who is the road operator. And if there is any other structural condition except for 1)-3) to be defined as "Primary Arterial Roads" in your country, please answer the following questions.

	Name of road	4) who is the road operator?	5) what is any other structural condition except for 1)-3), if any?
Primary Arterial Roads			

Please indicate the name of your data source for the above answers, and if it is made available online, provide us with its URL for our reference.

Source	
URL	

Figure 3: Sample questionnaire sheet (Road Length (Primary Arterial Roads)) in English

A Questionnaire Survey by Road Statistics Committee of PIARC

The objective of this survey by Road Statistics Committee is to enable international comparison of comprehensive and individual maturity level of road transport (by 10 selective indicators) to be made among PIARC member countries, thereby helping gauge what will be necessary for each country to further develop its road and road transport.

The result of this survey, after examination, synthesis, and analysis of collected data, will be presented at the next World Road Congress to be held in Prague Czech Republic in October 2023 and by the end of that year we expect to publish its report in three languages (English, French, and Spanish) and make it widely available to all PIARC members.

Here, some inquiries of 10 selective indicators we expect to collect are proposed as follows;

- Q1 ☐ Road Length (Motorway)
- Q2 ☐ Road Length (Primary Arterial Roads)
- Q2-1 Road Length (Other Roads)
- Q3 ☐ Bridge Length
- Q4 ☐ Tunnel Length
- Q5 ☐ Number of Vehicles in use
- Q6 ☐ Annual Total Driving Distance of Vehicles
- Q7 ☐ Road Fatalities
- Q8 ☐ Annual Expenditure for Roads
- Q9 ☐ Fuel Consumption
- Q10 ☐ Road policies

We kindly ask each member country to provide us with the data of each indicator corresponding to its articulated definition together with the relevant information such as the official data source and whatever.

Also we expect the latest figures regarding 10 indicators will be provided, and we wish some countries could volunteer to share two kinds of the latest figures for 2020 and 2019 or before, so that we can analyse the effects of COVID-19 to the relevant indicators which are Q5, Q6, Q7, and Q9 susceptible to that pandemic.

Such dedicated volunteers can duplicate the sheet of Q5, 6, 7, and 9 and answer each for 2020 and the year before COVID-19.

The survey sheets with your answers are expected to be returned to the below e-mail address **no later than 28th February 2022**, and please do not hesitate to contact the following persons for whatever questions if you may have.

E-mail: PIARCroadstatistics@road.or.jp

Contact point: Road Statistics Committee (Person in charge: Tomonobu TANINO & Takumi NISHIMURA)

Thank you for your cooperation in advance!

Your information in charge of this survey

Please provide the information about your profile in charge of this survey

Name	
Organisation	
Department	
Address	
E-mail	
Phone	
Fax	
Website	

Figure 4: Sample questionnaire sheet (Introduction) in English

Pregunta2 Vías arteriales primarias

El objetivo de esta encuesta es estudiar la longitud y la definición de las "carreteras arteriales primarias" en los países miembros.
Hemos definido las "Vías Arteriales Primarias" de la siguiente manera, y le rogamos que rellene el siguiente formulario de celdas

	Definición
Vías arteriales primarias	A excepción de las "Autopistas" definidas en la Pregunta1, las "Vías Arteriales Primarias" equivalen a las carreteras de alto nivel y a las autopistas nacionales destinadas principalmente a proporcionar transporte interurbano de larga distancia. En principio, las "Carreteras Arteriales Primarias" cumplen las siguientes 3 condiciones estructurales: 1) excluir las "Autopistas" definidas en la Pregunta1, 2) excluir las carreteras urbanas, las carreteras provinciales (regionales) y otras carreteras de menor nivel, y 3) ser en gran medida coherentes con las carreteras nacionales troncales

P.2-1 Presente el nombre oficial y la última longitud de las "Carreteras Arteriales Primarias" de su país que se ajustan a nuestra definición. Si hay más de un tipo de carretera aplicable a las "Carreteras Arteriales Primarias" en su país, por favor, proporcione su información en celdas separadas.

Año con las últimas estadísticas	Vías arteriales primarias (km)			Total
				0

Nota:
Por favor, presente el nombre oficial de "Vías arteriales primarias" que se ajuste a nuestra definición.

Si lo desea, puede añadir algunas notas a pie de página a las cifras anteriores en el recuadro (cualquier tipo de información relevante excepto las preguntas de abajo)

P.2-2 Para comprobar la equivalencia de sus "carreteras arteriales primarias" con nuestra definición, responda a las tres preguntas siguientes en términos de características estructurales mediante un menú desplegable.

	Nombre de la carretera	1) Número mínimo de carriles (Sí / No)	2) exclusión de las carreteras urbanas, provinciales(regionales) y otras de menor calidad (Sí / No)	3) En gran medida, se ajusta a las carreteras nacionales principales (Sí / No)
Vías arteriales primarias				

P.2-2-1 Nos gustaría saber quién es el operador de la carretera. Y si hay alguna otra condición estructural excepto las 1)-3) para ser definidas como "Carreteras Arteriales Primarias" en su país, por favor responda a las siguientes preguntas.

	Nombre de la carretera	4) ¿quién es el operador de la carretera?	5) ¿cuál es cualquier otra condición estructural excepto las 1)-3), si es que hay alguna?
Vías arteriales primarias			

Por favor, indique el nombre de su fuente de datos para las respuestas anteriores, y si está disponible en línea, facilítenos su URL para nuestra referencia.

Fuente	
URL	

Figure 5: Sample questionnaire sheet (Road Length (Primary Arterial Roads)) in Spanish

Una encuesta realizada por el Comité de Estadísticas de Carreteras de la AIPCR

El objetivo de esta encuesta del Comité de Estadísticas de Carreteras es permitir la comparación internacional del nivel de madurez global e individual del transporte por carretera (mediante 10 indicadores selectivos) entre los países miembros de la AIPCR, ayudando así a calibrar lo que será necesario para que cada país siga desarrollando su carretera y su transporte por carretera.

El resultado de esta encuesta, tras el examen, la síntesis y el análisis de los datos recogidos, se presentará en el próximo Congreso Mundial de Carreteras que se celebrará en Praga, República Checa, en octubre de 2023, y para finales de ese año esperamos publicar su informe en tres idiomas (inglés, francés y español) y ponerlo a disposición de todos los miembros de la AIPCR.

A continuación, se proponen algunas consultas de 10 indicadores selectivos que esperamos recoger;

- P1 Longitud de la carretera (autopista)
- P2 Longitud de la carretera (carreteras arteriales primarias)
- P2-1 Longitud de la carretera (otras carreteras)
- P3 Longitud del puente
- P4 Longitud del túnel
- P5 Número de vehículos en uso
- P6 Distancia total anual de conducción de vehículos
- P7 Víctimas mortales en carretera
- P8 Gasto anual en carreteras
- P9 Consumo de combustible
- P10 Políticas de carreteras

Rogamos a cada país miembro que nos facilite los datos de cada indicador correspondientes a su definición articulada junto con la información pertinente, como la fuente de datos oficial y lo que sea.

También esperamos que se proporcionen las últimas cifras relativas a 10 indicadores, y deseamos que algunos países se ofrezcan a compartir dos tipos de las últimas cifras para 2020 y 2019 o antes, para que podamos analizar los efectos de COVID-19 a los indicadores relevantes que son P5, P6, P7, y P9 susceptibles a esa pandemia.

Dichos voluntarios dedicados pueden duplicar la hoja de las P5, P6, P7 y P9 responder a cada una de ellas para 2020 y el año anterior a COVID-19.

Se espera que las hojas de la encuesta con sus respuestas sean devueltas a la dirección de correo electrónico indicada a continuación **a más tardar el 28 de febrero de 2022**, y no dude en ponerse en contacto con las siguientes personas para cualquier pregunta que pueda tener.

Correo electrónico: PIARCroadstatistics@road.or.jp

Punto de contacto: Comité de Estadísticas de Carreteras (Responsable: Tomonobu TANINO y Takumi NISHIMURA)

Gracias por su colaboración de antemano.

Su información a cargo de esta encuesta

Por favor, facilite la información sobre su perfil a cargo de esta encuesta

Nombre	
Organización	
Departamento	
Dirección	
Correo electrónico	
Teléfono	
Fax	
Página web	

Figure 6: Sample questionnaire sheet (Introduction) in Spanish

Question2 Routes principales

L'objectif de cette enquête est d'étudier la longueur et la définition des "routes principales" dans les pays membres. Nous avons défini les "routes principales" comme suit. Veuillez remplir le formulaire ci-dessous des cellules colorées en bleu.

	Définition
Routes artérielles primaires	À l'exception des "autoroutes" définies dans la question 1, les "routes principales" sont équivalentes aux routes à haut niveau de service et aux routes nationales principalement destinées à assurer le transport interurbain à longue distance. En principe, les "Routes Principales" répondent aux 3 conditions structurelles suivantes : 1) elles excluent les "Autoroutes" définies dans la Question 1, 2) elles excluent les routes urbaines, les routes provinciales (régionales) et autres routes de niveau inférieur, et 3) elles sont largement compatibles avec les routes nationales.

Q.2-1 Veuillez présenter le nom officiel et la dernière longueur des "Routes Principales" de votre pays qui correspondent à notre définition. S'il y a plus d'un type de routes applicables aux "Routes Principales" dans votre pays, veuillez fournir leurs informations dans des cellules séparées.

Année avec les dernières statistiques	Routes artérielles primaires (km)			Total
				0

Note :
Veuillez présenter le nom officiel des "Routes artérielles primaires" qui correspond à notre définition.

Le cas échéant, vous pouvez ajouter des notes de bas de page aux chiffres ci-dessus dans l'encadré (toutes sortes d'informations pertinentes, sauf pour les questions ci-dessous)

Q.2-2 Pour vérifier l'équivalence de vos "routes principales" à notre définition, veuillez répondre aux trois questions suivantes en termes de caractéristiques structurelles par un menu déroulant.

	Nom de la route	1) nombre minimum de voies (Oui / Non)	2) exclusion des routes urbaines, provinciales (régionales) et autres routes de qualité inférieure (Oui / Non)	3) largement conforme aux routes nationales (Oui / Non)
Routes artérielles primaires				

Q.2-2-1 Nous aimerions savoir qui est l'exploitant de la route. Et s'il existe d'autres conditions structurelles, à l'exception de 1)-3), pour être définies comme "routes artérielles primaires" dans votre pays, veuillez répondre aux questions suivantes.

	Nom de la route	4) qui est l'opérateur routier ?	5) quelle est toute autre condition structurelle à l'exception de 1)-3), le cas échéant ?
Routes artérielles primaires			

Veuillez indiquer le nom de votre source de données pour les réponses ci-dessus, et si elle est disponible en ligne, fournissez-nous son URL pour notre référence.

Source	
URL	

Figure 7: Sample questionnaire sheet (Road Length (Primary Arterial Roads)) in French

Une enquête par questionnaire menée par le Comité des statistiques routières de AIPCR

L'objectif de cette enquête du Comité des statistiques routières est de permettre une comparaison internationale du niveau de maturité global et individuel du transport routier (par 10 indicateurs sélectifs) entre les pays membres de AIPCR, aidant ainsi à évaluer ce qui sera nécessaire à chaque pays pour développer davantage ses routes et son transport routier.

Le résultat de cette enquête, après examen, synthèse et analyse des données recueillies, sera présenté au prochain Congrès mondial de la route qui se tiendra à Prague, en République tchèque, en octobre 2023. D'ici la fin de cette année, nous prévoyons de publier son rapport en trois langues (anglais, français et espagnol) et de le mettre à la disposition de tous les membres de AIPCR.

Nous proposons ici quelques enquêtes sur les 10 indicateurs sélectifs que nous prévoyons de collecter, comme suit ;

- Q1 Longueur de la route (autoroute)
- Q2 Longueur des routes (routes nationales)
- Q2-1 Longueur des routes (autres routes)
- Q3 Longueur des ponts
- Q4 Longueur des tunnels
- Q5 Nombre de véhicules en service
- Q6 Distance totale parcourue annuellement par les véhicules ☐
- Q7 Morts sur la route
- Q8 Dépenses annuelles pour les routes
- Q9 Consommation de carburant
- Q10 Politiques routières

Nous demandons à chaque pays membre de nous fournir les données de chaque indicateur correspondant à la définition proposée, ainsi que les informations pertinentes telles que la source officielle des données et autres.

Nous espérons également que les derniers chiffres concernant 10 indicateurs seront fournis, et nous souhaitons que certains pays se portent volontaires pour partager deux types de chiffres récents pour 2020 et 2019 ou avant, afin que nous puissions analyser les effets de COVID-19 sur les indicateurs pertinents qui sont Q5, Q6, Q7 et Q9 sensibles à cette pandémie. Ces volontaires peuvent dupliquer la feuille des questions 5, 6, 7 et 9 et répondre à chacune d'elles pour 2020 et l'année précédant COVID-19.

Les feuilles d'enquête avec vos réponses doivent être renvoyées à l'adresse e-mail ci-dessous **au plus tard le 28 février 2022**. N'hésitez pas à contacter les personnes suivantes pour toute question que vous pourriez avoir.

E-mail : PIARCroadstatistics@road.or.jp

Point de contact : Comité des statistiques routières (Responsables : Tomonobu TANINO & Takumi NISHIMURA)

Merci d'avance pour votre coopération !

Vos informations en charge de cette enquête

Veuillez fournir les informations sur le profil de la personne en charge de cette enquête

Nom	
Organisation	
Département	
Adresse	
Courriel	
Téléphone	
Fax	
Site web	

Figure 8: Sample questionnaire sheet (Introduction) in French

4.2. DISTINGUISHING CHARACTERISTIC OF QUESTIONNAIRE

One of the key characteristics of our survey is to clarify how each indicator is defined in a country, thereby enabling its fair comparison among the countries on the international data platform. Thus each questionnaire sheet begins with a definition of the indicator to be collected and concerns the presence of an official definition of the indicator by a country, if any, with some additional noticeable information when the data is provided.

Also, the time when the data was generated in a country should be made clear so that it can be compared with one another at the same/nearly same time stage internationally. In addition, we ask for data source such as URL or name of a statistical report of a country in which the data is stored. In case we wonder if the data provided is accurate/whether its data definition is compatible with our definition, we can check and rectify the data if necessary.

5. CONDUCTING A DETAILED SURVEY OF 10 INDICATORS FOR ALL MEMBER COUNTRIES

Finalizing the questionnaire sheet for each indicator in 3 languages, we have got prepared to conduct a detailed survey for all member countries. Kindly supported by General Secretariat, the below cover letter (refer to Figure 9 as an example of English version) with a set of questionnaire sheets of Microsoft Excel explained in the chapter 4, has been delivered in 3 languages as an official request to each First Delegate.

We have requested First Delegates to complete and return the survey since December 2021 while setting the deadline (end of February 2022) which may seem tight. In consequence, we have extended the deadline several times, checking the response rate, and Table 3 indicates which countries have kindly responded to our request. In total we can collect, synthesize and analyze the data provided by 29 countries for our output. Here let us give great thanks to persons in charge of such 29 countries.

December 2021

Dear First Delegates of PIARC member countries

As Chair of Road Statistics Committee (RSC) of PIARC, I would like to ask for your kind cooperation in the survey to produce and then release the road statistics of PIARC.

As a consequence of substantive discussion and comprehensive studies among RSC members in this working cycle since 2020, RSC has managed to finalize a survey questionnaire which consists of inquiries of 10 selective indicators to be discovered. The scope of 10 indicators is defined according to 7 important areas of interest that road administrations can easily evince: infrastructure, vehicle, performance, safety, budget, energy, and policy.

The result of this survey, after examination, synthesis, and analysis of collected data, will be presented at the next World Road Congress to be held in Prague Czech Republic in October 2023 and by the end of that year we expect to publish its report in three languages and make it widely available to all PIARC members.

Here, 10 indicators we expect to collect are proposed as follows:

	Areas of interest	Indicator	Remarks
Q1	Infrastructure	Road Length (Motorway)	Network length
Q2	Infrastructure	Road Length (Primary Arterial Roads)	Network length
Q2-1	Infrastructure	Road Length (Other Roads)	Network length
Q3	Infrastructure	Bridge Length	Physical length
Q4	Infrastructure	Tunnel Length	Physical length
Q5	Vehicles in Use	Number of Vehicles in use	
Q6	Road Transport Performance	Annual Total Driving Distance of Vehicles	
Q7	Safety	Road Fatalities	UN definition based
Q8	Budget	Annual Expenditure for Roads	OECD definition based
Q9	Energy	Fuel Consumption	Limited to Road sectors
Q10	Policy	Road policies	Qualitative

You will notice that these indicators are clear/interesting while encompassing some important aspects of the existing road statistics. When each data is generously provided by our PIARC fellow members in a proper manner, we promise to enable international comparison of comprehensive and individual maturity level of road transport to be made among member countries, thereby helping gauge what will be necessary for each country to further develop its road and road transport.

Then looking at the survey sheets as attached, it would be appreciated if you could fill them (cells colored in blue) with the data and the official data source of your country. In addition to the latest figure, you are requested to provide us with the information about how you officially define those data for each classification. Obviously, clarification of data definition is the essence of this survey, so I wish you could keep it in mind when each question is answered.

The survey sheets with your answers are expected to be returned to the below e-mail address no later than 28th February 2022, and please do not hesitate to contact the following persons for whatever questions if you may have.

Contact point: Road Statistics Committee

(Person in charge: Tomonobu TANINO & Takumi NISHIMURA)

E-mail: PIARCroadstatistics@road.or.jp

I thank you in advance for your support and look forward to your reply.

Best regards,

Hirofumi OHNISHI

Chair of Road Statistics Committee of PIARC

Supported by Shigeru KIKUKAWA, Vice President of PIARC

Figure 9: Cover letter in as a sample of English version

Table 3: Survey response status

	Q1 Road Length (Motorway)	Q2 Road Length (Primary)	Q2-1 Road Length (Other)	Q3 Road Length (Bridge)	Q4 Road Length (Tunnel)	Q5 Vehicle in Use	Q6 Road Transport Performance	Q7 Road Fatalities	Q8 Budget	Q9 Fuel Consumption	Q10 Road policy
1 AT Austria	Note, Definition Not satisfy 3 conditions	Note	Only 90,000 km. All paved, broad width.	No physical length. Number and areas of bridges.	Physical length and number provided.	Passenger and freight vehicles. Environmentally-friendly vehicles.	Motorway, all roads. By vehicle category.	By road category.	Only motorway.	Petroleum, diesel oil.	2030 Mobility Plan.
2 BE Belgium	No express category name Definition	No road category name	Almost paved	No physical length. Number of bridges.	NO	No definitions. Environmentally-friendly vehicles.	All roads. By vehicle category. Note : only vehicles registered in Belgium.	All roads.	NO	Petroleum, diesel oil.	Active mode.
3 BG Bulgaria	Answers by route	YES	Almost paved. Broad width.	No physical length. Number of bridges.	No physical length. Number of tunnels.	NO	NO	By road category.	YES	NO	Road safety. No check mark.
4 CA Canada	Definition	Note	Lanes and alleys Sidewalks	No physical length. Number of bridges.	No physical length. Number of tunnels.	Passenger and freight vehicles. No environmentally-friendly vehicles.	Only motorway.	All roads.	Note.	Petroleum, diesel oil, LPG.	Many check marks. Perhaps not present policies.
5 CA QC Canada-Quebec	Note, Definition	Note	Accès aux ressources Locale Note.	Physical length provided? Areas. Note.	Physical length nationally? Areas. Note.	NO	NO	NO	YES	NO	NO
6 CH Switzerland	No express category name	Note	All paved, broad width	NO	NO	Passenger and freight vehicles. Environmentally-friendly vehicles.	By road category. By vehicle category.	All roads.	YES	YES Note.	NO
7 CR Costa Rica	Note, definition No motorway. Roads with 3 conditions	Note Total is incorrectly calculated.	Calles de Travesía as = Pedestrian crossing? Note	Answers by route?	Answers by route?	Passenger and freight vehicles. Environmentally-friendly vehicles.	All roads. By vehicle category. Note.	No limit of the number of days.	By budget category? Categorized in detail.	YES Note.	National Transport Plan 2011-2035
8 CZ Czech Republic	Definition	YES	NO	NO	Physical length provided. Longer than motorway length?	Passenger and freight vehicles. Environmentally-friendly vehicles.	NO	By road category.	YES	YES Different unit ?	YES
9 DE Germany	Note, Definition	Note	All paved, broad width	Physical length and number provided.	Physical length and number provided.	Passenger and freight vehicles. Environmentally-friendly vehicles.	By road category. By vehicle category.	By road category.	Only motorway.	NO	Federal Transport Infrastructure Plan
10 DK Denmark	Note. No answer to 3 conditions	YES	Road category name	Only 42km ? Only bridges administrated nationally.	Only 2km ? Only tunnels administrated nationally.	Passenger and freight vehicles. Environmentally-friendly vehicles.	By road category. By vehicle category.	By road category.	Only national data.	YES	No check mark.
11 FR France	Definition	YES	YES	NO	Physical length and number provided.	Passenger and freight vehicles. Environmentally-friendly vehicles.	All roads.	All roads.	NO	YES	NO
12 GR Greece	Unclear whether limited access is met. Definition	YES	YES	Physical length and number provided.	Physical length and number provided.	Passenger and freight vehicles. No environmentally-friendly vehicles.	Only motorway. By vehicle category.	By road category.	Only motorway.	Petroleum, diesel oil, LPG.	NO
13 ID Indonesia	Answers to survey by paper	YES	YES	Physical length	Physical length	Passenger and freight vehicles. No environmentally-friendly vehicles.	NO	All roads.	Only national data.	NO	Strategic Plan. No check mark.
14 IE Ireland	Dual Carriageway without 3 conditions	YES	Note	No physical length. Number of bridges.	YES Note.	Passenger and freight vehicles. Environmentally-friendly vehicles.	By road category. By vehicle category.	By road category.	NO	NO Note	YES Very detailed.
15 IT Italy	Autostrada is not included. No expressway category name?	No road category name?	All road category name unknown? All paved.	Physical length and number provided.	Physical length and number provided.	Passenger and freight vehicles. No environmentally-friendly vehicles.	NO	NO	NO	NO	NO
16 JP Japan	Definition Urban Motorways	Note	Note	Physical length and number provided.	Physical length and number provided.	Passenger and freight vehicles. Environmentally-friendly vehicles.	All roads.	All roads.	Government budget only, excluding private motorway companies	Petroleum, diesel oil, LPG.	Outline of the budget request for roads for 2022
17 KR South Korea	Perhaps ordinary national roads included. Unit by meter	No national road. Unit by meter	Unit by meter. Only 70,000km.	Physical length and number provided.	Physical length and number provided.	Passenger and freight vehicles. No environmentally-friendly vehicles.	All roads. By vehicle category.	By road category.	YES	NO	YES
18 LT Lithuania	Units: probably meters No answer to 3 conditions.	Only length answered.	Only length answered.	No physical length. Number of bridges.	NO	NO	NO	NO	NO	NO	NO
19 LU Luxemburg	Voie express (B) without 3 conditions	Too wide range of arterial roads.	NO	Physical length provided.	Physical length provided.	Only passenger vehicles	NO	By road category.	YES	NO	NO
20 MZ Mozambique	No motorway or unanswered	YES	YES	Physical length and number provided.	NO	Passenger and freight vehicles. No environmentally-friendly vehicles.	NO	By road category.	YES	NO	Many check marks.
21 NL Netherlands	Answer only for length. No answer to 3 conditions, etc.	NO	Only length answered.	NO	NO	Passenger and freight vehicles. No environmentally-friendly vehicles.	All roads. By vehicle category.	All roads.	NO	Different unit, Kg	Almost all items check-marked.
22 NZ New Zealand	Answers by route	Expressways without 3 conditions categorized	YES	NO Partially provided.	Physical length provided. Lane - Length	Passenger and freight vehicles. Environmentally-friendly vehicles.	No motorway data provided.	No motorway data provided.	YES	YES	YES
23 PT Portugal	Definition	YES	O Only 10,000km. All paved, broad width.	NO	NO	Passenger and freight vehicles. Environmentally-friendly vehicles.	By vehicle category.	By road category.	Only concession companies.	YES	NO
24 RO Romania	Answers by route	Answers by route	NO	NO	NO	Passenger and freight vehicles. No environmentally-friendly vehicles.	By road category. By vehicle category.	By road category.	YES	NO	NO
25 SE Sweden	Without 3 conditions	No road category name	Road category name, etc. unknown.	NO	NO	Passenger and freight vehicles. Environmentally-friendly vehicles.	By road category. By vehicle category.	By road category.	YES	YES	Vision Zero.
26 SK Slovakia	Answers by route. Some routes without 3 conditions	Answers by route	All paved, broad width	Physical length and number provided.	Physical length and number provided.	Passenger and freight vehicles. Environmentally-friendly vehicles.	By vehicle category	By road category.	YES	Petroleum, diesel oil	YES
27 TN Tunisia	Answers by route	RN, RR ?	Only 60,000km.	NO	NO	Passenger and freight vehicles. No environmentally-friendly vehicles.	By vehicle category	All roads.	YES	Only total amount.	YES
28 US United States	Definition	YES	YES	Physical length, number and area provided.	Physical length and number provided.	Passenger and freight vehicles. No environmentally-friendly vehicles.	By vehicle category	By road category.	YES	YES	YES
29 ZA South Africa	Undivided Dual carriageway without 3 conditions	YES	NO	Physical length provided.	Physical length provided. Only 5km.	NO	Only motorway.	Only motorway.	YES	NO	NO

6. ANALYSIS OF COLLECTED DATA IN COLLABORATION WITH SOME OFFICIAL STATISTICS

29 countries including some LMICs kindly responded to the survey. They are listed below.

Austria, Belgium, Bulgaria, Canada, Canada-Quebec, Switzerland, Costa Rica, Czech Republic, Denmark, France, Germany, Greece, Indonesia, Ireland, Italy, Japan, South Korea, Lithuania, Luxemburg, Mozambique, Netherlands, New Zealand, Portugal, Romania, Sweden, Slovakia, Tunisia, United States and South Africa

6.1. MOTORWAYS

28 out of 29 countries have presented length of Motorways. Although 3 structural conditions are indicated in « 3.2.GIVING A CLEAR DEFINITION OF FINALLY SELECTED 10 INDICATORS » to clearly define Motorways, all countries' Motorways do not satisfy 3 conditions exactly and some countries do not even answer anything. We do not have to make too rigorous examination of them, and from the practical perspective of our survey with some degree of tolerance, the data of some countries that may satisfy at least 2 conditions can be regarded as Motorways (e.g., Austria, Luxembourg, Sweden, and South Africa).

Also, we have somehow made a few necessary modifications to the data regarding Motorways as follows :

- Ireland claims Dual Carriageway as Motorways, although only one structural condition is satisfied. Therefore, we classify Dual Carriageway as Primary Arterial Roads rather than Motorways.
- South Korea claims National Highway as Motorways, which satisfies two conditions. Normally, however, National Highway is categorized into Primary Arterial Roads in most countries. Then we regard National Highway defined in South Korea as Primary Arterial Roads in our classification, rather than Motorways.
- Since we have discovered that motorways operated by a concessionaire called Autostrada are excluded from the data of Motorways in Italy, the length of those motorways is additionally counted as Motorways of Italy.

Each length of Motorways of the 28 countries is graphically arranged in Figure 10. Obviously a country with its larger surface area tends to own more extensive length of Motorways, such as the United States and Canada in particular. On the other hand, some smaller territorial countries (eg. Japan, Italy, ...) are ranked relatively higher in this group. Then if you want to know the maturity level of development of Motorways for each country on the international platform, it may be necessary to measure how densely and extensively Motorways are networked in a country from the perspective of surface area as well as population or road users, instead of focusing on length only. Later in this chapter, we will analyze several sets of data combined from the viewpoint.

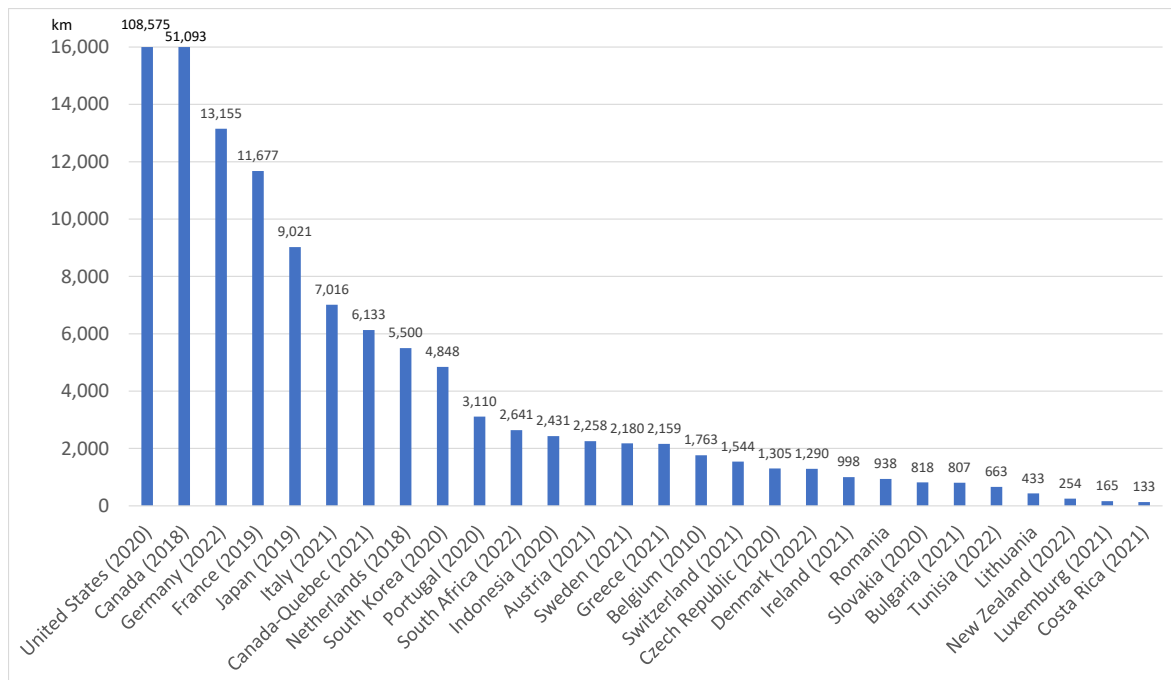


Figure 10: Length of Motorways

There are two basic propositions about how developed in length Motorways or Primary Arterial Roads should be enough to satisfy social needs.

One is that roads should be extensively developed in proportion to population which may be equivalent to road users. However, considering that the essential function of road is to establish a connection between distant areas, the scale of surface area cannot be ignored from the viewpoint of a required road length. Another is that the needed length of road can be determined by surface area. Similarly, significance of road depends on how many users and beneficiaries exist, and it becomes necessary to reflect on population at the same time.

The below formula is hypothetically proposed to integrate the above two propositions, making a required road length proportional to the square root of the population multiplied by surface area[1].

$$\text{Road Length} = \alpha \sqrt{\text{Population} * \text{Area}}$$

This constant of proportionality is called Land Characteristic Index, and the square root of population and surface area is referred to as $\sqrt{\text{PA}}$ in the following.

A graphical juxtaposition of each length of Motorways divided by $\sqrt{\text{PA}}$ is shown in Figure 11. This analysis indicates that Netherlands has the most extensive motorway network under the condition of the scale of its population and surface area assessed. Looking from the left to right in this graph, the maturity level of motorway network defined by the above theory becomes lower, and there may be more room for development in the further right. It can apply to even some developed countries such as Japan (19th), Sweden (20th) and etc.

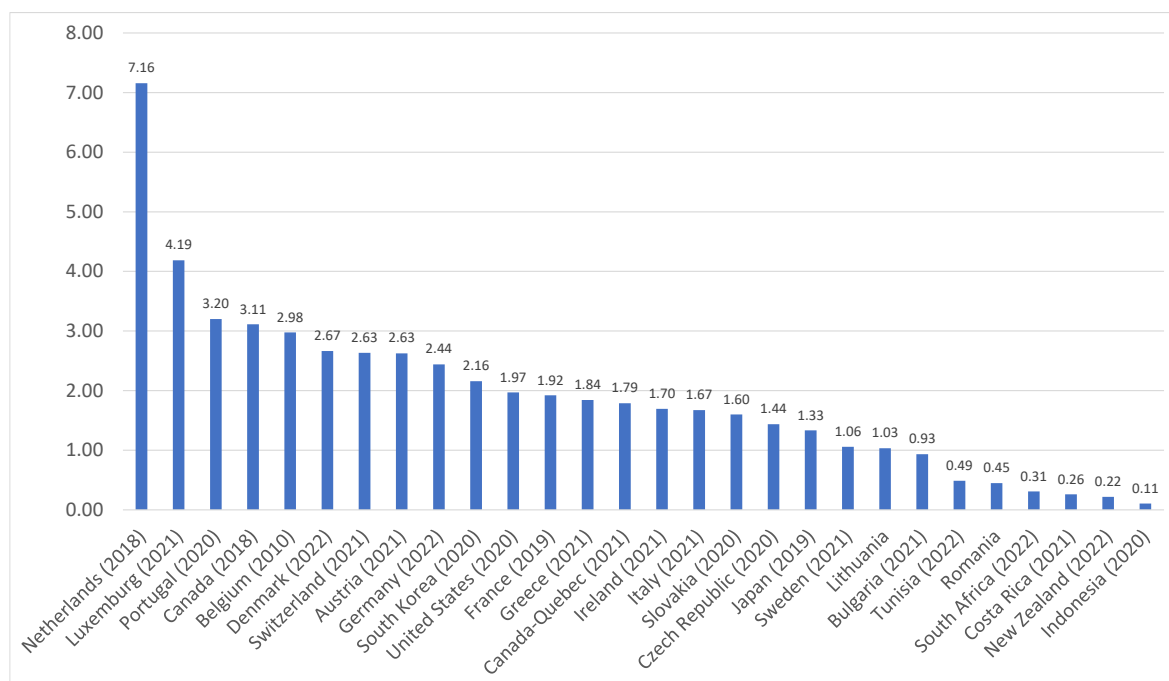


Figure 11: Length of Motorways divided by $\sqrt{PA}$

Figure 12 is a scatter diagram of $\sqrt{PA}$ and Length of Motorways for 28 countries. The gradient of the approximate line drawn through the origin is 1.77 with its correlation coefficient squared equal to 0.8491 which can ensure high reliability of data analysis. Then it can be deduced that a country smaller than 1.77 in Figure 11 (from Ireland ranked 15th to Indonesia the lowest) is plotted below the approximate line in Figure 12 and that such a country may need to develop a more widespread motorway network in the light of this new international benchmark we propose.

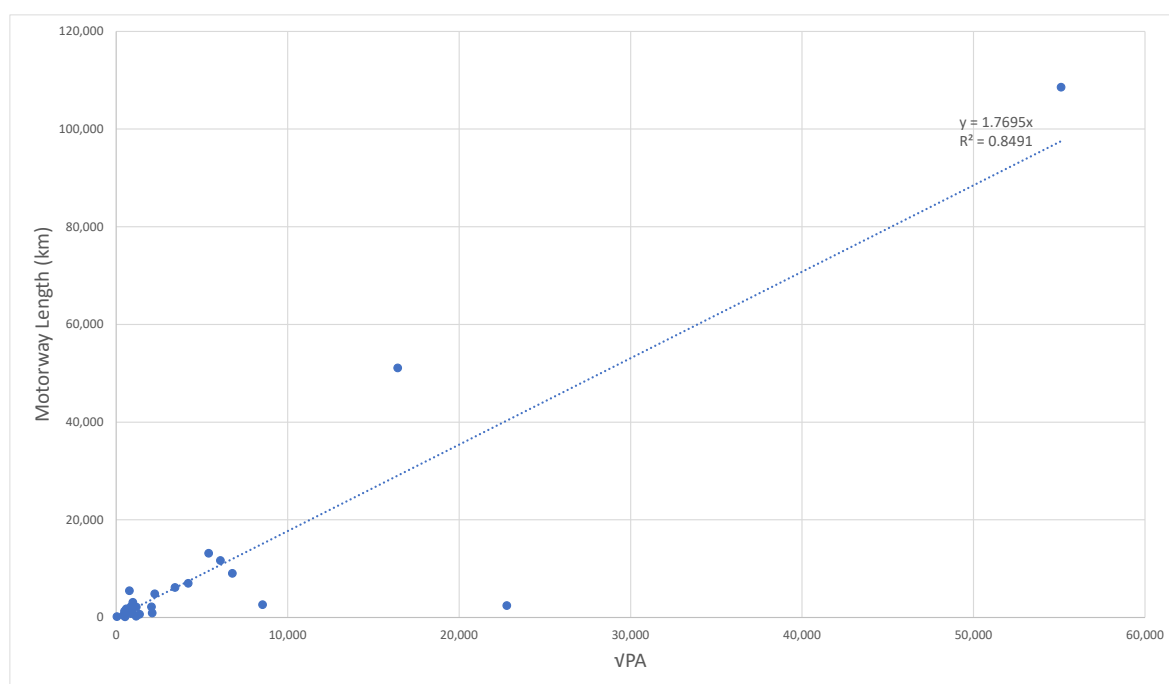


Figure 12: Correlation between $\sqrt{PA}$ and length of Motorways

In addition Figure 13 shows the correlation between length of Motorways divided by $\sqrt{\text{PA}}$ and GDP per capita. Since its correlation coefficient squared is equal to 0.707, the result of the analysis also seems reliable although some data disperse. From this graph we may infer that the more developed motorway's network of a country is, the wealthier the country is, and vice versa.

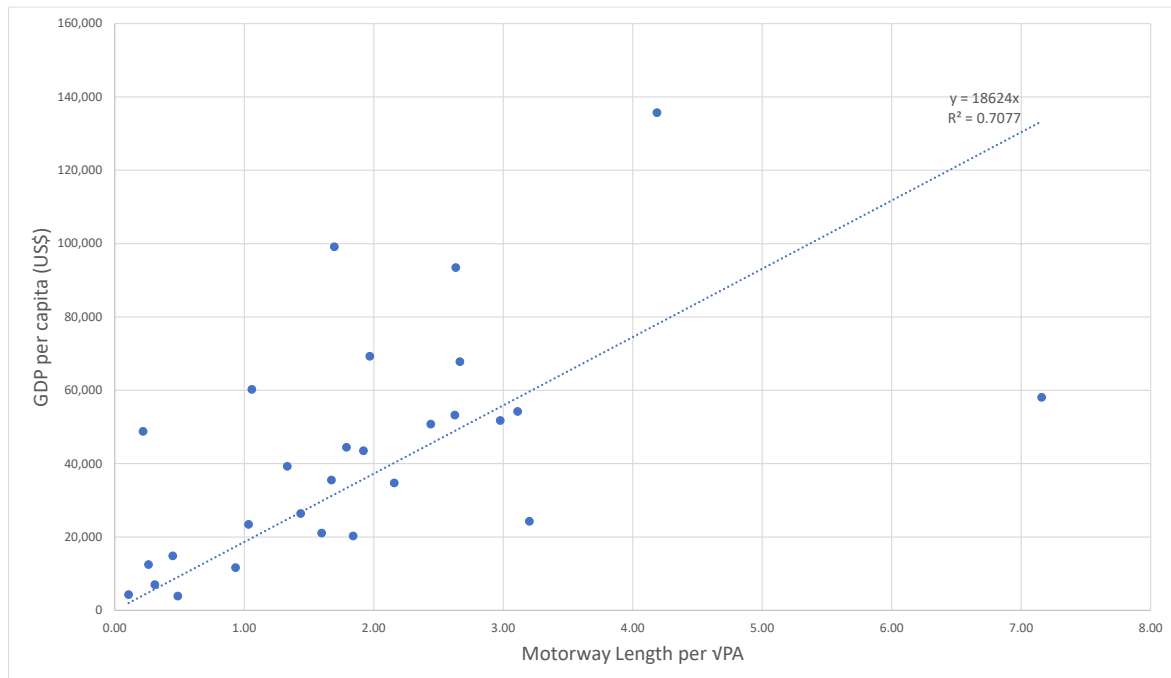


Figure 13: Correlation between GDP per capita and length of Motorways divided by $\sqrt{\text{PA}}$

6.2. PRIMARY ARTERIAL ROADS

Primary Arterial Roads are defined as equivalent to high-standard roads and national highways primarily intended to provide interurban long distance transport, except for Motorways.

In our survey, Primary Arterial Roads are, in principle, expected to satisfy the following 3 categorial conditions:

- 1) exclude "Motorways" as defined above,
- 2) exclude urban roads, provincial (regional) roads and other lower-standard roads, and
- 3) be largely consistent with national trunk roads

28 countries have presented the length of Primary Arterial Roads. Figure 14 indicates its arrangement in order of length from the left to right. Also Figure 15 concerns length of Primary Arterial Roads divided by $\sqrt{\text{PA}}$ in the same way as the previous section for Motorways.

Looking closely into the obtained data, it seems that some countries claim Primary Arterial Roads as operated and maintained by the national road administrations. Then their length should vary depending on the jurisdiction of the central government, and we can infer that some developed countries' length of Primary Arterial Roads becomes unduly small, such as France, because it has delegated management of national roads to local governments. The same thing may happen to Sweden and Italy, although their national roads under the control of local governments can be categorized as Primary Arterial Roads by our definition. Therefore, it may be difficult to make a fair

comparison of length of Primary Arterial Roads due to specific circumstances apart from the definition based on the categorial requirements.

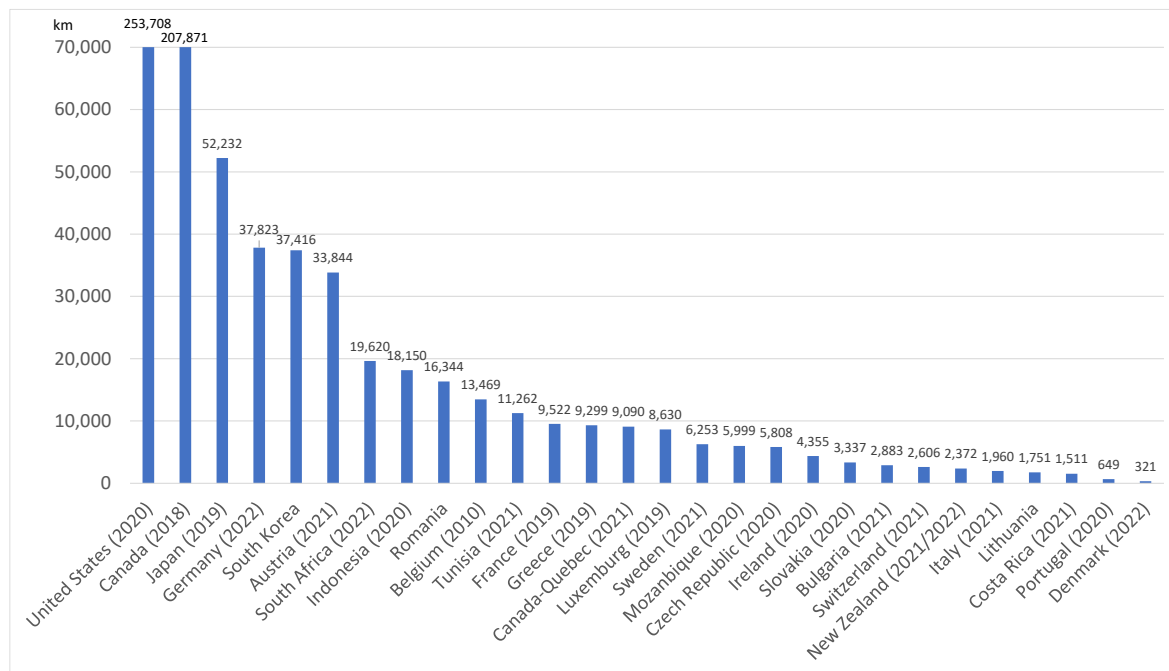


Figure 14: Length of Primary Arterial Roads

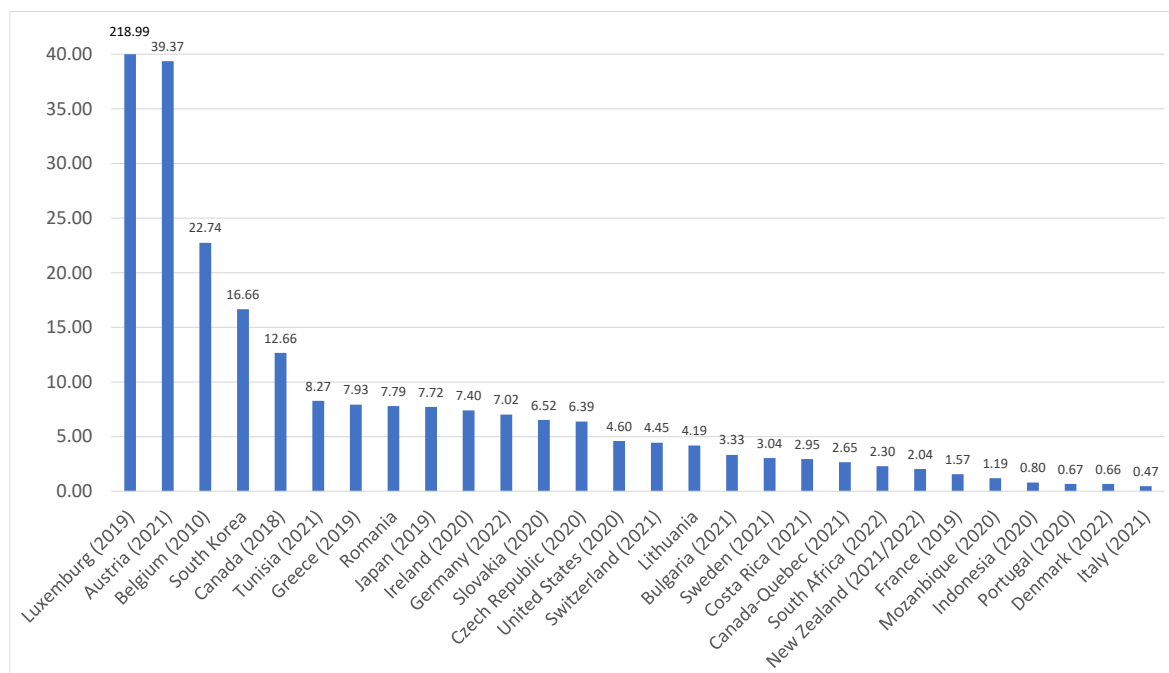


Figure 15: Length of Primary Arterial Roads divided by $\sqrt{PA}$

Another reason that we have difficulty in making a fair comparison of length of Primary Arterial Roads on the international platform is a substantial variation of their structural standards and functions dependent on each country.

As an example of structural standards, Figure 16 shows whether or not the minimum number of lanes defined for Primary Arterial Roads exists. While 32% of the countries claim Yes, 68% claim No.

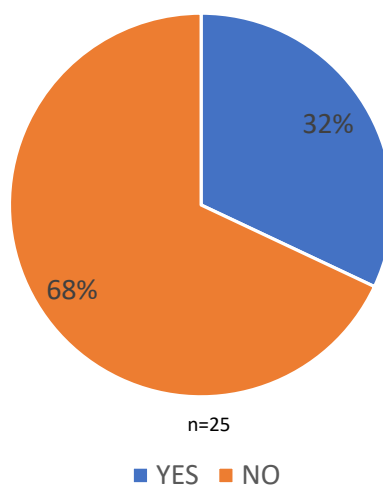


Figure 16: Existence or non-existence of minimum no. of lanes defined for Primary Arterial Roads

Also we check if urban, provincial (regional), and other lower-standard roads are excluded from Primary Arterial Roads, since Primary Arterial Roads are expected to function as a long-distance connection between cities and provinces. 74% of the countries claim Yes, and 26% claim No, as referred to Figure 17.

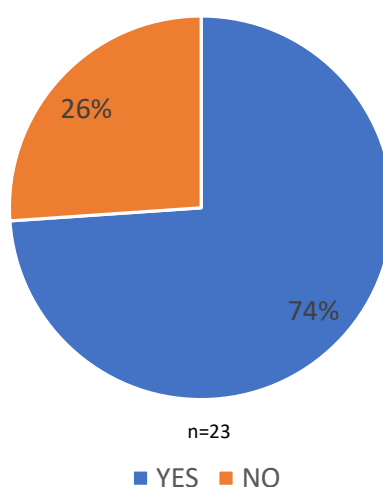


Figure 17: Exclusion of urban, provincial (regional), and other lower-standard roads

Figure 18 indicates how commensurate with national trunk roads Primary Arterial Roads are thought to be. 96% of countries admit that Primary Arterial Roads are largely consistent with national trunk roads, and they may be regarded as identical to national trunk roads. As is articulated in the above, it seems very difficult to enable a fair international comparison of Primary Arterial Roads because of their varied standards and functions. On the other hand, many countries claim that Primary Arterial Roads are classified as national trunk roads which should be under control of the central government. Therefore, there is a contradiction between organizational jurisdiction and actual level of service provided for Primary Arterial Roads.

In general development of the network of Primary Arterial Roads should be responsible for the central government of a country because Primary Arterial Roads serve for its users to drive a long

distance between cities and provinces as a viable alternative route of Motorways. Thus the role of Primary Arterial Roads must be immutable without any need of definition of the number of lane or whatever.

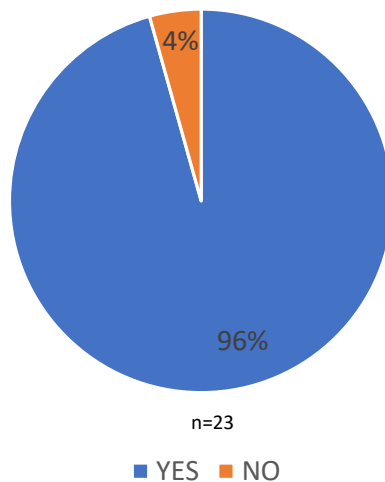


Figure 18: Largely consistency with national trunk roads

6.3. OTHER ROADS

Each length of Other Roads except for Motorways and Primary Arterial Roads is graphically arranged in Figure 19. Definition of Other Roads must be expansive and different from each country, thereby causing an inconclusive result to be delivered. For example, looking at some developed countries such as France, Japan and Germany, each length of Other Roads is 1,082,894 km, 293,248 km, and 178,622 km respectively. From the perspective of population and surface area as well, the difference may be explained by the statistical coverage of Other Roads rather than the maturity level of road development. The point is to which level of roads are categorized as Other Roads.

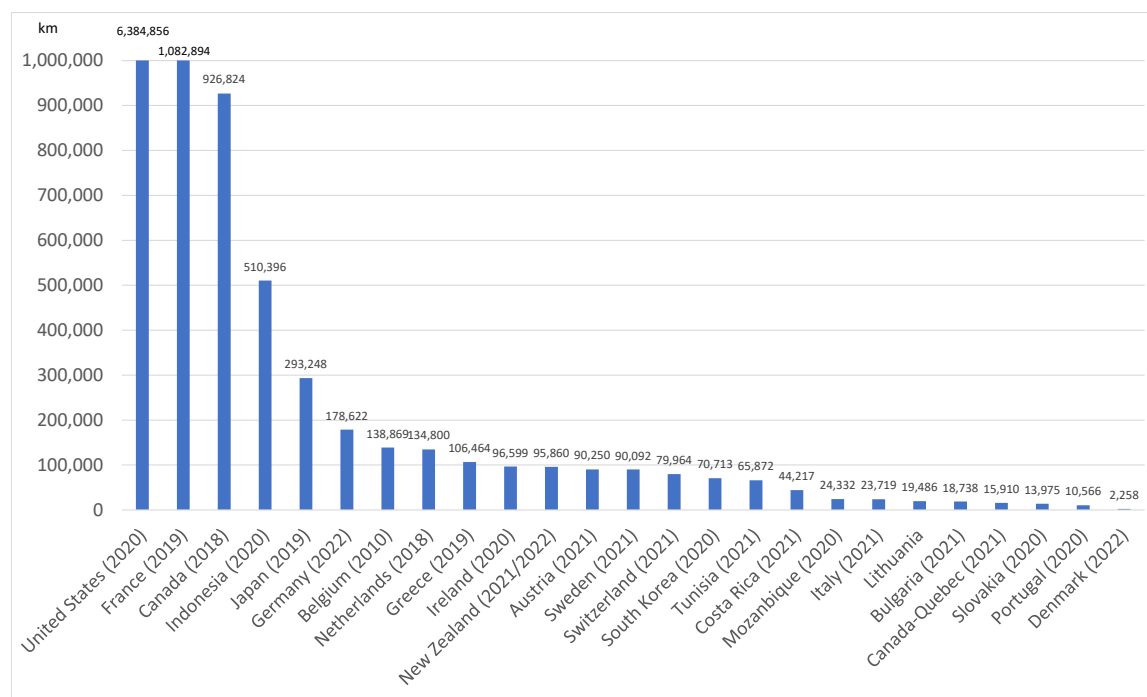


Figure 19: Length of Other Roads

Generally speaking, high-income countries which have developed their road network throughout history will claim that roads must be paved when counted in statistics. On the other hand, many sections of roads in low- and middle-income countries are unpaved. Also, some countries may claim that statistically counted roads should be wide enough for vehicles from both directions to pass each other, and others may not. Even tiny roads such as alleys and trails which seem unavailable for vehicles are included for Other Roads in the statistics of several countries. Thus, in order to understand qualitative coverage of Other Roads, level of pavement and road width is surveyed. According to Figure 20, 63% of the countries claim all of their Other Roads are paved; 26% claim that most are paved; 11% claim that most are unpaved. Also Figure 21 shows that in 94% of the countries their Other Roads are wide enough for vehicles to pass each other and that not wide enough in only 6%.

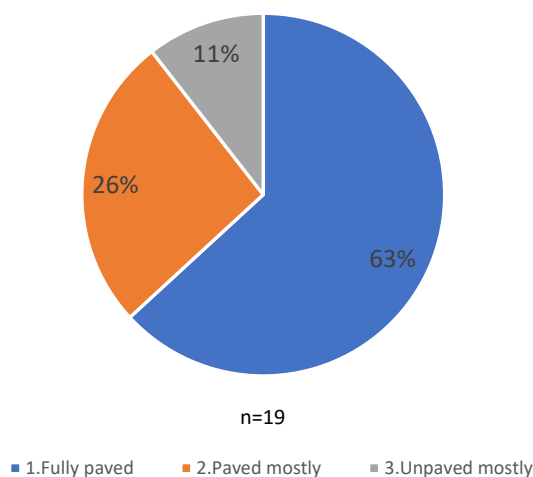


Figure 20: Pavement

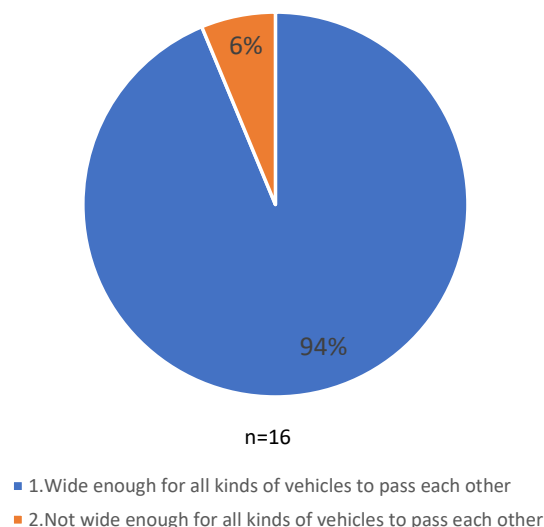


Figure 21: Road width

Figure 22 illustrates the share of length of Motorways, Primary Arterial Roads and Other Roads, which will help us speculate about which type of road can serve more for economic activities of each country. According to Figure 22, length of Motorways accounts for less than 5% share of all in many countries, although Motorways should greatly contribute to transport of people, goods, or whatever. However, in some countries such as Canada-Quebec, the Czech Republic, Denmark, Italy and Portugal, Motorways account for about 20 percent more or less of total in length.

On average each share of road type is 5.6% for Motorways, 11.0% for Primary Arterial Roads and 83.4% for Other Roads according to the data obtained from the 25 countries. This result may help road administrations think of the appropriate share balance of three road types in a country, thereby determining the priority of development for each.

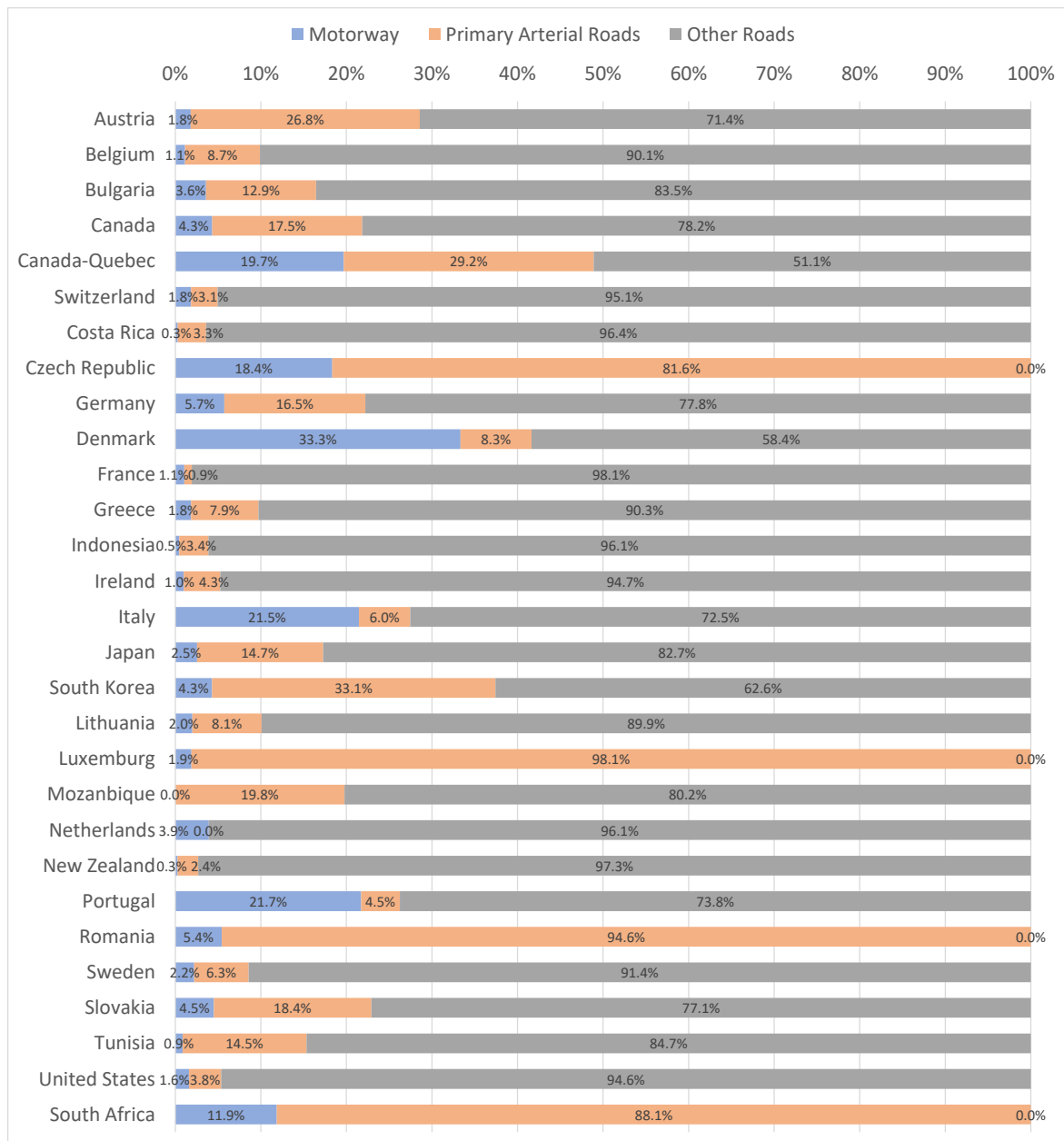


Figure 22: Share of road types (Motorways, Primary Arterial Roads, and Other Roads)

6.4. BRIDGES

Regarding Bridges, our survey concerns physical length of Bridges, instead of network length.

Physical length means that it adds up each length of a bridge. When each north- and south-bound road has one bridge (ex. 100m long) separately in the same section, its physical length of bridges is 200m. Meanwhile, network length of the case is 100m without double-counted for each direction.

Looking at Figure 23 and Figure 24, 12 out of 29 countries have answered their physical length of Bridges for Motorways, and 3 countries (Canada, Austria and Bulgaria) have answered only their statistical number of Bridges for Motorways instead (in total 11 answers for the number).

Focusing on physical length in Figure 23, the United States are followed by Japan, South Korea, Germany and so on. The main reason why the physical length of Japan and South Korea becomes relatively greater is that both of them are mountainous countries requiring many bridges in order

to connect cities by short routes through mountains without detours (learnt from this example, it would be misleading to make an international comparison of road density per inhabitable surface area because there is a mistaken assumption that roads do not exist in uninhabitable area, without any understanding of an essential function of roads).

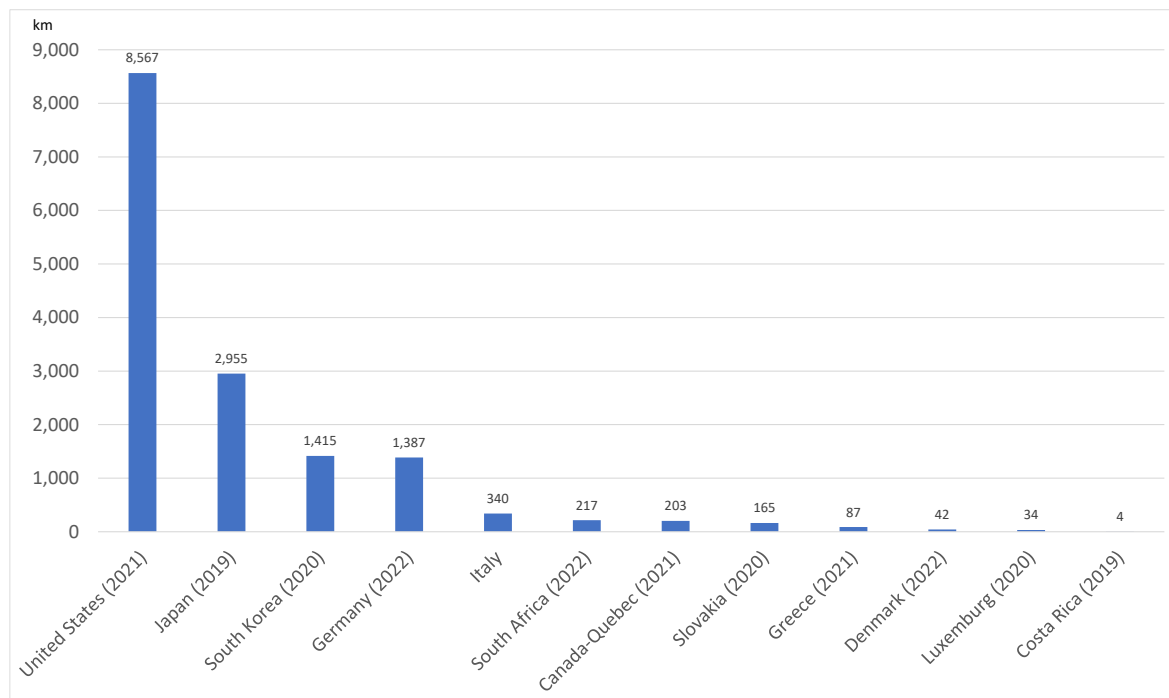


Figure 23: Physical length of Bridges for Motorways

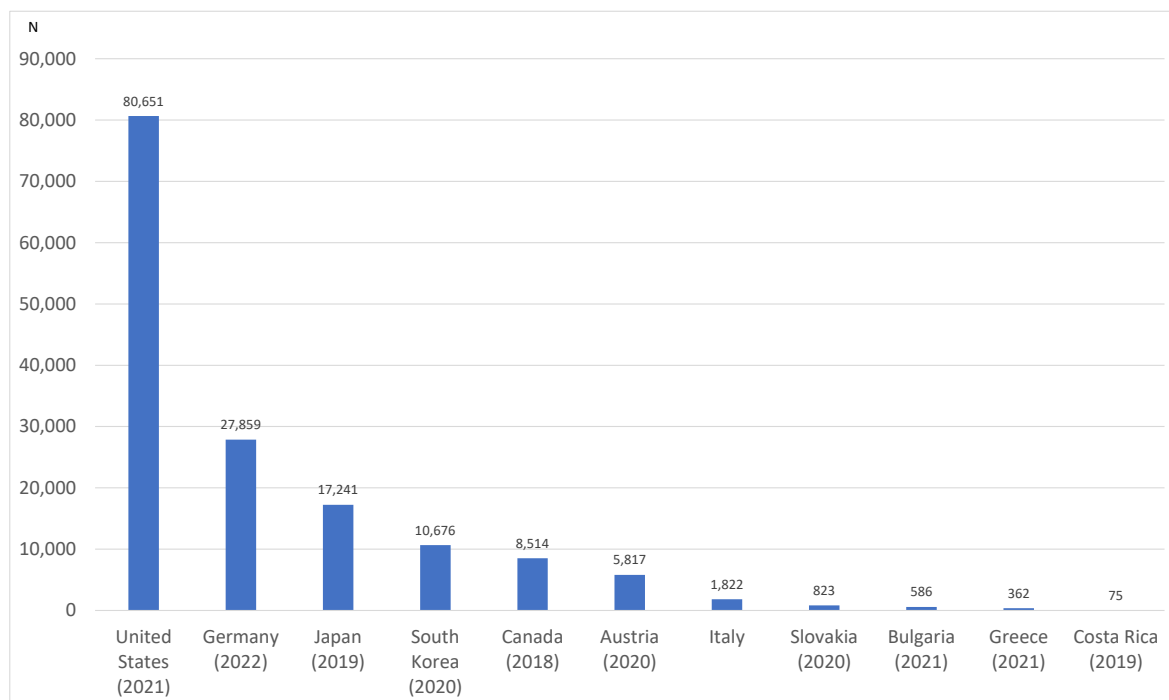


Figure 24: Number of Bridges for Motorways

Also, we make an in-depth survey of the minimum length to be defined as Bridges in order to check its qualitative coverage because each country seems to define Bridges by its own stipulation.

Figure 25 indicates that 56% of the countries define Bridges as longer than 6 meter and that 33% and 11% claim 2 meter and 3 meter, respectively. This difference will make a considerable divergence in length of Bridges as well as their number

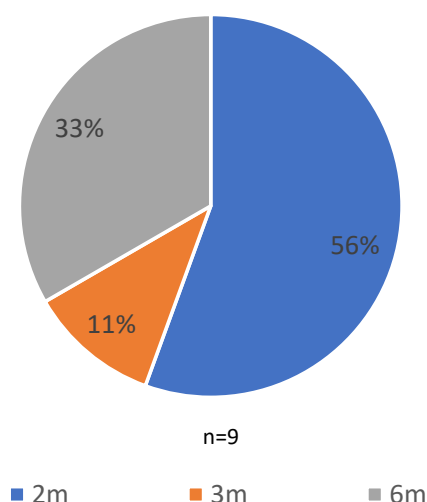


Figure 25: Minimum length to be defined as Bridges

In addition, TC4.2 « Bridges » has generously shared with us their interesting findings related to age repartition and the mean age of bridge stock for bridge owners of member countries. Based on the data provided, according to Figure 26 and Figure 27, TC4.2 has summarized their analytical result as follows :

- Countries with young bridge stock like Poland and (South) Korea (mean age about 15-25 years)
- Countries with old bridge stock like Belgium and Slovakia (mean age about 50 years)
- Countries with about 40 years mean age of their bridge stock: the majority. But some countries have only few new bridges and few old bridges like Switzerland and Niger. While others have either old or young bridges like New-Zealand and Portugal (see Figure 26).

For more information, please see the technical report of TC 4.2 Road Bridges, Road Bridges - New Rehabilitation Materials and Technologies. (<https://www.piarc.org/en/order-library/38668-en-Road%20Bridges%20-%20New%20Rehabilitation%20Materials%20and%20Technologies>)

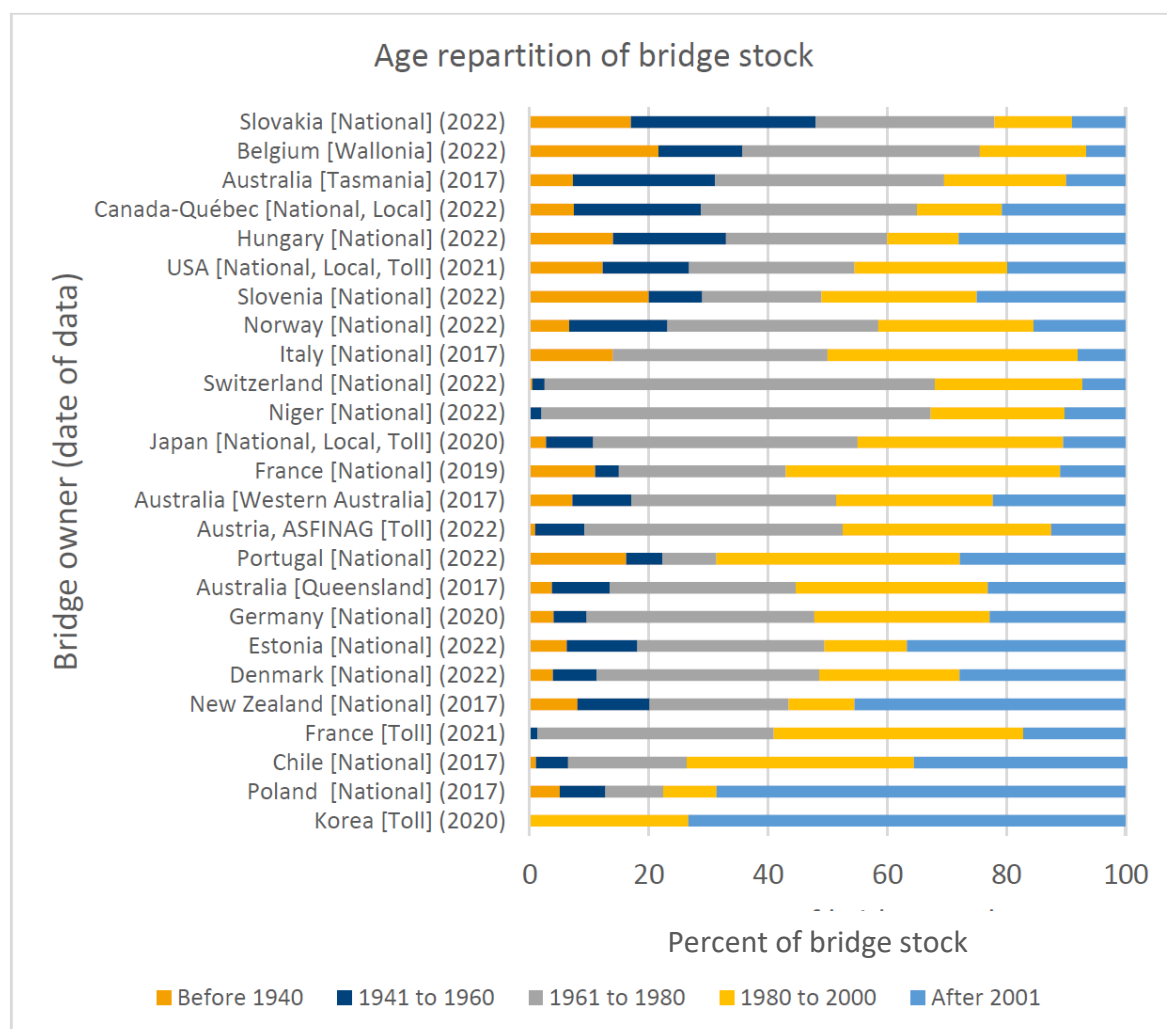


Figure 26: Age repartition of bridge stock

Source: TC 4.2 Road Bridges, Road Bridges - New Rehabilitation Materials and Technologies

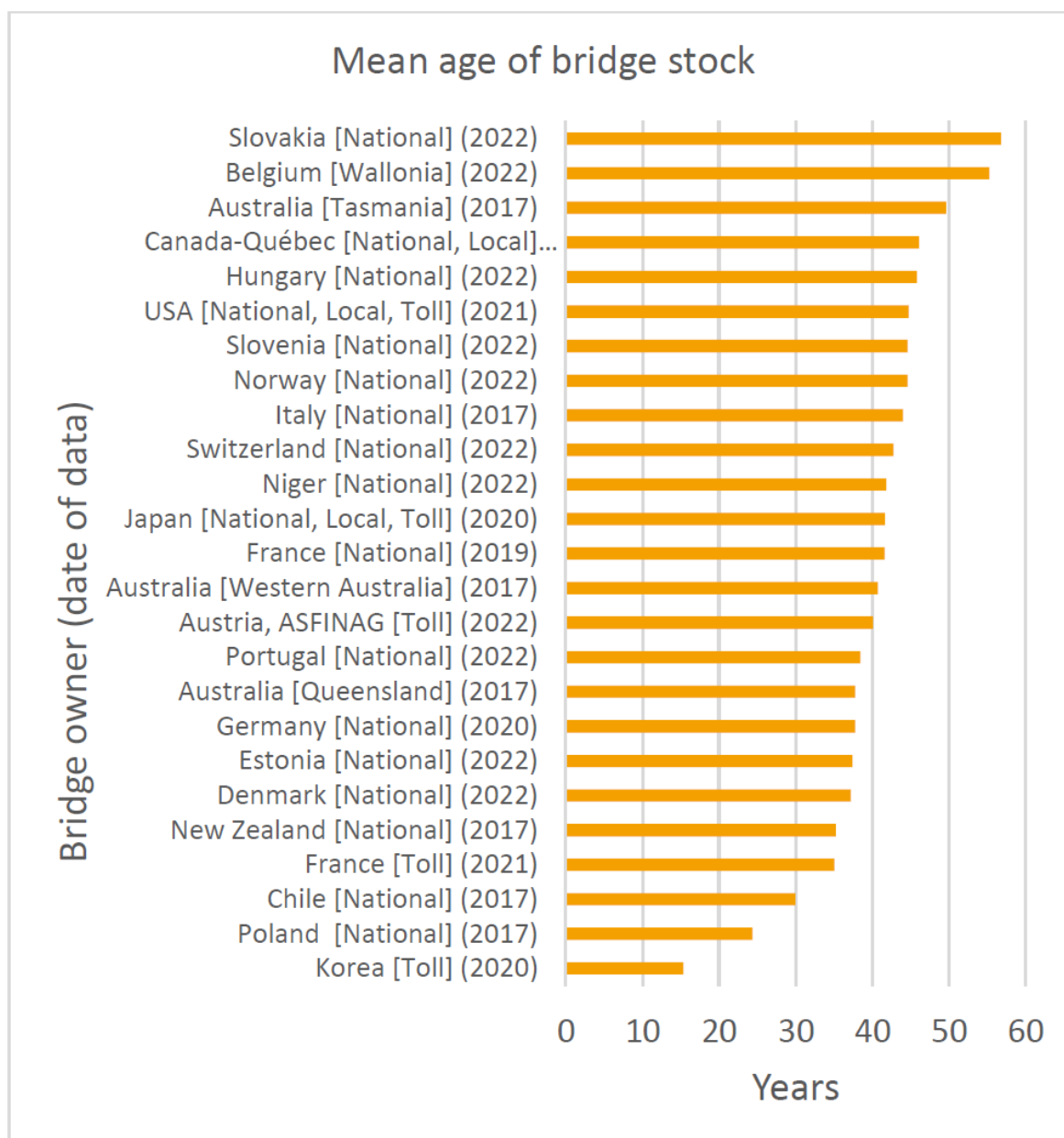


Figure 27: Mean age of bridge stock

Source: TC 4.2 Road Bridges, Road Bridges - New Rehabilitation Materials and Technologies

6.5. TUNNELS

Likewise, as illustrated in Figure 28 and Figure 29, Tunnels are measured by their physical length of Motorways for 17 countries, and 3 countries have answered their statistical number of tunnels instead (totally 12 countries for the number)

The general tendency of the obtained result about Tunnels is similar to that of Bridges.

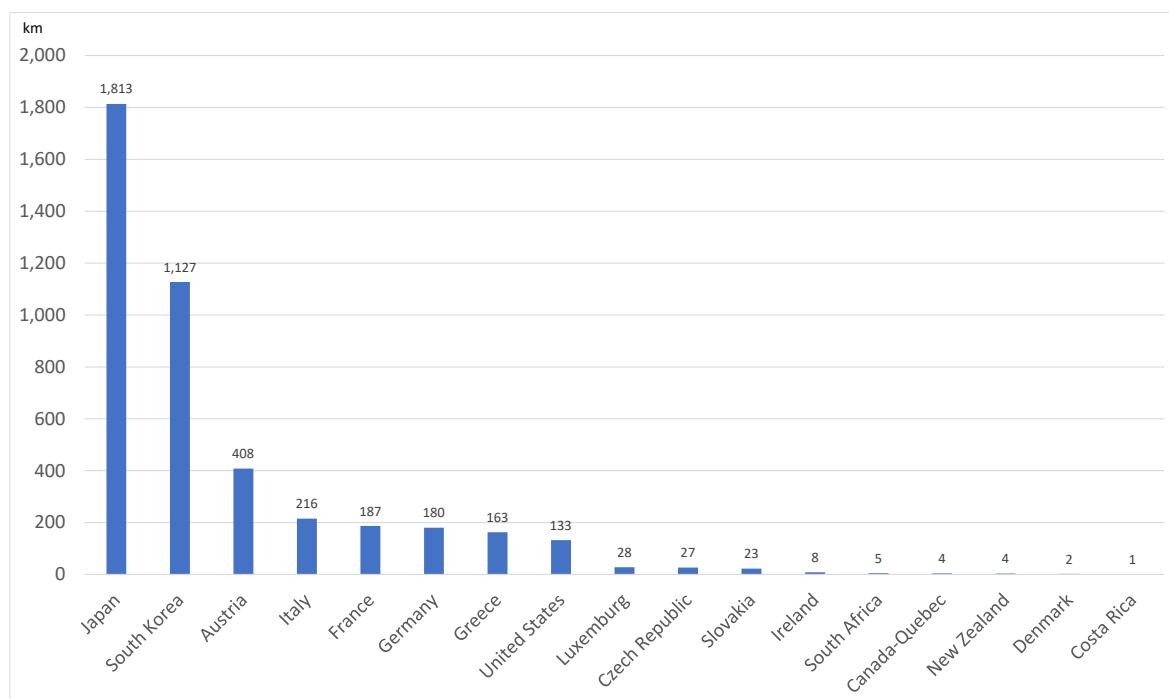


Figure 28: Physical length of Tunnels for Motorways

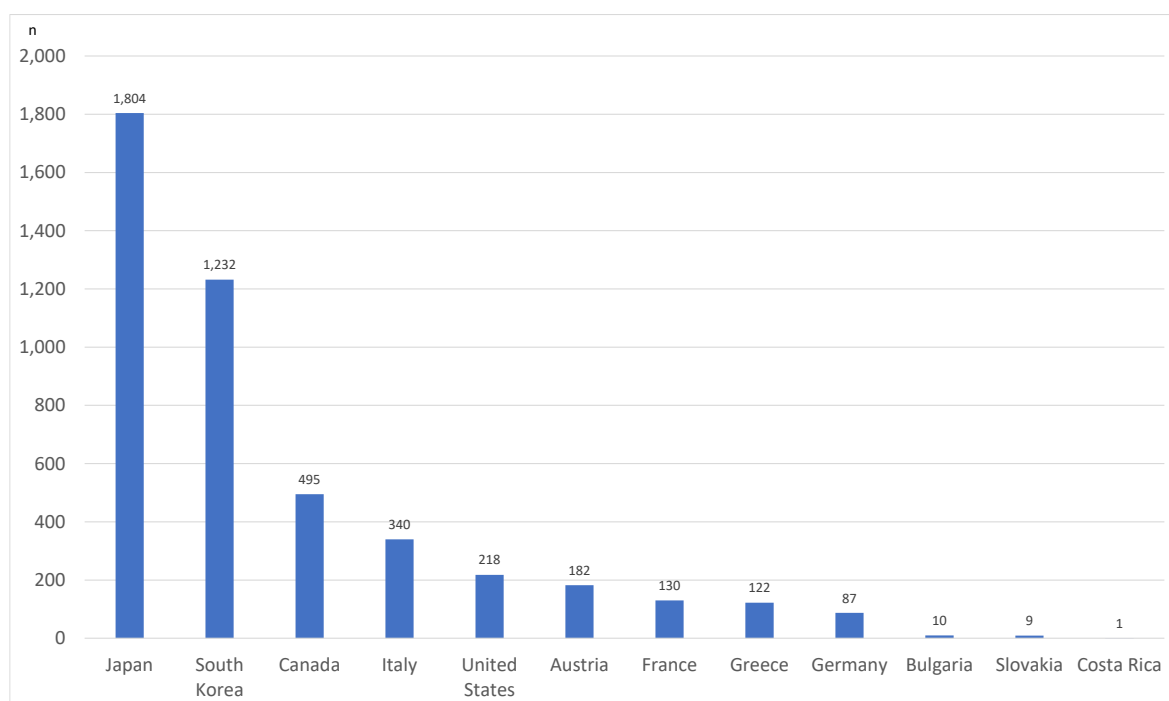


Figure 29: Number of Tunnels for Motorways

6.6. VEHICLES IN USE

Figure 30 graphically shows the number of Vehicles in Use for the 24 countries which have provided their data. The number of Vehicles in Use of a country should be directly proportional to the number of road users or population, which may be related to its level of economic development.

Also, Figure 31 is the juxtaposition of the number of Vehicles in Use per population. While the index exceeds 1.0 in Canada and New Zealand whose societies must be heavily dependent on automobiles, the lowest and the 2nd lowest countries in its value, Mozambique and Tunisia seem to still struggle to own the sufficient number of vehicles corresponding to their population.

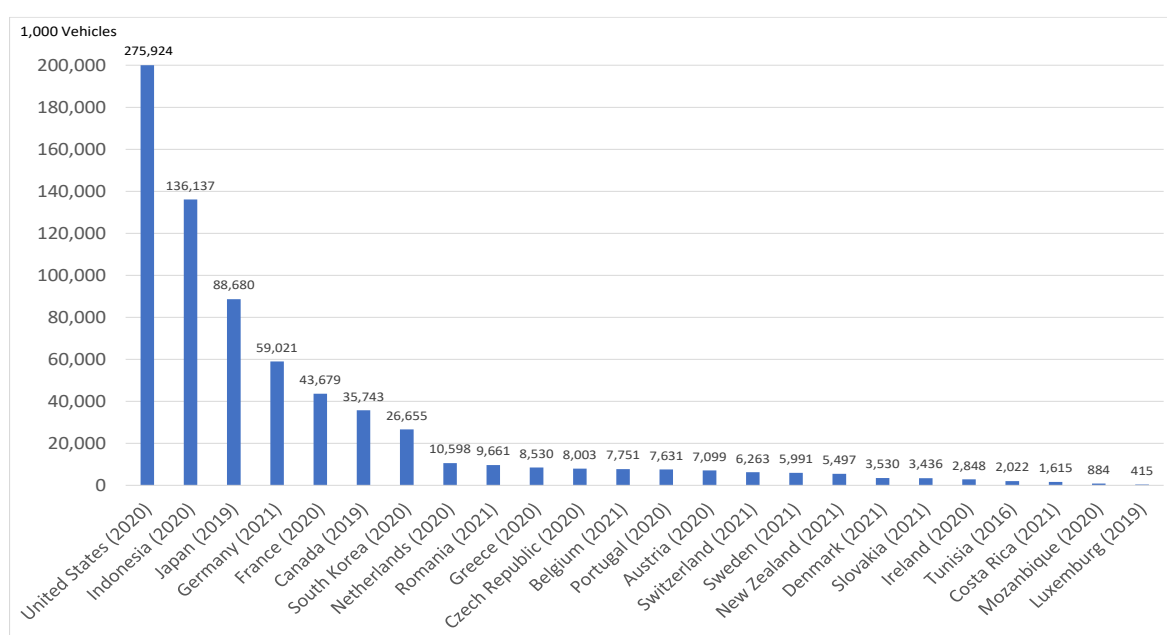


Figure 30: Number of Vehicles in Use

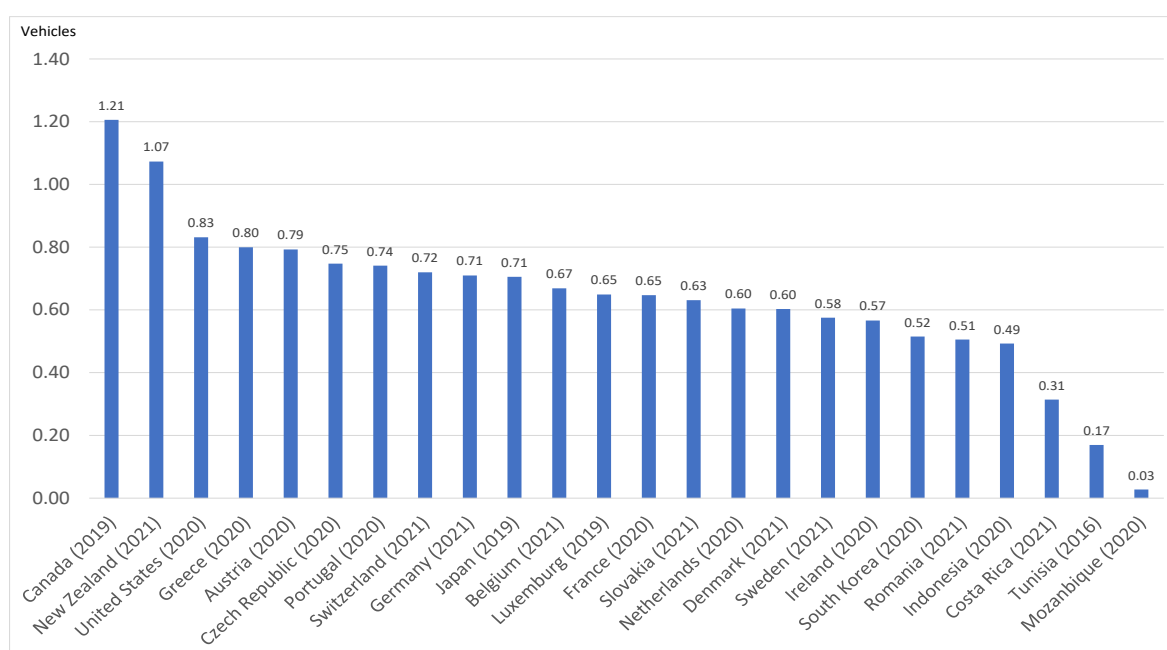


Figure 31: Number of Vehicles in Use per population

In addition, Figure 32 and Figure 33 are the analytical result of the correlation between GDP per capita and the number of Vehicles in Use per capita as well as the correlation between length of Motorways divided by VPA and the number of Vehicles in Use per capita. It can be inferred that the number of Vehicles in Use statistically correlates with economic development as well as maturity of the network of Motorways.

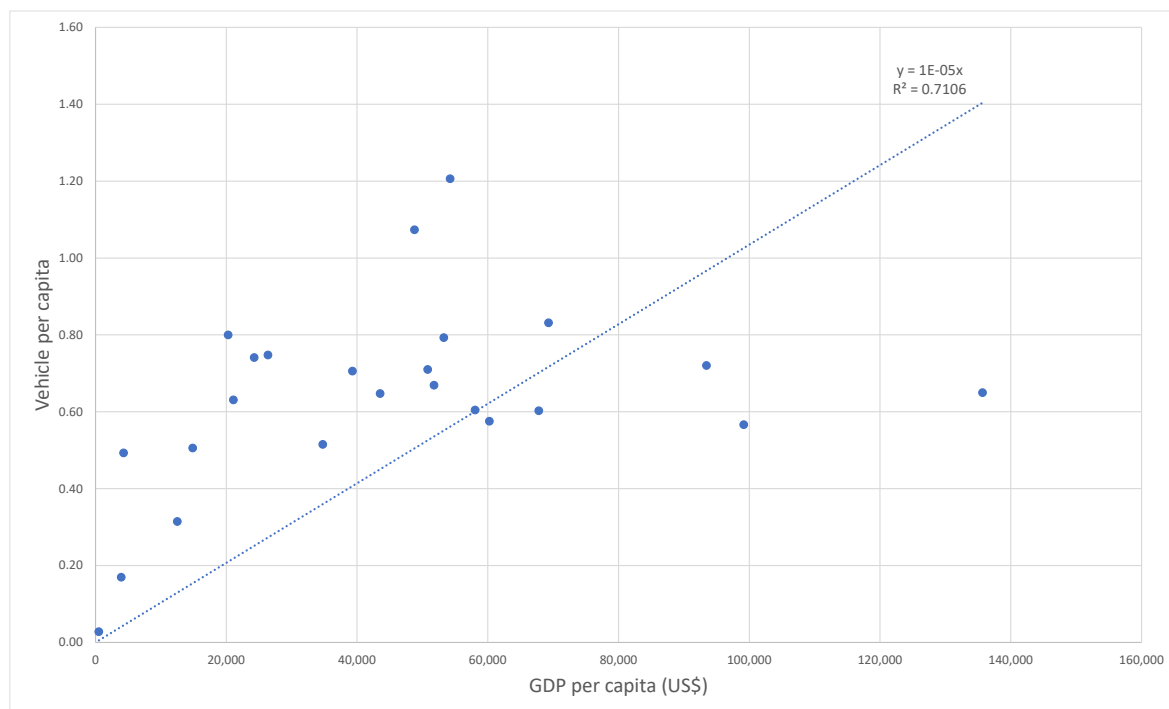


Figure 32: Correlation between GDP per capita and number of Vehicles in Use per capita

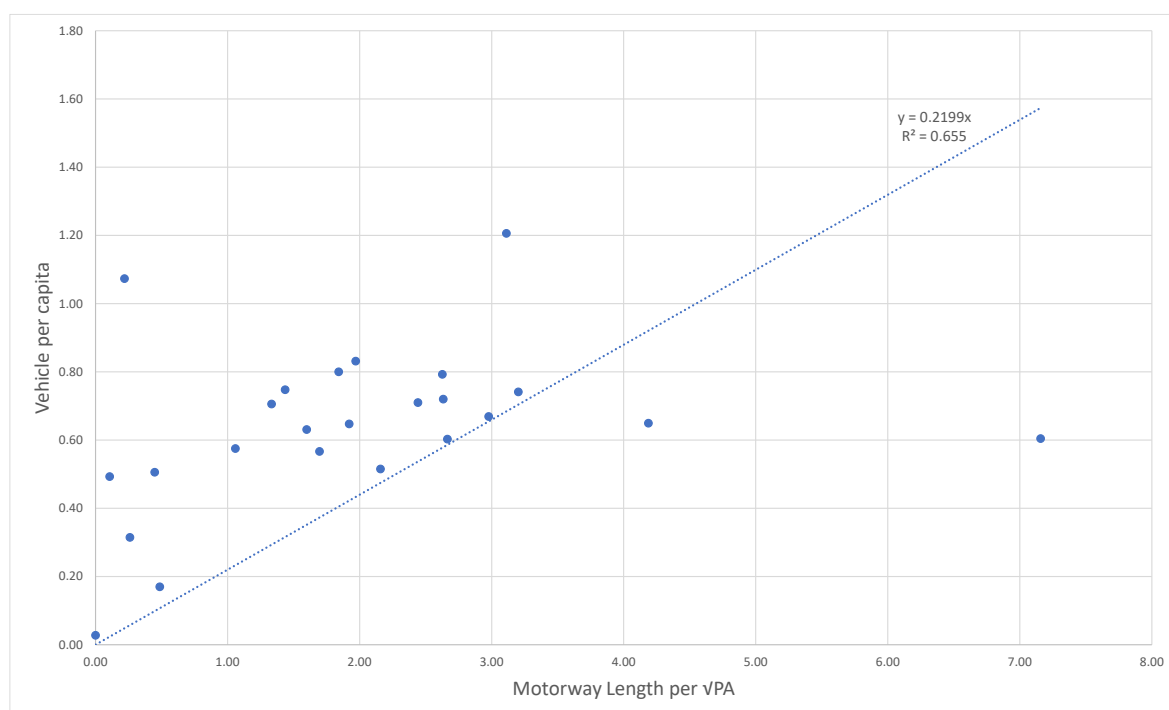


Figure 33: Correlation between length of Motorways divided by $\sqrt{PA}$ and Vehicle per capita

Figure 34 illustrates the share of Vehicles in Use in type. In most countries the share of Passenger (cars) exceeds 60%, and the share of Freight (vehicles) is 59% in the United States. 59% of Freight seems much higher, and it may be due to the fact that the number of light duty trucks such as pickups, SUVs, vans and etc. is also counted as Freight in the United States.

Also, Motorcycle is dominant over 80% in the share of Indonesia, and this trend may apply to the other South-eastern Asian countries which have not responded to this survey.

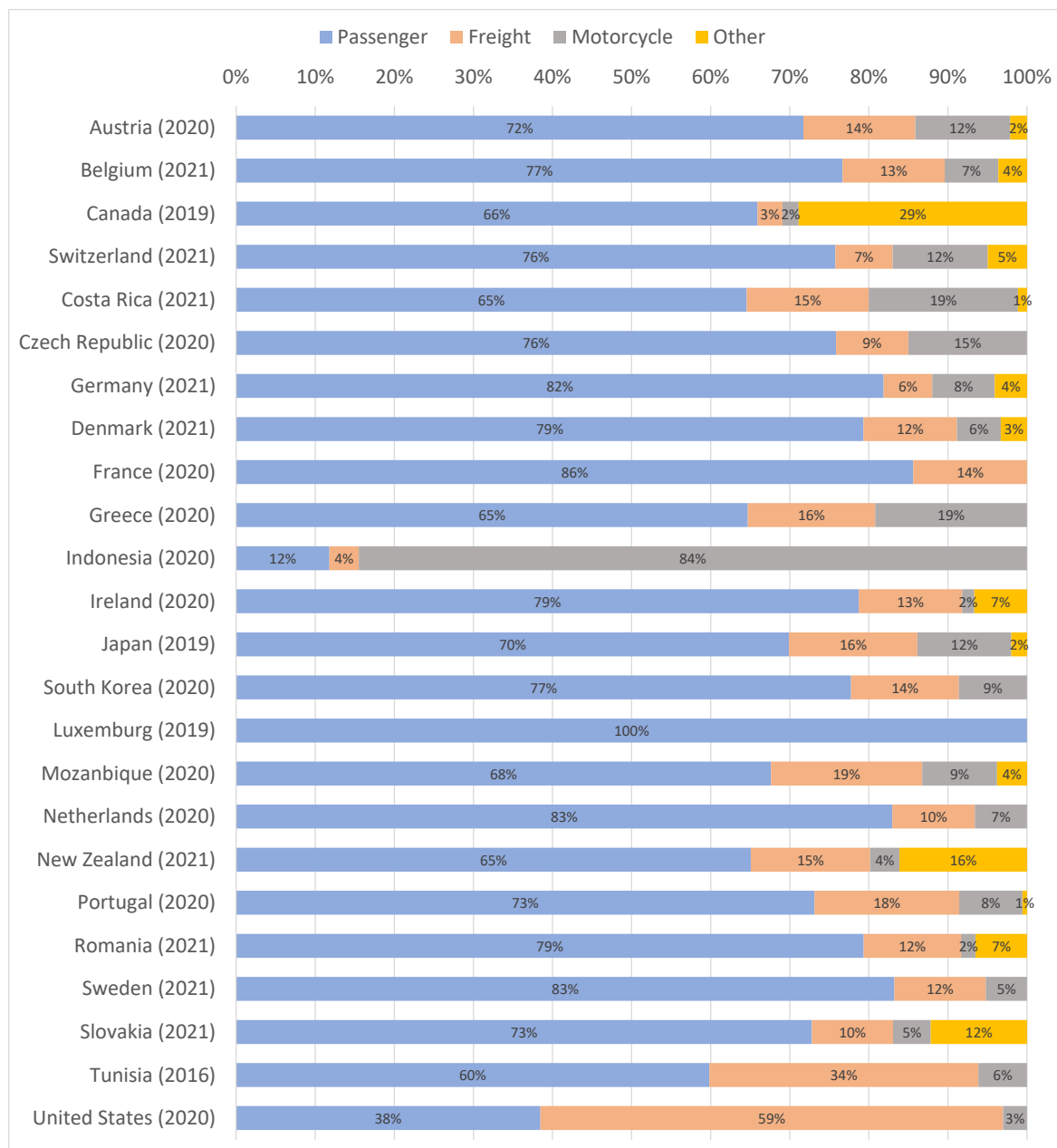


Figure 34: Share of vehicle type

In this survey we also focus on how widely available environmentally good (eco-friendly) Vehicles in Use become in road transport across the world. According to Figure 35, out of 14 countries, there are the most number of Hybrid Vehicle in Japan, and more Electric Vehicle can be seen in Germany and France. Sweden is also characterized by a large number of Methanol powered Vehicle.

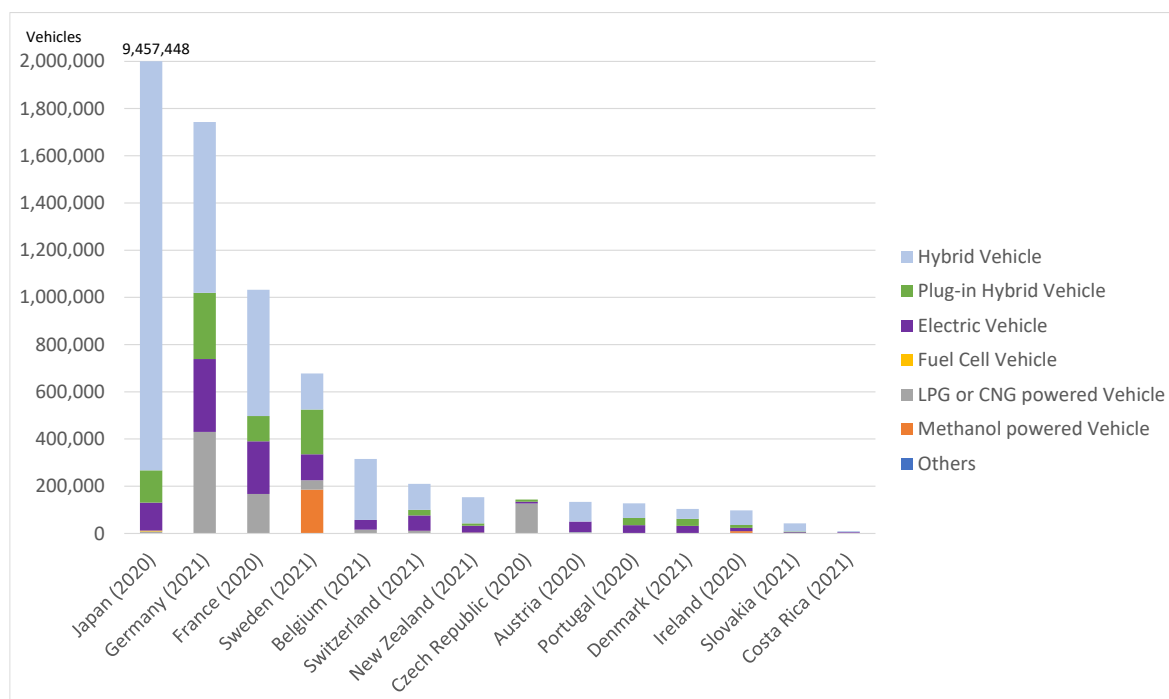


Figure 35: Number of Environmentally good (eco-friendly) Vehicles in Use

6.7. ROAD TRANSPORT PERFORMANCE

Figure 36 shows the Annual Total Driving Distance of Vehicles (ATDDV) on all types of roads for 15 countries which provided their data. In general, the more substantially the number of Vehicles in Use grows, the higher ATDDV becomes.

Figure 37 indicates ATDDV per vehicle, and the index measures the highest in Belgium where a vehicle travels more than 19,000km on average in a year. On the other hand we should notice that the data provided by many countries concerns 2020 or 2021 when COVID-19 rampant across the world should cause ATDDV to become smaller than normal by widespread hesitation and restriction of travel and drive.

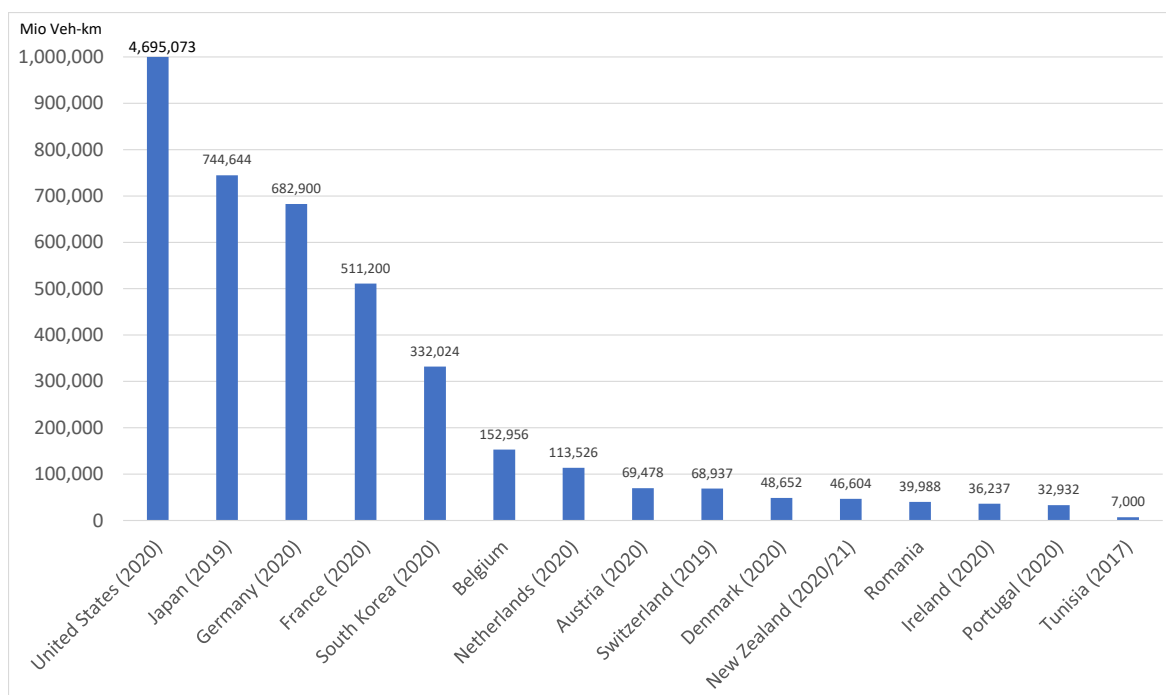


Figure 36: Annual Total Driving Distance of Vehicles (ATDDV) for all roads

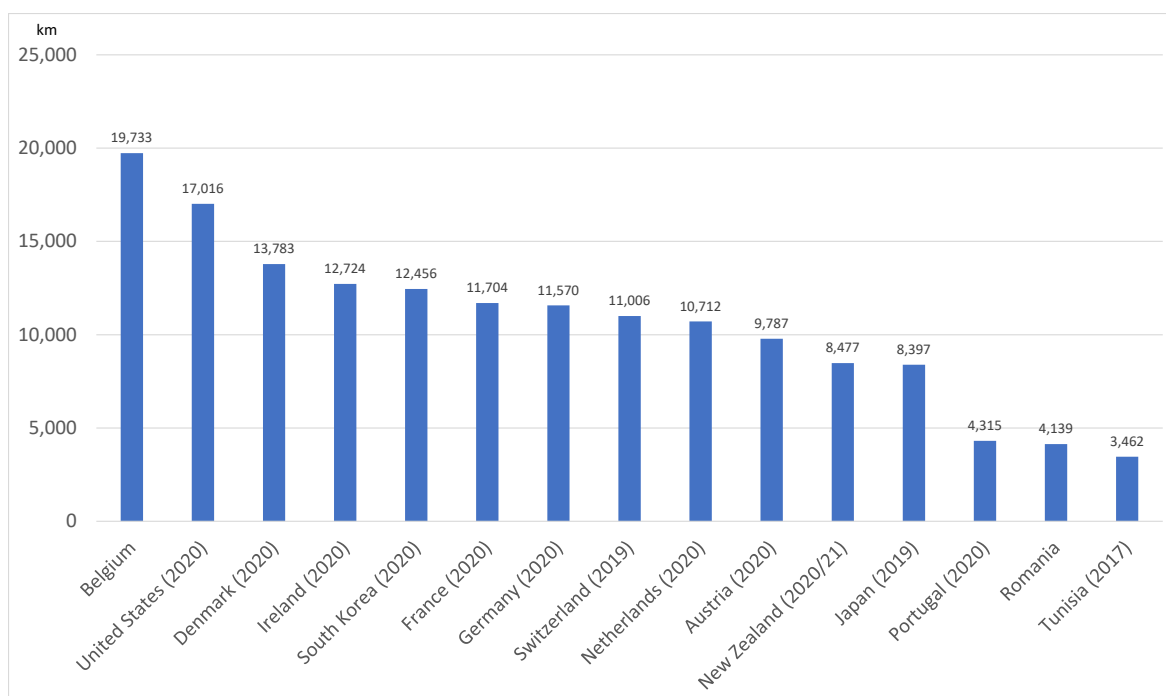


Figure 37: Annual Total Driving Distance of Vehicles (ATDDV) per Vehicle

Also, Figure 38 interests the correlation between length of Motorways divided VPA and ATDDV per vehicle. It seems a positive correlation, thereby expecting the more developed network of Motorways to encourage a longer travel distance of a vehicle.

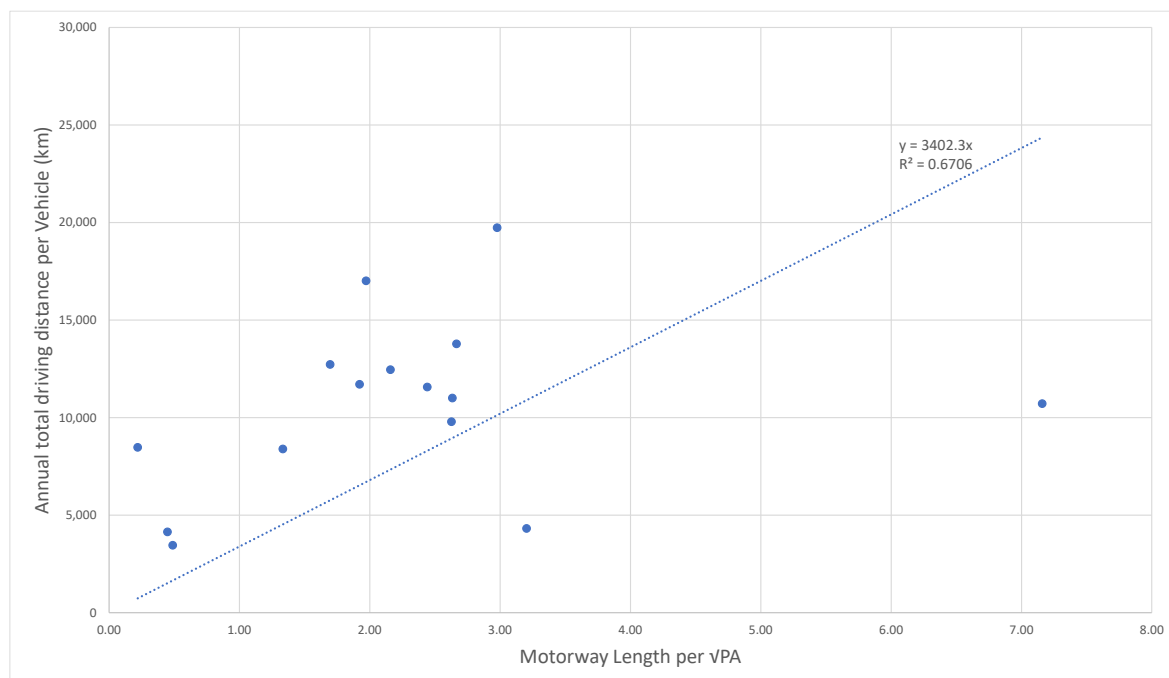


Figure 38: Correlation between length of Motorways divided by $\sqrt{PA}$ and ATDDV per vehicle

6.8. ROAD FATALITIES

Road fatalities for all roads of 24 countries and Motorways of 15 countries are presented in Figure 39 and Figure 40, respectively.

Knowing that a country of more population tends to suffer more road fatalities, it is necessary to pay attention to fatality rate, and fatalities for all roads per 1,000 population are visualized in Figure 41. The highest is the United States, followed by New Zealand, Indonesia, Tunisia and so on, and the lowest is Portugal.

Also, we focus on fatalities for all roads per ATDDV as shown in Figure 42. Tunisia and Romania, marking the highest and the 2nd highest, may be aware of a challenging problem in terms of road safety. On the other hand, Belgium, Switzerland, Denmark and etc. relatively have the lowest value of the index.

As is the same with ATDDV, it is necessary to take into account the significant effect of COVID-19, which may have decreased fatalities of the countries in comparison with before (after) and during COVID-19 impact.

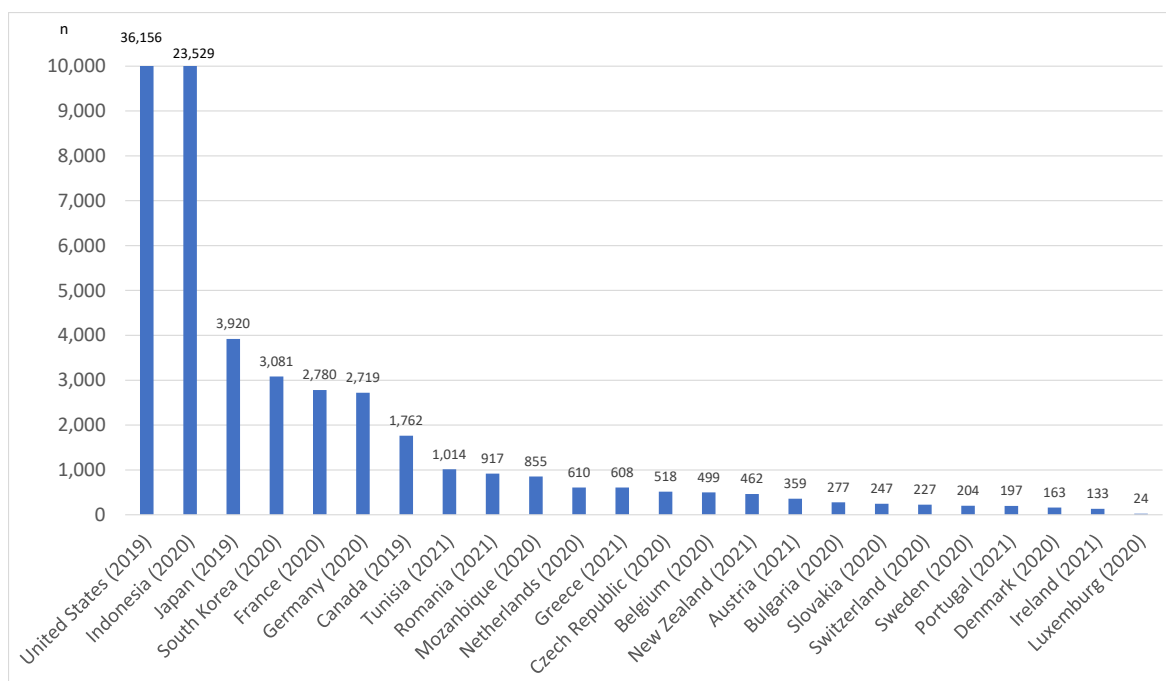


Figure 39: Road fatalities for all Roads

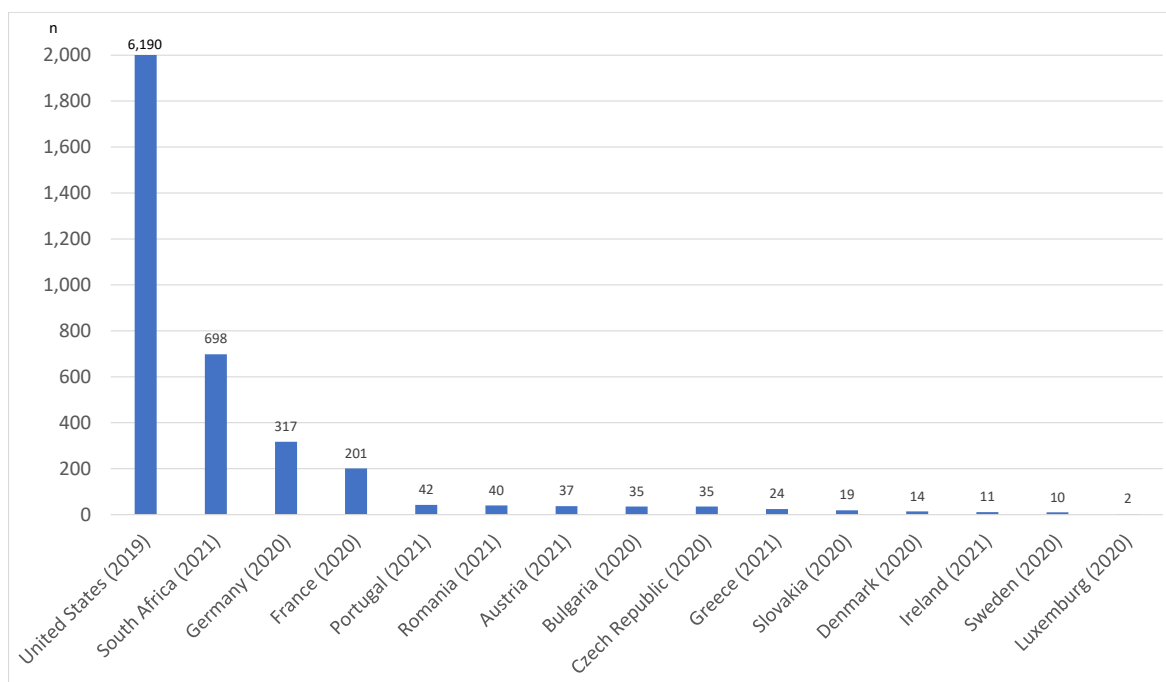


Figure 40: Road fatalities for Motorways

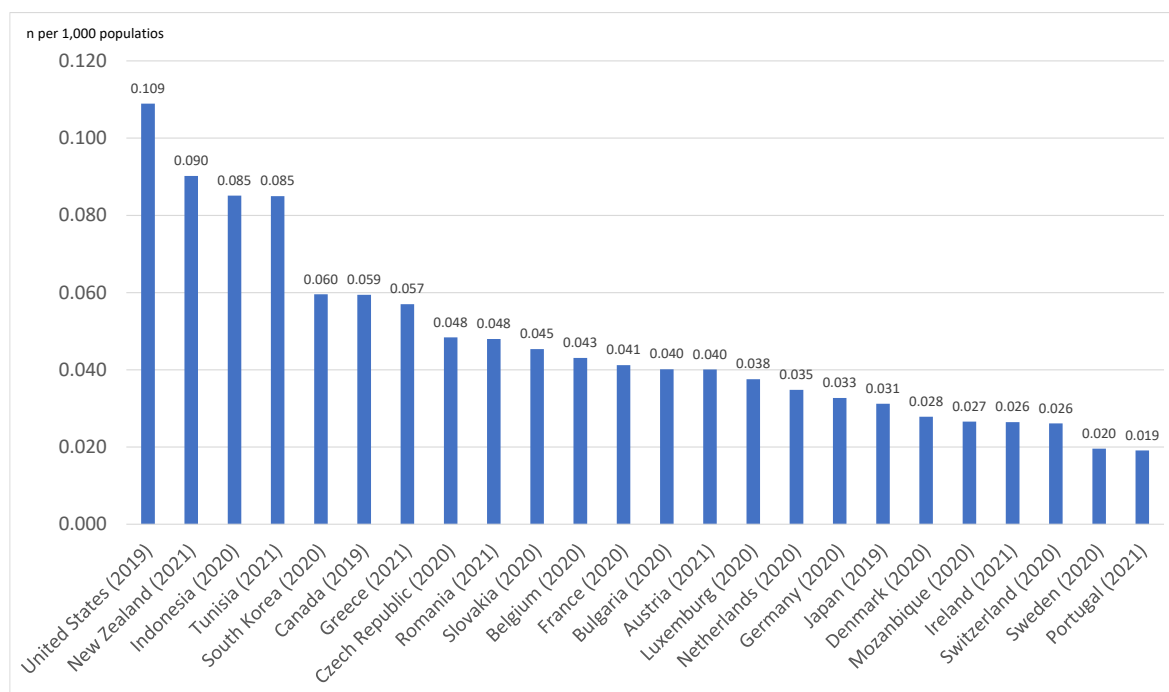


Figure 41: Road fatalities for all roads per 1,000 population

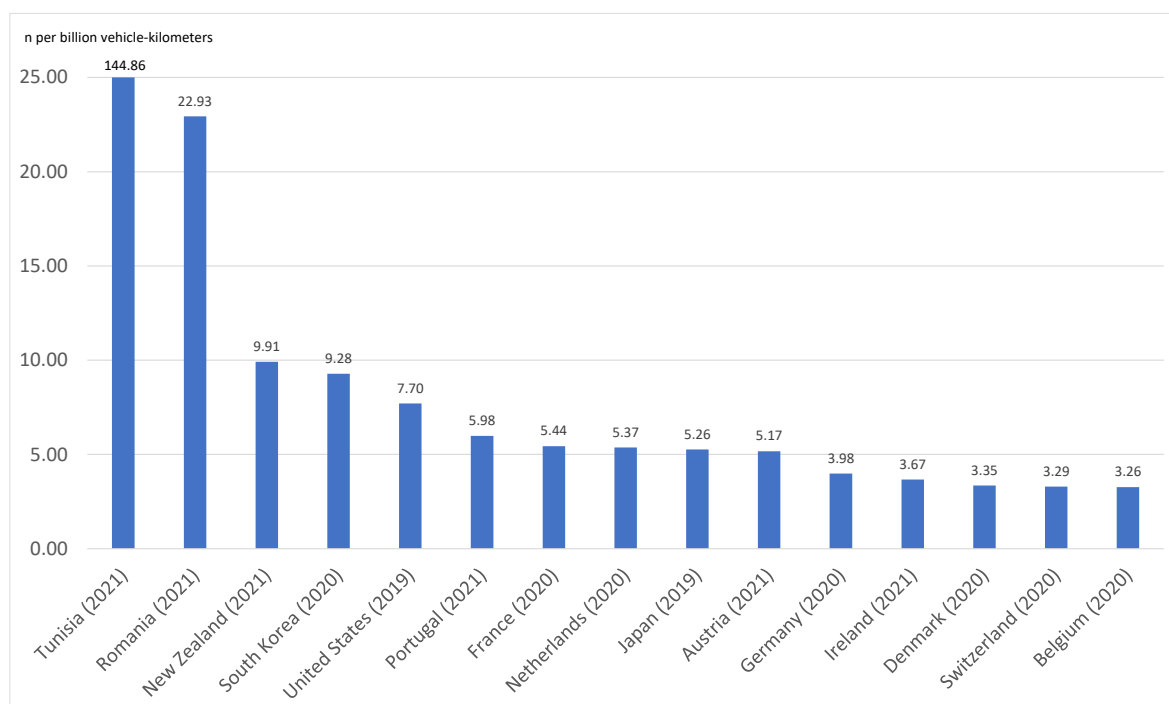


Figure 42: Road fatalities for all roads per Annual Total Driving Distance of Vehicles (ATDDV)

Figure 43 is the analytical comparison between 5 countries (Austria, Germany, Portugal, Romania and the United States) in terms of the dominance of Motorways over all roads for length, fatalities and ATDDV.

Looking at length, Motorways account for only a few percent against all roads except for Portugal, but their share exceeds more than 10 percent of fatalities as well as more than 30 percent of ATDDV except for Romania. Although the detailed data except for Motorways (Primary Arterial Roads,

Urban roads, Regional Roads and etc.) is not presented here, it can be inferred from this graph that Motorways will carry a relatively larger share of ATDDV equal to traffic-distance per length than the others probably, and then Motorways will be regarded as the safest because of lower fatality rate by comparison

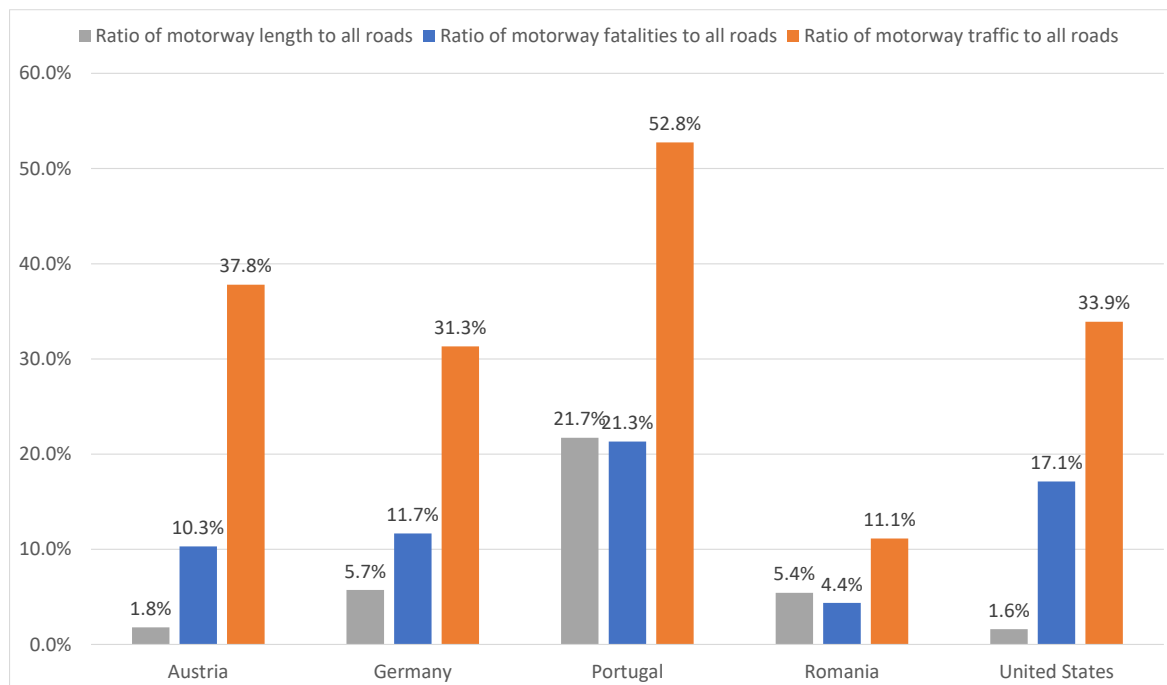


Figure 43: Share of Motorways to all roads (length, fatalities, traffic)

6.9. ANNUAL EXPENDITURE FOR ROADS

Figure 44 illustrates road expenditure of 22 countries as a percentage of GDP. The raw data of road expenditure based on each national currency is converted to U.S. dollars, and we have calculated the ratio of its figure to GDP of a country in U.S. dollars.

Austria, Germany and Greece present the data of expenditure for Motorways only while the other countries for all roads. Even the countries with relatively higher road expenditure financed indicate at most 1.52% of GDP in Mozambique, 1.17% in Switzerland, 1.09% in Japan and so on.

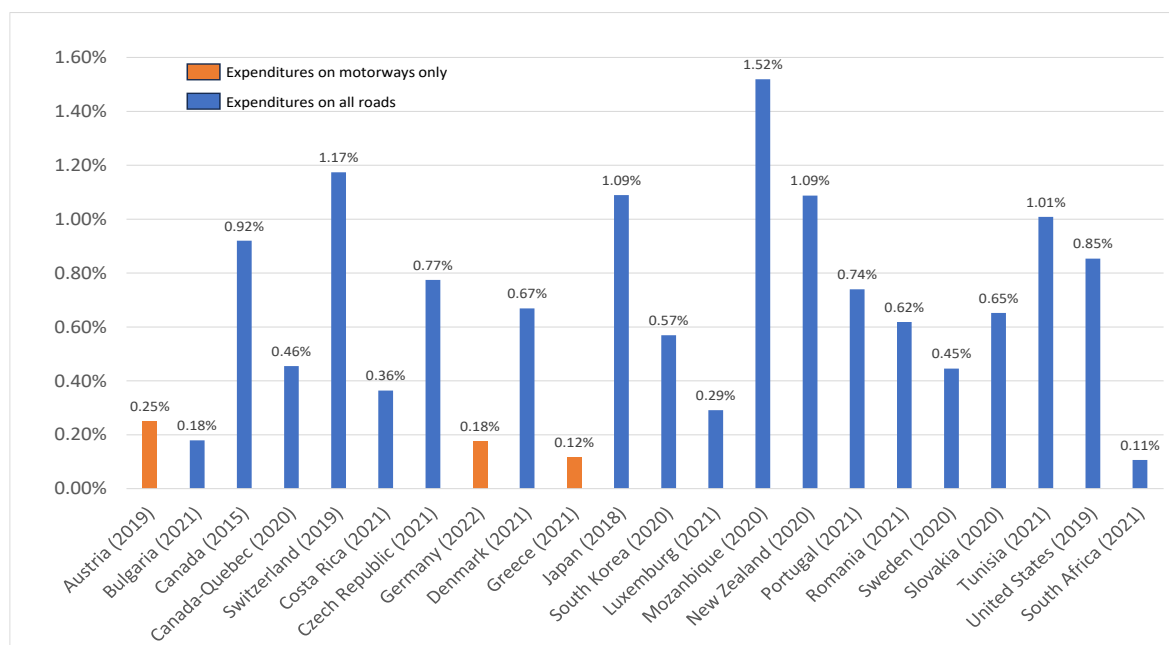


Figure 44: Road expenditure as a percentage of GDP

Figure 45 shows the share of Investment and Maintenance in the expenditure of 22 countries. In many countries, Investment exceeds Maintenance. In particular, Investment accounts for more than 80% in Canada, Canada-Quebec, Germany, Luxembourg, Portugal and Tunisia. On the other hand, in Bulgaria, Denmark, New Zealand and South Africa, Maintenance is over Investment. However, Investment aimed at upgrade, structural reform, etc. of existing roads, instead of newly constructed roads might be interpreted as Maintenance. Then it would be necessary to distinguish Investment for new roads from that for existing roads which could be regarded as Maintenance. Actually Germany claims to spend more money for structural maintenance of existing roads rather than newly constructed or extended roads.

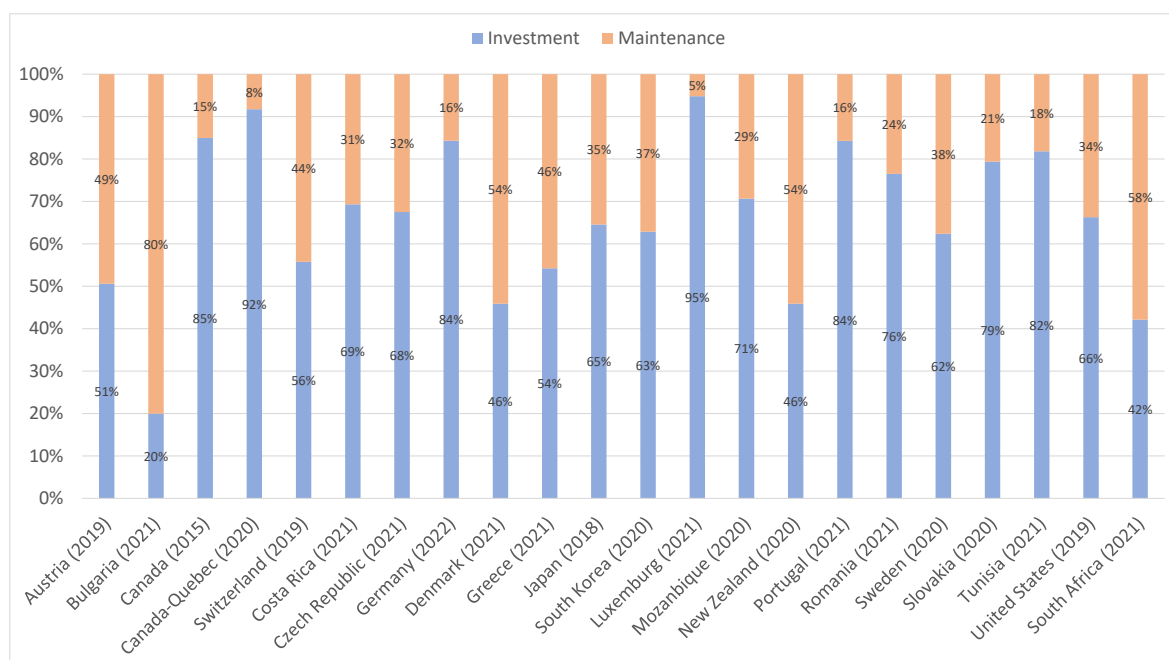


Figure 45: Share of Investment and Maintenance

6.10. FUEL CONSUMPTION

Figure 46 and Figure 47 respectively concern fuel consumption and that per vehicle for 15 countries. Looking at Figure 46, some developed countries, the United States, Japan, Canada and etc. indicate higher total consumption, and Tunisia is the highest consumption rate in Figure 47.

We should also notice that data provided by the countries concerns 2020 or 2021 when COVID-19 rampant across the world should cause fuel consumption to become lower than normal by widespread hesitation and restriction of travel, under the same condition as ATDDV and fatalities.

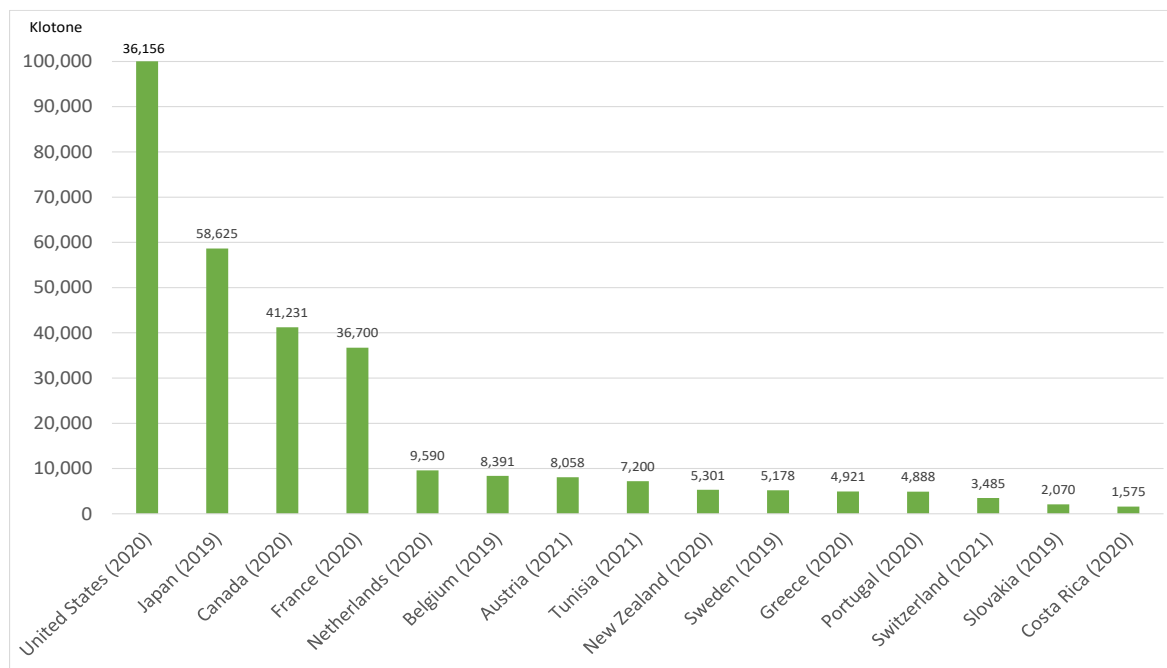


Figure 46: Fuel consumption

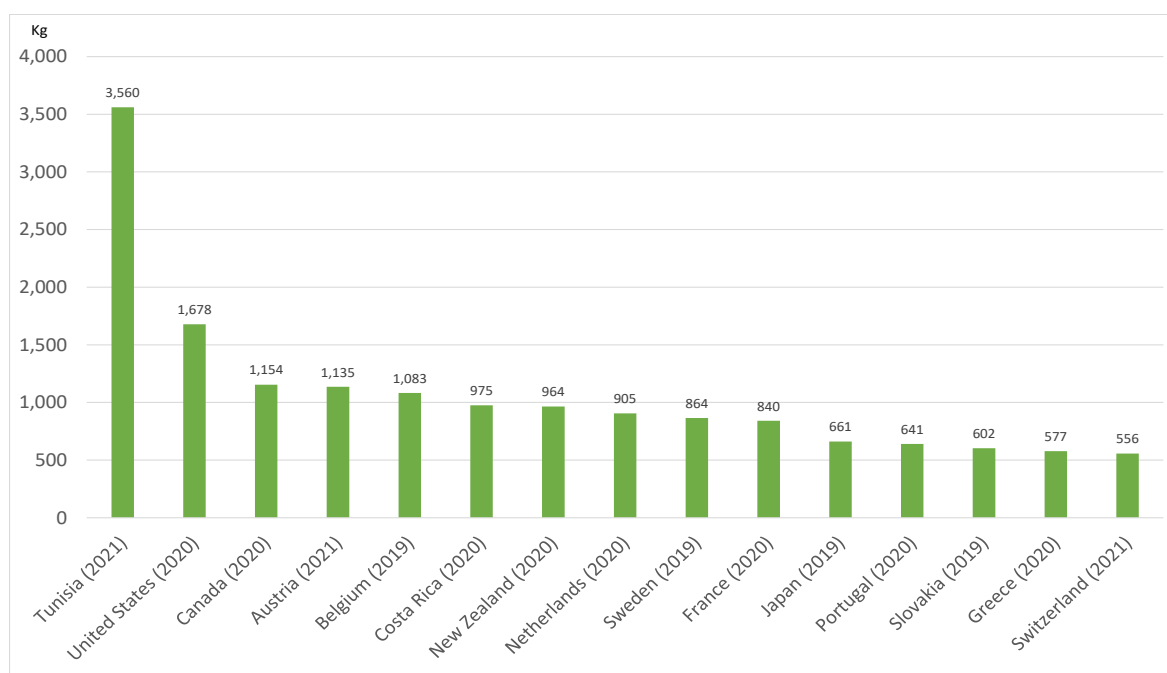


Figure 47: Fuel consumption per vehicle

Each share of a fuel type of 14 countries is visualized in Figure 48. In many European countries, Diesel/Light oil is more dominant, and the United States, Canada and Japan consume more Gasoline/Petrol rather than the other fuel types.

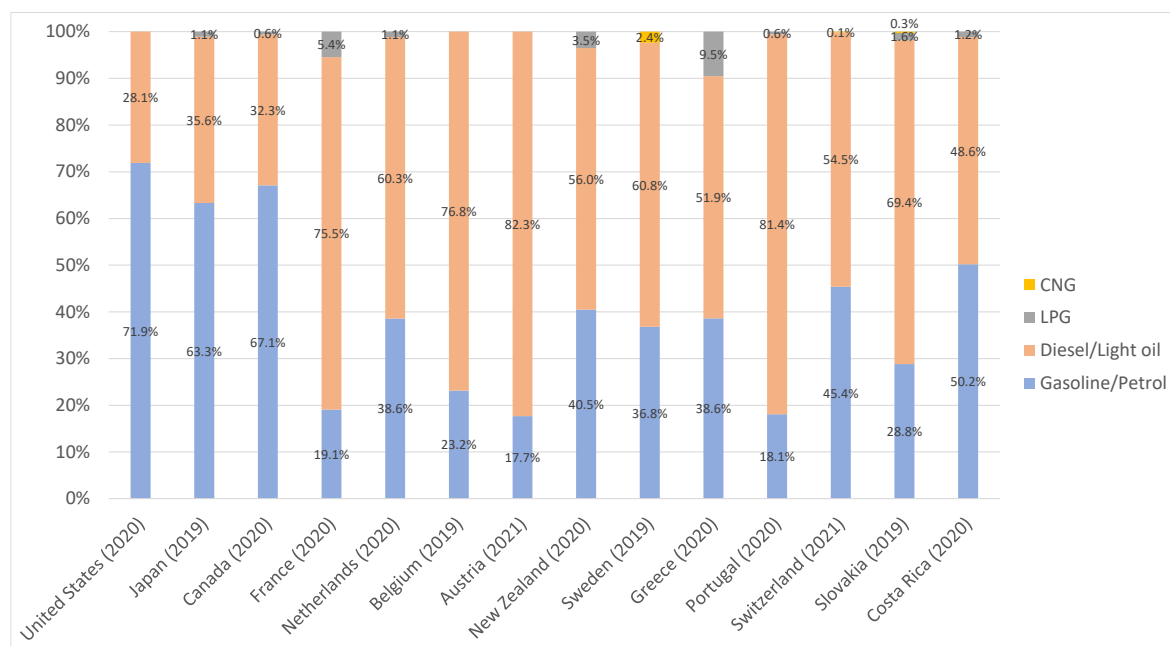


Figure 48: Share of consumption by fuel type

6.11. ROAD POLICIES

Road Policies, unlike the other quantitative indicators inquired in this survey, represent in a qualitative manner the official policy or the overall strategy of road development formulated by the Ministry or Road agencies of each country.

Since Road Policies are normally composed of some key components which are itemized, we have proposed 14 probable items for each country to choose 5 preferential ones out of 14. Also it is possible to additionally choose the one which is not included in 14.

Looking at Figure 49, there are 15 items of Road Policies preferentially selected by 16 countries. The preferential one common to the most countries is « Road Safety », and the 2nd most is « Maintenance/Repairs » and « New Technology », followed by « Construction », « Multi-Modal and Modal shifts », and « Environment ». Table 4 clarifies which countries have selected which items as their preferential ones. It is not easy to identify a marked trend of answers, partly because some countries have selected more than 6 items (although they are requested to choose only 5 preferential items) ; 11 by Canada, 10 by Mozambique and 12 by Netherlands.

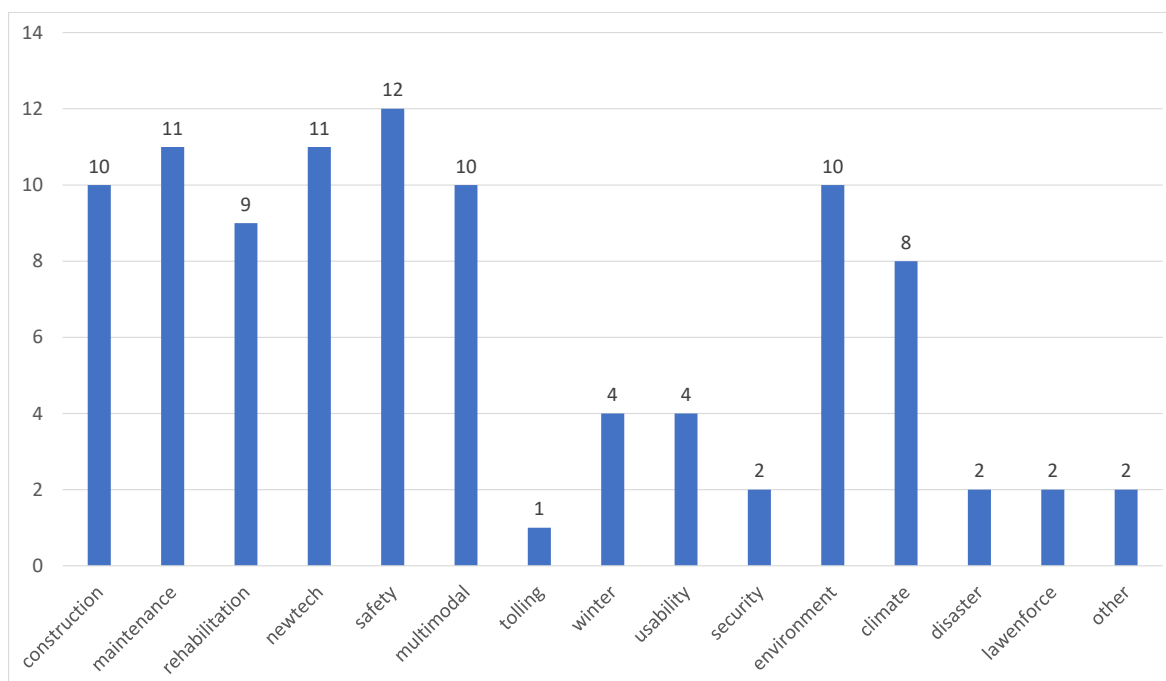


Figure 49: Items of priority in Road Policies

Table 4: Items of priority in Road Policies

	construction	maintenance	rehabilitation	newtech	safety	multimodal	tolling	winter	usability	security	environment	climate	disaster	lawenforce	other
Austria				✓	✓	✓					✓	✓			
Belgium		✓	✓	✓	✓	✓									
Canada	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓	
Costa Rica	✓	✓	✓			✓						✓			
Czech Republic	✓	✓	✓	✓		✓					✓				
Germany		✓	✓	✓	✓	✓					✓				
Ireland					✓	✓		✓			✓	✓			
Japan	✓	✓		✓	✓								✓		
South Korea	✓			✓	✓										✓
Mozambique	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓	
Netherlands	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
New Zealand	✓				✓	✓			✓			✓			
Sweden		✓			✓				✓		✓				✓
Slovakia	✓	✓			✓			✓			✓				
Tunisia	✓	✓	✓	✓					✓						
United States			✓	✓	✓						✓	✓			
	10	11	9	11	12	10	1	4	4	2	10	8	2	2	2

Each country's title of an official document related to Road Policies as well as its abstract is tabulated in Table 5. The summary of Table 5 is as follows :

- 12 countries have answered the title of a document of Road Policies with its outline, and 15 countries have answered only the outline of Road Policies.
- 16 countries' answers concern Road Policies, and 8 countries refer to Transport Policies as well.

- ✚ Judged from the outline of Road Policies of a country, Austria (transport de-carbonization), Germany (transport network strengthening by structural maintenance and new construction) and Sweden (road safety) may be able to constrict the scope of their policies, as written in each parenthesis.
- ✚ On the other hand, Japan, South Korea and the United States have 4 or 6 important areas of policies which are multi-pronged.
- ✚ Road development is one of the items of Road Policies for many countries ; 9 countries (Bulgaria, the Czech Republic, Denmark, Germany, Japan, South Korea, Mozambique, New Zealand and the United States) interest road improvements. Bulgaria, the Czech Republic and Mozambique are struggling to improve the network of trunk roads which are still underdeveloped. The rest prioritize upgrading the existing road network.
- ✚ As is proved in Figure 49 and Table 4, many countries regard road safety as a crucial and fundamental component of Road Policies. Especially Sweden, as is remarked in the above, has released the policy of road safety called « Zero Vision », where zero fatality by road accidents would be achieved.
- ✚ Climate change is also addressed as a necessary component of Road Policies by some countries ; Austria, Bulgaria, Denmark, Japan and the United States. The Paris Agreement, which has come into effect since 2016, calls for countries to be committed to climate change, and they plan to take some countermeasures against global warming, such as reduction of CO2 emissions and realization of a decarbonized society.
- ✚ Regarding maintenance of road network, 4 countries (Belgium, Germany, Japan and Tunisia) articulate something related to the matter in their Road Policies. Germany and Japan prioritize maintenance as well as upgrade of road network.
- ✚ Improvement of organizational administrative capability of a road agency is also an important component of Road Policies for South Korea, Tunisia and the United States.

Table 5: A title and an abstract of an official document related to Road Policies

Country	Title	Abstract
AT Austria	Austria's 2030 Mobility Master Plan – Realigning the mobility sector	Mobility satisfies basic human needs, and goods transport plays a key role in economic progress. At the same time, tackling the climate crisis in the transport sector is especially challenging. We need clear frameworks and dedicated implementation programmes to reverse the trend in carbon emissions. Much has changed since the last strategic planning document for the transport sector, the Austrian Transport Master Plan for 2012, was published. Mainstream society has become more aware of the climate crisis. Even more advancements in digitalisation have been made. The pandemic immediately turned our lives upside down, with no timeline for returning to a pre-Covid normal. Yet our priorities now remain the same as they were back then: Transport must be social, safe, environmentally friendly and efficient. The federal government's target of becoming climate-neutral by 2040, which is consistent with the science, meets the requirements of the Paris Agreement. However, all stakeholders at the European level and in Austria must act in concert if we are to meet this aim. The European Commission's European Green Deal is an opportunity to make this happen. The EU's ambitious climate targets for 2030 and beyond will provide massive support for Austria's mobility transition. Achieving a climate-neutral transport sector by 2040 is the project of the century. The vision for 2040 outlines our ideal future, which serves as the basis for backcasting: planning by starting with our target and working our way back. When we were designing the 2030 Mobility Master Plan, it quickly became clear that we needed a way to connect our vision for 2040 with today's reality. Extrapolating based on past and current trends alone would not be enough to meet the objective of this project of the century: to become climate-neutral by 2040. The necessity of decarbonising the transport sector by 2040 has made it clear that we need more than just forecasts of how transport will develop. We need clear solutions that will ensure that we meet this target. Meet the requirements of the Paris Climate Agreement The 2030 Mobility Master Plan therefore identifies ways to avoid, shift and improve traffic and transport and significantly increase the share of eco-mobility in total transport – foot and bicycle traffic, public modes of transport, and shared mobility. The starting point for the 2030 Mobility Master Plan is therefore a backcasting model, which is based on a sensible combination of avoiding traffic, shifting traffic and improving the efficiency of each mode of transport. It is backed by a marked increase in the energy-efficiency of the entire transport system within the available carbon budget. We used studies (such as the Transition 2040 project of the Environment Agency Austria, which was commissioned by the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology), expert assessments and plausibility analyses, for example, to specify traffic and transport services, capacity utilisation, final energy consumption and modal split boundaries for the development of transport demand.

Country	Title	Abstract
		We adjusted the three variables of avoiding, shifting and improving to decide on a plausible state for a carbon-free transport system, which we could use as a basis for developing clear measures. The figures provided are intended as indicators of the scope and direction of changes.
BE Belgium	n/a	The Belgian (motor)road network is managed by the three Regions of the country, apart from the municipal network (local network). The network is very well developed throughout the territory. Overall, the focus is on maintaining and modernizing the network, in particular for the purpose of modal transfer to active modes.
BG Bulgaria	One of the main road policies is related to the completion of the roads from the TEN-T network and bringing them to the necessary requirements for road safety and integration of intelligent transport systems	1. Road safety issues are among the most difficult to solve in the field of road infrastructure. In Bulgaria, the level of traffic safety is still determined by the need all the roads to have all the required elements, ie. have road markings, adequate road signs and be secured, where necessary, with road restraint systems. The elements that have the ability to influence the perceptions of drivers who upgrade the minimum requirements are the currently sought solutions and at the focus of the road administration. In this regard, the efforts of RIA will be focused on providing good traffic conditions, through repairs to improve the existing infrastructure, and to upgrade the elements that determine road safety. It is necessary to take action to build intelligent transport systems with priority for high-speed infrastructure, through which drivers are informed in time about traffic conditions and accidents or other conditions that impede free and safe movement. To take measures, both for motorways and for high-emergency sections, to limit the possibility of allowing speeds higher than the allowable one, by taking joint actions with the Ministry of Interior and building systems for monitoring medium speed and automatic indication of an accident. Last but not least, on motorways it is necessary to take measures to upgrade the existing restrictive systems and their reflective elements in order to increase the visibility of road elements and the orientation of drivers. With regard to the rest of the road network and sections categorized as blackspots, it often comes to the point that to take action to upgrade and improve traffic safety, it is necessary to undertake comprehensive repairs. After conducting inspections and identifying problems, key measures are set to implement in order to improve traffic safety. Some of them are: - corrective actions to calm the traffic and reduce the speed in the sections of the settlements, by building situational changes; - improving the visibility of the road elements in order to create a visual image of the driver for the condition of the route; - upgrading of the signalization in the sections. With regard to the policy for management and increase of safety, in 2021 the Ministry of Regional Development and Public Works approved the Sectoral Strategy for Traffic Safety on the Republic Roads. The strategy includes a number of measures, including intelligent transport systems, to increase road safety. In pursuance of the

Country	Title	Abstract
		Strategy, in 2022, for the first time in the Agency, a budget was allocated only for the implementation of road safety measures. In this regard, in 2022 it is planned to begin activities to eliminate multi-year blackspots and high-accident areas, which are not yet categorized as blackspots. For 2020, a total of 53 blackspots have been identified in the country, of which 33 have a recurrence in the last three years, for 2021 we still do not have data. All these sections, as well as others not yet categorized, need to take action, modern solutions to improve the connection between the road and the driver, a comprehensive vision and concept for their safety. In line with safety policy and in connection with the implementation of Bulgaria's obligations under DIRECTIVE (EU) 2019/1936 of the European Parliament and of the Council of 23 October 2019 amending Directive 2008/96 / EC on road infrastructure safety management, investments in road safety need to be increased and in the coming years to eliminate the identified blackspots and high-accident areas, without lagging behind in the implementation of modern measures and solutions on new roads and highways. 2. According to the Integrated Plan in the field of energy and climate of the Republic of Bulgaria 2021 - 2030, for counteracting climate change and its impact on the economy, Bulgaria has prepared a National Strategy for Adaptation to Climate Change and an Action Plan adopted by decision of the Council of Ministers in 2019 The strategy fills a gap in Bulgaria's climate change policy, outlining the country's approach to adapting key sectors of the economy to the changing climate. In the National Analysis and Assessment of the Risk and Vulnerability of the Sectors in the Bulgarian Economy to Climate Change (MoEW 2014) the transport sector is assessed as extremely sustainable for the period until 2035. This is primarily due to the expected moderate climate change by 2035 and secondly, the transport system, which is designed and built in view of the local climatic conditions. One of the strategic objectives in the transport sector is "Incorporating climate change adaptation considerations into key planning and decision-making processes", formulating the following types of adaptation options: - Review and improve project preparation procedures; - Review and improvement of operating and maintenance standards; - Review and update design standards. 3. The projects for construction of road infrastructure on the TEN-T network included in the program envisage construction of ITS, which include control centers for traffic management, software for monitoring and traffic management, as well as counting points for traffic registration, permanent video surveillance, meteorological surveillance systems, information boards, etc. The road safety audits of the conceptual designs, technical designs, before and after commissioning are performed on the projects and the measures specified in the road safety reports are implemented during the design / construction.

Country	Title	Abstract
CA Canada	Investing in Canada Plan - Trade and Transportation Corridors Initiative	n/a
CR Costa Rica	National Transport Plan 2011-2035	The National Transport Plan 2011-2035, approved in 2013, constitutes the roadmap for decision-making regarding investment in the transport system. The plan establishes monitoring and review mechanisms so that changes in transport policy do not jeopardize the viability of the plan itself or the achievement of the established goals. Regarding highways, chapter 2 defines the highway network for the country, establishing its classification and technical reference parameters. Additionally, a series of projects and strategic actions are detailed for the improvement of connectivity. The plan divides the national road network into: 1. High Capacity Road Network and Complementary Road Network.
CZ Czech	Road Policies are formulated in Transport Policy of the Czech Republic period 2021 - 2027, with an outlook until 2050 and Transport Sector Strategies	Objectives for Road Transport: - Road network corresponding to real need of users, - Completion of the backbone network of high capacity motorways and better connections to neighbouring states, - Network of Class I Roads of sufficient quality and capacity for interconnection of regions and motorways, - Better infrastructure for urban mobility, - Optimal technical condition of the existing and new road network, - Safe road network, - Adjusting to challenges of autonomous mobility
DK Denmark	n/a	Since 2019 two significant agreements for the road sector have passed the Parliament. • "A green deal for Transport (Udmøntning af pulje til grøn transport" fra "klimateaftale for energi og industri mv. 2020") • Infrastructure plan 2035 (Infrastrukturplan 2035) The green deal defines the climate goals for the transport sector including road sector. There are specific goals for the decarbonisation of the road vehicles especially electrification.

Country	Title	Abstract
		The infrastructure plan is an agreement of the public investments in the transport sector until 2035. Investments in the primary roads, bicycle transport and public transport are the largest part of the investments prioritized in the plan. Links to the documents: https://www.altinget.dk/misc/Retf%C3%A6rdig%20retning%20for%20Danmark_2019-06-25_ENDELIG.pdf https://fm.dk/media/18085/klimaafale-for-energi-og-industri-mv-2020.pdf https://www.trm.dk/media/0onne5gg/endelig-aftaletekst-250621-final-a.pdf https://www.trm.dk/media/rt1h51td/endelig-aftaletekst-infrastrukturplan-2035-final-a.pdf
GR Germany	Federal Transport Infrastructure Plan (2016-2030)	The Federal Transport infrastructure Plan (FTIP) is an overall strategy for the development of the Federal Government's transport infrastructure. In the past, each FTIP had a different priority. In the 1980s, it was the upgrading of the rail network. In the 1990s, it was the reunification of our country. In the 2000s, it was the provision of links to and from our major urban areas. Today, the focus is on strengthening the overall network – and making our infrastructure fit for the global digital era. This means modernizing transport routes, linking up infrastructure and accelerating mobility. The new FTIP addresses this challenge. With investment totalling 269.6 billion euros and over 1,000 projects to be started by 2030, it is a robust programme for our infrastructure. We are committed to five major innovations: 1) We are providing a firm prospect of funding. With the record level of funding available from the investment ramp-up, the FTIP is a realistic and fundable overall strategy for the structural maintenance and construction of our infrastructure. 2) We are reinforcing the principle of giving structural maintenance precedence over upgrading and new construction. The overall picture shows a record share of 69 percent for the modernization of our infrastructure. 3) We are establishing clear priorities. Investment will be made in those places where people and the economy derive the greatest benefit. This means strengthening the major transport arteries and junctions – thereby enhancing the capacity of the entire network. 4) We are removing bottlenecks. The new FTIP focuses investment in upgrading and new construction across all modes of transport on unblocking bottlenecks, thereby optimizing the flow of traffic throughout the network. 5) We have intensively involved the public. The FTIP 2030 is the first Federal Transport Infrastructure Plan that was drawn up and developed in collaboration with the public – from the basic approach through project proposals to the draft.
IE	National Investment	This is the new Department of Transport's high-level strategic framework for prioritising future investment in the land transport network. It represents the

Country	Title	Abstract
Ireland	Framework for Transport Ireland	Department's contribution to Project Ireland 2040, the Government's long-term strategy for accommodating population growth in a sustainable manner and making Ireland a better country for all of its people. It has been developed to ensure that our transport sectoral strategy is underpinned by and supports the achievement of the spatial objectives and National Strategic Objectives set out in the National Planning Framework. See https://www.gov.ie/en/consultation/737a6-national-investment-framework-for-transport-in-ireland-nifti for full document.
JP Japan	Road-related budget report for 2022	Outline of the road-related budget report is as follows. In order to build the world's safest, smartest and most sustainable road transport system, we will implement road measures under the following basic policies. 1 Disaster prevention and mitigation, and national land toughening - Protecting people's lives and livelihoods from disasters 2 Measures against aging roads through preventive maintenance - Passing on safe and secure roads to the next generation 3 Development of networks and hubs to support human flow and logistics - Connecting people and regions 4 Creating safety and security and liveliness in road space - Creating communities and towns 5 DX of the road system - Realization of xROAD 6 Realizing a Green Society: Contributing to Carbon Neutrality by 2050
KR Korea	A multi-connected road that connects people, society, economy, and the future	1. To take a leap by investing in the right people in the right place 2. To provide inclusive people-centered transportation services 3. To create a safe road environment 4. To build a future road leading to innovative growth
MZ Mozambique	Roads Policy (Published in 2008)	The main objectives of the roads policy for national development are: 1. National Integration: Establishment of a road network that provide mobility for people and goods at national level 2. Economic growth: Establishment of access to areas with high potential for agriculture, tourism, industry and natural resources 3. Poverty reduction: Facilitate the access to rural areas and allow access to employment, school and other social services 4. Regional Integration: Promote the rehabilitation and maintenance of international corridors in particular to ones connecting landlocked countries

Country	Title	Abstract
		5. Trading: Development of a road network that stimulate trading and reduce the transport costs and providing access to markets
NL Netherlands	Dutch Multi-Year Programme for Infrastructure, Spatial Planning and Transport (MIRT)	n/a
NZ New Zealand	Government Policy Statement on LAND TRANSPORT	The GPS outlines the government's strategy to guide land transport investment over the next 10 years. It also provides guidance to decision-makers about where the government will focus resources, consistent with the purpose of the LTMA 2003, which is: "To contribute to an effective, efficient, and safe land transport system in the public interest".
SE Sweden	Vision Zero	The goal of Swedish policy for the number of deaths in the road transport sector was to be halved between 2007–2020, with the number of people seriously injured reduced by one quarter. For 2030, there is a new goal with a 50 percent reduction of fatalities and another 25 percent reduction of seriously injured. The Vision Zero concept is an ambitious and visionary objective, which also entails a systemic change in Swedish road safety efforts. Vision Zero means that the traffic system is adapted to people, rather than inducing people to adapt to the traffic system. In September 2016, the Government adopted a comprehensive policy document for future road safety efforts – a new start for Vision Zero. The Vision Zero approach has been adopted by countries and cities around the world.
SK Slovakia	National Road Safety Strategy of the SR 2021-2030	n/a
TN Tunisia	DGPC strategic plan for 2030	Tunisia has a good road network in comparison with peer countries, however certain dimensions need to be reviewed: '- Insufficient maintenance activities '- An institutional framework limiting the rapid and quality development of the network The estimated needs for the development and maintenance of the road network would cost 30 billion TND over 15 years while the budget estimates will be between 13 and 19 billion TND over the next 15 years and it is necessary to prioritize projects according to clear criteria.

Country	Title	Abstract
		The first priority will be given to maintenance (300 Mn TND per year), moreover it is necessary to review the maintenance strategy by creating a database and setting up scientific criteria for prioritization, for the gradual outsourcing of execution and by improving the operation of the network. Measures should be taken to improve the institutional framework for: - Improve the general framework: organization, incentives and working conditions (including travel conditions) - Improve the performance of studies and the monitoring and control of projects - Provide training opportunities to DGPC executives
US United States	FY2022-2026 DOT Strategic Framework	The Federal Highway Administration (FHWA) is an agency within the U.S. Department of Transportation (DOT) that supports State and local governments in the design, construction, and maintenance of the United States highway system and various federally and tribal owned lands. US road policies are established by USDOT and FHWA—largely through the lens of the draft DOT Strategic Framework and the following six strategic goals— 1. Safety: Make our transportation system safer for all people. Work toward a future where transportation-related serious injuries and fatalities are eliminated. 2. Economic Strength & Global Competitiveness: Grow an inclusive and sustainable economy. Invest in our transportation system to provide American workers and businesses reliable and efficient access to good paying jobs, resources, and markets. 3. Equity: Reduce inequities. Support and engage people and communities to promote safe, affordable, accessible, and multimodal access to opportunities and services while reducing transportation related disparities and adverse community impacts and health effects. 4. Climate & Sustainability: Tackle the climate crisis by ensuring that transportation plays a central role in the solution. Substantially reduce greenhouse gas emissions and transportation-related pollution and build more resilient and sustainable transportation systems to benefit and protect communities. 5. Transformation: Design for the future. Invest in purpose-driven research and innovation to meet the challenge of the present and modernize a transportation system of the future that serves everyone today and, in the decades, to come. 6. Organizational Excellence: Strengthen our world class organization. Advance the Department's mission by establishing policies, processes, and an inclusive and innovative culture to effectively serve communities and responsibly steward the public's resources.

7. CONCLUSIONS

Throughout our work during this cycle, we have summarized some findings to be noted and other issues to be solved while having managed to develop a prospective PIARC flagship product with a limited manpower. They are listed as follows:

- 10 indicators in total we have selected to see the whole picture of roads and road transport in 29 member countries including some LMICs can highlight essential and appealing aspects of international road statistics. They are presented so that they become internationally comparable. Especially a qualitative indicator focused on Road Policies seems interesting and informative, thereby suggesting current key interests of road administrations for us.
- We have somehow taken a conventional method of collecting data, by use of a spreadsheet as a questionnaire for each indicator, but it will be further streamlined and standardized if some innovative software tools are normally used. We recognize that there are already Microsoft Forms and Google Forms made available for free.
- Our mission is not limited to data collection and exhibition. In addition data examination and analysis in combination with some primary country data are part of our work, including interpretation of some qualitative indicators such as road policies we have addressed in this cycle. Several findings as analytical results are presented as follows:
 - In terms of the maturity level of development of Motorways and Primary Arterial Roads, the concept that both population (P) and surface area (A) may impact on a required road length can be applied; length of Motorways divided by $\sqrt{PA}$ is a hypothetical index with novelty. It is inferred that the more developed motorway's network of a country is, the wealthier the country is, and vice versa.
 - Regarding some indicators such as length of Bridges and Tunnels, we find it difficult to propose a clear and satisfactory definition because their respective definitions vary from country to country.
 - The number of Vehicles in Use statistically correlates with the level of economic development as well as maturity level of the network of Motorways.
 - Annual Total Driving Distance of Vehicles (ATDDV) is the sum of vehicles kilometers traveled. In general the more substantially the number of Vehicles in Use grows, the higher ATDDV becomes. On the other hand we should notice that the data provided by many countries concerns 2020 or 2021 when COVID-19 rampant across the world should cause ATDDV to become smaller than normal by widespread hesitation and restriction of travel and drive. This trend also emerges when road fatalities and fuel consumption of vehicles are considered.
 - Knowing that a country of more population tends to suffer more road fatalities, it is necessary to pay attention to fatality rate, and fatalities for all roads per 1,000 population are visualized. The highest is the United States, followed by New Zealand, Indonesia, Tunisia and so on, and the lowest is Portugal.
 - In many countries, Investment exceeds Maintenance. In particular, Investment accounts for more than 80% in Canada, Canada-Quebec, Germany, Luxembourg, Portugal and Tunisia. On the other hand, in Bulgaria, Denmark, New Zealand and South Africa, Maintenance is over Investment. However, Investment aimed at upgrade, structural reform, etc. of existing roads, instead of newly constructed roads might be interpreted as Maintenance. Then it would be necessary to distinguish Investment for new roads from

that for existing roads which could be regarded as Maintenance. Actually Germany claims to spend more money for structural maintenance of existing roads rather than newly constructed or extended roads.

- In many European countries, Diesel/Light oil is more dominant, and the United States, Canada and Japan consume more Gasoline/Petrol rather than the other fuel types.
 - Road Policies, unlike the other quantitative indicators inquired in this survey, represent in a qualitative manner the official policy or the overall strategy of road development formulated by the Ministry or Road agencies of each country. Since Road Policies are normally composed of some key components which are itemized, we have proposed 14 probable items for each country to choose 5 preferential ones out of 14. The preferential one common to the most countries is « Road Safety », and the 2nd most is « Maintenance/Repairs » and « New Technology », followed by « Construction », « Multi-Modal and Modal shifts », and « Environment ».
- In the next working cycle some more qualitative indicators can be added, focusing on Road Administration System, Road Technical Standards, Road-related Law System and so on, which may not be regarded as statistical data.
- It is hoped that more traditional quantitative data will be incorporated into our output, but it depends on the number of dedicated workforce for this committee. It would be difficult to make it happen if there were only a small number of active members available likewise in this cycle. Also it is crucial to collaborate with the other TCs to further substantiate our own statistics. We really appreciate generous support by TC4.2 Bridges to our output in which its own survey result has been effectively delivered.

Finally, we would like to express our sincere appreciation for many relevant people who have contributed to our survey and publication of this report.

8. GLOSSARY

Term	Definition
ATDDV	Annual Total Driving Distance of Vehicles
GDP	Gross Domestic Product
ITF	The International Transport Forum
OECD	Organisation for Economic Cooperation and Development
$\sqrt{\text{PA}}$	square root of Population and surface Area
UN	The United Nations

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