

# ***Transport Starter Data Kit: Historical socio-transport data for Taiwan***

## **Authors**

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## **Abstract**

Data on transport activity is an important element for the development of national transport decarbonisation strategies. By having freight and passenger transport information, the impacts on vehicle and fuel consumption changes from replacing internal combustion engine vehicles with electric vehicles can be calculated. The development of a national decarbonisation strategy requires significant efforts. However, access to data is often a barrier to starting transport system modelling in developing countries, thereby causing delays. This article provides data that can be used to support a model for Taiwan, which may act as a starting point for further model development and scenario analysis. The data are collected entirely from publicly available and accessible sources, focusing on national reports, statistical yearbooks, and academia.

## **Keywords**

U4RIA

Transport data

Transport modelling

MAED

Taiwan

## Specifications Table

<b>Subject</b>	Transport
<b>Specific subject area</b>	Transport Data
<b>Type of data</b>	Tables Graphs
<b>How data were acquired</b>	Literature survey (databases and reports from international organisations; journal articles)
<b>Data format</b>	Raw and analysed
<b>Parameters for data collection</b>	Data collected based on inputs required to create an energy system model for Taiwan
<b>Description of data collection</b>	Data were collected from the websites, annual reports and databases of international organisations, as well as from academic articles and existing modelling databases.
<b>Data source location</b>	Not applicable
<b>Data accessibility</b>	With the article and in a repository. Repository name: Zenodo. Direct URL to data: <a href="https://doi.org/10.5281/zenodo.6540029">https://doi.org/10.5281/zenodo.6540029</a>

## Value of the Data

- The data can be used to develop national transport demand models to inform national investment outlooks and decarbonisation strategies.
- The data are useful for country analysts, policy makers, and the broader scientific community, as a zero-order starting point for model development.
- This data could be used to examine a range of possible transport pathways, in addition to the examples given in this study, to provide further insights into the evolution of Taiwan's transport system.
- The data can be used both for conducting an analysis of transport activity and emissions, but also for capacity building activities.
- The data can be used as a call to action in addressing transport data gaps and establishing parameters for data collection to improve the consistency of transport-climate research in these countries.

## 1. Data Description

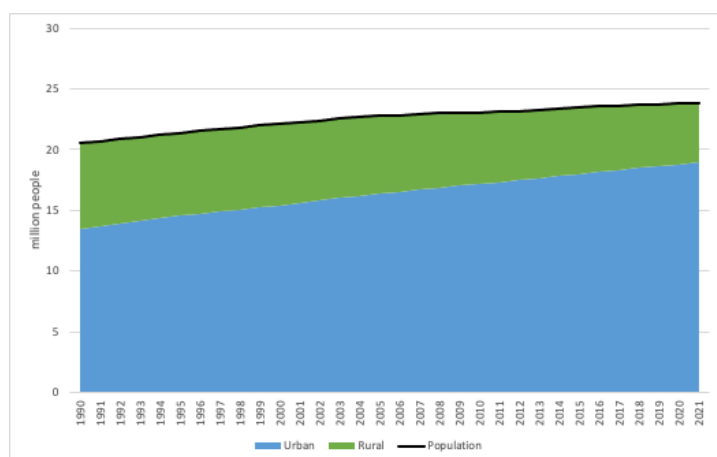
The data provided in this paper can be used to support the development of a transport model for Taiwan. The data provided were collected from publicly available sources, including statistical yearbooks, transport ministry reports, statistics from national authorities and affiliated research institutions, academia, and journal articles. Global datasets (primarily from the World Bank) were only consulted if severe data gaps existed. The dataset includes parameters on passenger and freight transport activity, disaggregated by transport mode (road, rail, aviation, etc.) and geographic scale (inter-city or inner-city), if available. The dataset also covers the size of the vehicle fleet, disaggregated by vehicle types. The data coverage and subtypes vary among the parameters. The overall ambition is to include the most recent available year(s).

<i>Item</i>	<i>Description of Content</i>
Figure 1	A graph showing total population (million people), as well as the share of urban and rural population in Taiwan.
Figure 2	A graph showing total GDP (million USD in 2015), as well as the share of the different sectors contributing to GDP in Taiwan: agriculture, construction, mining, manufacturing, service, and energy.
Table 1	A table showing passenger transport activity in Taiwan for the most recent year data was available. The data are curated from national statistics agencies or other government-affiliated agencies.
Table 2	A table showing freight transport activity in Taiwan for the most recent year data was available.
Table 3	A table showing vehicle fleet data in Taiwan for the most recent year data were available.

The transport starter data kits usually include an additional dataset by the UN DESA Statistics Division for the parameters of passenger and freight transport activity<sup>1</sup>. However, UN DESA does not provide estimates for Taiwan.

## 1.1 Population

Population data including total population, population growth, and split by rural or urban was gathered from The World Bank Open Data platform<sup>2</sup>. Figure 1 displays the total population disaggregated by urban and rural in Taiwan.



**Figure 1: Total population (million people) disaggregated by urban and rural in Taiwan**

<sup>1</sup> Freight: <https://www.sdg.org/datasets/undesa::indicator-9-1-2-freight-volume-by-mode-of-transport-tonne-kilometres/about> ;

Passenger: <https://www.sdg.org/datasets/undesa::indicator-9-1-2-passenger-volume-passenger-kilometres-by-mode-of-transport/about>

<sup>2</sup> <https://data.worldbank.org/>

## 1.2 Gross domestic product (GDP)

GDP data including total GDP, GDP growth, and GDP share by sector (agriculture, manufacturing, service) was collected from The World Bank Open Data platform<sup>2</sup>. Where data was not available, data processing was done. Figure 2 shows the total GDP, as well as the share by sector, in Taiwan.

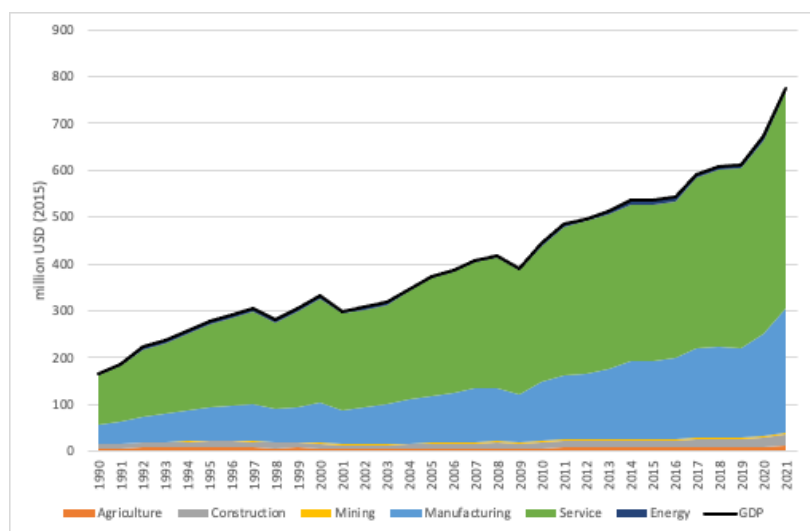


Figure 2: Total GDP (million USD in 2015) disaggregated by share in Taiwan

## 1.3 Passenger transport activity

Information on passenger transport activity in Taiwan is only captured through rail transport and buses (covering public transport in cities and intercity buses). For rail transport, the passenger activity is 30455 million passenger-km in 2019. Buses record 17064 million passenger-km for the same year. Rail passenger activity increased by 45% since 2010, while bus passenger activity stayed at the same level between 2010 and 2019. The data was sourced from the Asian Development Bank's Asian Transport Outlook Database.

Table 1: Recorded passenger transport activity (million passenger-km) in Taiwan

Mode	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Rail	20930.786	22825.847	24207.701	25322.754	26339.951	27110.887	27949.684	29003.961	29624.218	30455.602
Buses	16307.047	17039.888	17585.569	17927.53	18384.479	17565.272	17378.671	17053.464	17136.287	17064.21

Source: ADB, 2021, Asian Transport Outlook Database, <https://data.adb.org/dataset/asian-transport-outlook-database>

The data for buses exists from 1991 onwards, where it was 20548 million passenger-km. The bus passenger transport activity decreased after 1991 but it has been between 14300 to 17000 million passenger-km since 1995. Rail passenger activity has been recorded since 1996. The average annual growth rate is 5.5% since 2000.

## 1.4 Freight transport activity

Information on freight activity for Taiwan has been retrieved for rail, road, waterways, and domestic aviation. In total, freight transport recorded 356551 million tonnes-km in 2019. 44369 million tonnes-km were transported by road, 516 million tonnes-km by rail, 302818 million tonnes-km by waterways, and 8846 by domestic aviation in 2019. A major difference from other countries is that waterways represent the main freight transport method. As Taiwan is an island, the transport of goods via coastal shipping seems to be the most common method. The data is curated by Asian Development Bank's Asian Transport Outlook Database.

**Table 2: Recorded freight transport activity (million tonnes-km) in Taiwan**

Mode	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Road	29631.57	29550.82	29851	38473.58	37851.7	37805.31	38532.69	40350.86	44169.16	44369.95
Rail	866.301	847.707	828.475	727.279	681.421	634.22	562.276	512.372	542.497	516.578
Waterways	212252.16	234942.87	180069.96	198799.24	216022.84	224799.46	226103.27	205807.2	273207.04	302818.67
Domestic aviation	11873.34	10590.01	9343.51	9195.63	9443.18	9079.68	8958.73	9391.88	9597.33	8846.33

Source: ADB, 2021, Asian Transport Outlook Database, <https://data.adb.org/dataset/asian-transport-outlook-database>

The data coverage is relatively good. The data for all mentioned modes has been captured annually since 2004. Road data for the years since 1990 were identified and rail data exists since 1991. Waterways' activity has been recorded since 1994.

## 1.5 Vehicle fleets

Taiwan has a total of 22 million road vehicles, as of 2019. Official records cover information from 1991 to 2019. The peak was reached in 2011 and stayed since then between 21.5 and 22 million vehicles. Between 1991 and 2019, the total vehicle fleet grew by 156%. The largest growth was recorded for other vehicles (317%), followed by light-duty vehicles (263%). There are twice as many two-wheelers than light-duty vehicles on Taiwan's streets. They represent more than half of all road vehicles. Yet, the total number of two-wheelers decreased since 2011. The vehicle fleet data is sourced from Asian Development Bank's Asian Transport Outlook Database.

**Table 3: Vehicle fleet numbers in Taiwan**

Mode	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Two-wheelers	12477898	15173602	15139628	14195123	13735960	13661719	13668227	13755582	13835520	13992922
Light-duty vehicles	4764911	5960088	6091324	6236879	6405778	6573746	6666006	6763422	6845711	6919256
Buses	19845	29991	31098	31960	32928	33890	34531	34188	33877	33288
Others	40120	50050	60862	61017	61464	62074	63419	64791	65343	66205
Freight vehicles	873448	1012953	1023486	1037666	1054149	1069434	1078467	1086382	1090789	1100136

Total road vehicles	18176222	22226684	22346398	21562645	21290279	21400863	21510650	21704365	21871240	22111807
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Source: ADB, 2021, Asian Transport Outlook Database, <https://data.adb.org/dataset/asian-transport-outlook-database>

## 2. Methodology

The focus is on national data for passenger activity (passenger-km), freight activity (tonnes-km) and modes of transport (number of vehicles). The priority is to collect data released by national governments, government-affiliated organisations, or country-specific studies. The research identifies the most recent available data and any data available from 1990 onwards. The priority was for any data after 2010, because transport is a very dynamic growth sector and anything before 2010 adds limited value to understanding the current real-world situation.

Desk research is the main data collection approach for the Transport Starter Data Kits. The desk research examined annual yearbooks, transport statistics, country reporting, and any national statistical portals. Websites of the national government, transport ministries, statistical institutes and other related authorities were examined. Only when severe data gaps exist, global datasets are consulted. In some cases, World Bank data<sup>3</sup> on rail passenger and rail freight is included.

Each Transport Data for Starter Data Kit set contains an additional dataset, which is sourced from the United Nations Department of Economic and Social Affairs (UN DESA) Statistics Division. It is included as a secondary priority because this dataset is the result of a modelling exercise and covers every country. The UN DESA modelled passenger activity and freight activity has the purpose to support the Sustainable Development Goal Indicator 9.1.2<sup>4</sup>. The passenger activity provides information for road, rail, and air transport. Freight data covers the road, rail and inland water, and aviation. The passenger-km and tonnes-km data originate from the Open Sustainable Development Goals (SDG) Data Hub. In the UN DESA dataset, only the data for countries participating in the International Transport Forum (ITF) (representing mostly member countries of the Organisation for Economic Co-operation and Development (OECD)) and the United Nations Economic Commission for Europe (UNECE) (mostly European countries) are based on national reporting. For non-ITF/UNECE countries, data are estimated using the ITF model, which uses several covariates such as gross domestic product, population, and transport network coverage. A description of the model can be found in the ITF Transport Outlook 2017<sup>5</sup>. The UN DESA dataset is included in the Transport Data for Starter Data Kits as additional tables to fill in the incomplete picture that most countries present. The UN DESA modelled data is less accurate and it shall only be regarded as offering the wider picture of transport activity in the country.

<sup>3</sup> Rail passenger data: World Bank, 2022, Railways, passengers carried (million passenger-km), <https://data.worldbank.org/indicator/IS.RRS.PASG.KM>; rail freight data: World Bank, 2022, Railways, goods transported (million ton-km), <https://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6>

<sup>4</sup> UN DESA, 2021, Indicator 9.1.2: Freight volume by mode of transport (tonne kilometres): <https://www.sdg.org/datasets/undesa::indicator-9-1-2-freight-volume-by-mode-of-transport-tonne-kilometres/about> ;

UN DESA, 2021, Indicator 9.1.2: Passenger volume (passenger kilometres) by mode of transport: <https://www.sdg.org/datasets/undesa::indicator-9-1-2-passenger-volume-passenger-kilometres-by-mode-of-transport/about>

<sup>5</sup> ITF, 2017, ITF Transport Outlook 2017, <https://www.itf-oecd.org/transport-outlook-2017>

The collected data have been shared with a group of relevant SLOCAT partners to validate and explore any additional sources. The SLOCAT partners were selected based on their actions to lead projects in the region and their involvement in data-focused knowledge products or projects. The consultation involved ten anonymous organisations.

Desk research is an approach that limits the research to material available on the internet, accessible through search engines and linked to government and statistical institutes' websites. However, this does not pose a major limitation to obtaining data. Nearly every country has functional websites for statistics and transport authorities. In a few cases, websites are not well maintained, resulting in missing or broken hyperlinks to reports. By using services that provide access to archived websites, some of these broken pages can be retrieved. The collected information has been shared with partners and no additional information has been received.

Government datasets are generally published in local languages. For this study, the relevant information is accessed through the Asian Transport Outlook Database<sup>6</sup> which is available in English, thus no language issues were encountered.

Due to missing values in the country's historical GDP data, extrapolation between available years was done by the authors to address this. The World Bank's data platform provided GDP share by sector for agriculture, manufacturing, and services. However, GDP share by construction, mining, and energy was also needed to align the data structure with the MAED tool. To address the lack of data available for these sectors, the authors assumed that construction, mining, manufacturing, and energy all fall within the industry sector. Thus, to obtain data for the three remaining sectors, the remaining percentage after considering agriculture, manufacturing, and services from The World Bank's data platform, was divided by three. It is therefore assumed that the GDP share of the construction, mining, and energy sectors are the same.

### 3. Ethics Statement

Not applicable.

### 4. CRediT Author Statement

**Naomi Tan:** Investigation, Conceptualisation, Methodology; Data Collection; Visualization, Writing and Editing; **Robert Ambunda:** Data Collection; Investigation; Writing and Editing; **Nikola Medimorec:** Conceptualisation; Methodology; Data Collection; Investigation; Writing, Review & Editing; Supervision; **Angel Cortez:** Data Collection; **Agustina Krapp:** Data Collection; **Erin Maxwell:** Data Collection; **John Harrison:** Supervision; **Mark Howells:** Supervision

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<sup>6</sup> ADB, 2021, Asian Transport Outlook Database, <https://data.adb.org/dataset/asian-transport-outlook-database>

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## **Declaration of Competing Interests**

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.