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Page 1 of 10
Document 3032_2

Response to Request for Review - 6814 Busan Metro Line 1 Dadae

Dear Members of the CDM Executive Board,

Please find the summary of the responses to the issues raised and the action taken to correct the project-related documentation as part of the request for review for requesting registration for the No. 6814 project. The response is in accordance with para 9 a) in the Procedures for Review of Requests for Registration (EB55, Annex 40).

1) The DOE is requested to further substantiate how it has validated the "start of the construction contract" on 4 November 2009 as project start date as there have been cash outflow observed since 2006 according to the submitted investment analysis spreadsheet. In addition, the DOE shall clarify whether "contract start" refers to the date when the contract was signed or when it became effective. In case the project start date is revised, please ensure the validity of the input values to the investment analysis and the prior considerations. Please refer to VVM version 1.2 paragraphs 99-103 and Guidelines on the assessment of investment analysis version 5 paragraph 6..

DOE's response:

The request is more or less identical to CL 20 of the validation report which has been answered by the PP and cleared out. The investment analysis is based on a FSR developed by Yusin Corporation, Chungbuk Engineering, Hangaram, published 2008, prior to taking an investment decision on the metro. Land used potentially by the metro which was property of the Municipality was evaluated at the price as of the year 2008. Data years of the FSR do not coincide with actual investment years as there has been a delay. Major investment (construction, trains) in the FSR is for 2009-2013 whilst the first construction contract was only signed on 11/2009 and thus major expenses only started thereafter i.e. 2010. From 2006-2008 investments (the FSR previewed construction start 2009) also sum up to 10,000 million Wons, whilst basic design + actual design + research and survey measurements all sum up to 23,800 i.e. studies are more than what would be expended before. As a reminder the total investment cost is 720,100 million Won i.e. expenditures potentially prior are 1.3%. In accordance with EB: The "Glossary of CDM terms" defines the start date of a CDM project activity as: "the earliest date at which either the implementation or construction or real action of a project activity begins". To facilitate the clear definition of this term the Board further clarified that: "In light of the above definition, the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation, or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date, as they do not necessarily indicate the commencement of implementation of the project" The project starting date is the signature of the first construction contract being 04/11/2009. This is in accordance with the CDM Glossary of Terms. The actual start of construction is based on the construction contract of 04/11/2009 (see SQS ref. [25], File

15, sheet ID 1.1.). Completion date of construction is 08/10/2014 i.e. operational start will be end of 2014 or early 2015 which is 1 year later than is stated in the finance spreadsheet.

Thus, SQS concludes that the project start date has been determined correctly by the PP since the years in the FSR do not reflect the actual expenditures and the project suffered a delay i.e. construction start was around 1 year later than expected. Minor pre-project expenses which have been in fact executed in the time before the project start date do not influence that date and are in accordance with the "Glossary of CDM Terms".

2) The DOE is requested:

a) to clarify the inconsistencies in the NPV figures, -36,000 million KRW and -42,500 million, indicated in the validation report (p 42); and

DOE's response:

-42,500 million is the correct number as is stated in the PDD and the financial spreadsheet. In the text of the validation report, page 42, the NPV of the case with risk factor and including CDM was given. This is an error and is corrected in the new version. However, the value given in the Table 8 was correct.

b) to submit spreadsheet for the NPV calculation with the risk rate as the NPVs calculated with and without the risk rates appear to be identical in the submitted spreadsheet. Please refer to VVM version 1.2 paragraph 111..

DOE's response:

The spreadsheet allows the user to change the risk factor to make his own calculations. Assumptions Box C31 (highlighted in yellow) indicates the level of risk factor. 0% means that the project has 0% of expected passengers and 100% that the project has 100% of projected passengers. The PP inserted 30% as in the other projects and saved it in this manner for convenience. See new finance file attached (Annex 1: File 34 finance CDM Busan with risk factor fixed.xlsx).

3) The DOE is requested to further substantiate the following input values:

a) the total investment: how it has considered the range of 60-180 million USD for metro lines world wide (Bus-systems for the future, IEA, 2002) and 50-150 million USD/km mainly for European Metros in "another study" published in the year 2008 comparable, considering that: i) the project activity is an extension of an existing line, and ii) there are several metro projects in the host country and neighbouring countries;

DOE's response:

The investment cost is based on Yusin Corporation, Chung Suk Engineering, an independent 3rd party. To assess the plausibility of the value independent and well-known international sources are taken, these being the IEA and a published report by B Flyvberg, Comparison of Capital Costs per Route-Kilometre in Urban Rail, EJTIR, 8, no. 1 (2008) which show that the investment cost of the project with 74 million USD/km (underground metro) is at the lower end of international estimates. The Article of Flyvberg includes thereby also the investment cost of Seoul metro network (117km), which is stated to be 65.8 million USD/km in 2002 (Table 3, p.23; this includes not only underground stretches; underground metro is more expensive than elevated or at-level, see IEA source). The most complete and comparable metro network in the same host country thus also indicates the plausibility of the used value.

Park and Han (2003) estimate the cost of building metros in Korea by 80-100 million USD/km (see cited in J. Pucher et.al., Public Transport Reforms in Seoul, p.56; The study for the state of construction and improvement policy of advanced transit system of Korea, 2003, in addition Annex 2: Public Transport Reforms in Seoul: Innovations Motivated by Funding Crisis, Journal of Public Transportation, Vol. 8, No. 5, 2005, SQS ref. [90])

The study for the state of construction and improvement policy of advanced transit system of Korea, 2003pdf, SQS ref. [90]) IEA for underground metros, Flyvberg, Seoul Metro and overall Korean metros thus all report values which are comparable to Busan. All of these data is based on independent reports and includes specifically Korean metros.

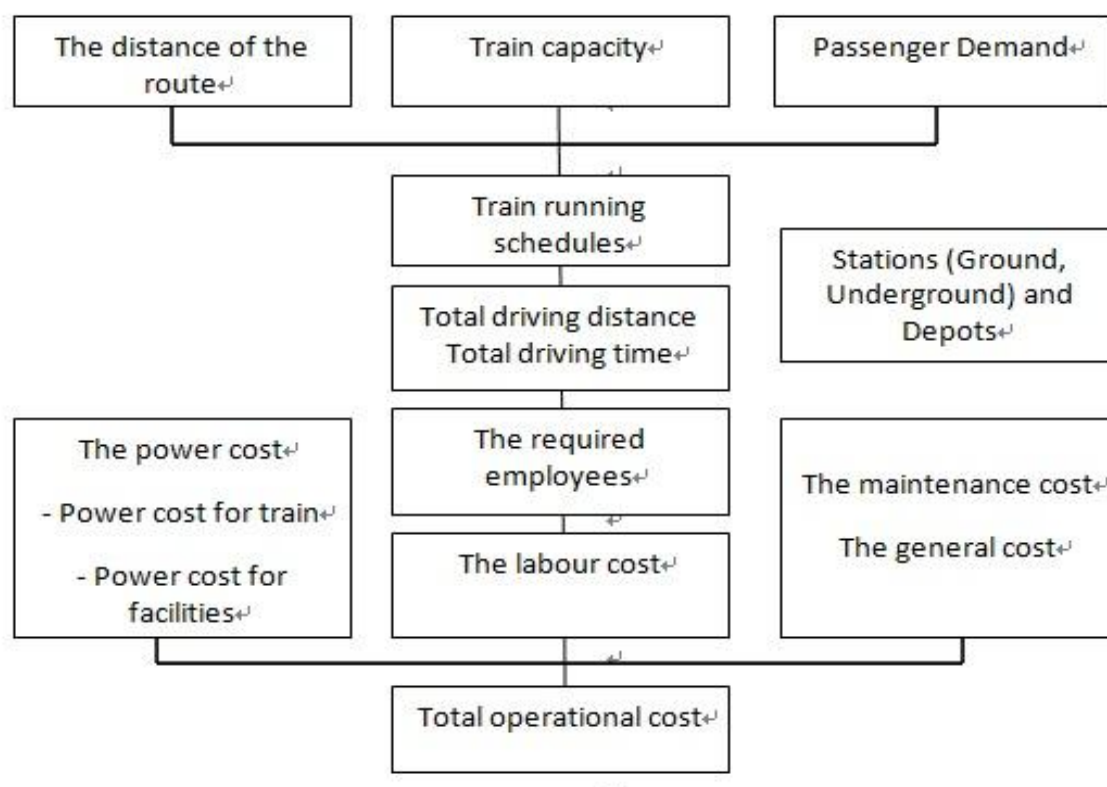
See also about the difficulty of comparing investments in metro: <http://www.railway-technical.com/finance.shtml>

b) the operational cost: how it has validated: i) the relatively high operational cost per passenger compared to other metro lines in the host country, ii) the suitability of every component of the operational cost; and iii) the cost which is specific to the extended part of the line, i.e. the project activity; and

DOE's response:

The operational cost is based on Yusin Corporation, Chungbuk Engineering, an independent 3rd party.

Costs only include additional costs such as additional drivers or station maintenance. The projections are based on the operating lines e.g. train electricity consumption per passenger of operating lines and are therefore reliable. The level of wages in the domestic metro was considered to estimate the average wage of the officials and the estimated wage was applied to calculate the operational labour cost. Maintenance costs are based on the current maintenance costs of trains applied to the additional trains. Overhead costs (7%) are based on the current overhead costs. The operational cost estimate follows this process:



As it is an extension of a line the operational costs per passenger are relatively high. This is logical as the end parts of lines (as is the case in extensions) have less passengers than the central parts, whilst having often higher costs due to longer distance between stations and therefore over-proportional electricity usage and train costs.

The extension is 8km with 6 stations i.e. 1.33km on average between each station, whilst the line 1 of which the project is an extension has 34 stations (http://www.humetro.busan.kr/english/03/01_01.php) with a total distance of 32.5km i.e. an average distance between each station of 0.96k or only 72% of the extension. Electricity consumption, train staff and train maintenance is however relative to distance whilst the passenger numbers are per station.

The average daily number of passengers per station on the extension is 5,400 passengers (year 2014 get-on passengers both directions; see SQS ref. [14], File 14) whilst the existing line had on average in the year 2009 11,400 passengers per day per station (See Annex 3: Busan pax per line 2009.xlsx) i.e. 220% more per station.

Summarized for an extension as is the project, the evidence above clearly shows that the additional costs are significantly higher than on the existing line whilst the number of passenger per station are significantly less, thus leading to higher above normal proportional operational costs per passenger. To compare line extension operational costs per km with full line operational costs per km is thus not adequate.

The number of employees, their salaries, the electricity costs and the maintenance costs (divided in station-, train- and system-maintenance costs) have been taken from the study of the Yusin Corporation, Chungbuk Engineering, an independent 3rd party (SQS ref. [78]), which was sent to SQS in responding to CL17. These figures were discussed in detail and crosschecked during the on-site visit by the SQS' validation team and the local expert Mr Ko (KFQ). Furthermore the performed assessment is confirmed in writing on 05/11/2012 by the Korean Foundation for Quality (KFQ), regarding the assessment on operational costs analysis for Busan Metro, in which Mr Ko confirms that the background data for operational costs for Busan Metro is duly reasonable and correct (see Annex 4: File Busan Operational Cost Evaluation (05.Nov.12)_1.xls).

Based on checks and information above, SQS considers the expected operational costs of Busan as plausible in the international context.

c) the fare box revenue: how it has validated the passenger projection. Please refer to VVM version 1.2 paragraph 111..

DOE's response:

The fare box revenue with the passenger projections are based on Yusin Corporation, Chungbuk Engineering, an independent 3rd party.

The demand estimation is based on the existing line. The project is only an extension of a metro line and thus demand estimates are based primarily on the existing line and origin-destination surveys of passengers using the metro line 1. Also results of population projection were taken into account.

4) The DOE is requested to further substantiate how it has validated the common practice analysis as:

a) the set of cities used for comparison includes cities with population less than 1 million while the methodology (page 6) states "If the larger urban zone (LUZ) of the city of the project activity contains more than one million inhabitants, then the set of cities for comparison includes all cities (including the city of the project activity) in the host country with a LUZ that contains more than 1 million inhabitants"; and

b) excluding the cities with less than 1 million at the time of the investment decision, there would be 7 cities for comparison out of which 5 cities already have MRTS in place while the methodology states "The proposed project activity is regarded as common practice if MRTS have already been implemented in 50% of the cities in the set of cities for comparison". Please refer to VVM version 1.2 paragraph 120..

DOE's response:

The methodology states that the LUZ needs to be taken (which is often larger than the official number of city inhabitants).

A. Eurostat, the European Union's statistical agency, has created the concept of Larger Urban Zone (LUZ) in an effort to harmonise definitions of urbanisation in the European Union and in countries outside the European Union. These definitions were agreed upon between Eurostat and the National Statistics Offices of the different countries of the European Union at the European Commission's Urban Audit of 2004. Eurostat's objective was to have an area of a significant share of residents commuting into the city, a concept known as the "functional urban region." To ensure a good data availability, Eurostat adjusts the LUZ boundaries to administrative boundaries that approximate the functional urban region.

B. The concept of LUZ needs to be transformed to the traditional concept of city inhabitants. The functional area is therefore taken for the cities for which no metropolitan area statistics are available. The result is depicted in Table 1 below.

Table 1 Metropolitan Population (year 2009) of Korean Cities

Urban Area based on functional area idem to LUZ	Population in millions
SNCA	24.38
Busan Metropolitan City	3.54
Daegu Metropolitan City	2.49
Daejeon Metropolitan City	1.48
Gwangju Metropolitan City	1.43
Ulsan Metropolitan City	1.11
Changwon (only city, 2010)	1.09
Cheongju	1.15
Jeonju	1.39
Cheonan	1.25
Pohang	1.30

File 62b SQS ref. [84]

Therefore we have 11 cities with > 1 million of which 5 have a MRTS (highlighted in yellow) which means. less than 50%.

In detail for the below cities which as metropolitan or functional area have > 1 million but less than 1 million when taking only the city population data which is however NOT in line with LUZ as used by the methodology depicted in Table 2 below:

Table 2 :

			Total population in metropolitan area
Cheongju (LUZ)	Cheongju city	643,161	1,153,443
	Cheongwon	149,783	
	Boeun	34,845	
	Okcheon	54,117	
	Yeongdong	50,426	
	Jeungpyeong	33,164	
	Jincheon	61,456	
	Goesan	36,775	
	Eumseong	89,716	
Jeonju (LUZ)	Jeonju city	635,007	1,387,253
	Iksan	306,669	
	Gimje	94,770	
	Gunsan	266,922	
	Wanju	83,885	
Cheonan (LUZ)	Cheonan city	540,832	1,245,560
	Gongju	124,172	
	Boryeong	106,754	

	Nonsan	127,097	
	Gyeryong	42,760	
	Geumsan	56,220	
	Yeongi	79,482	
	Buyeo	75,564	
	Seocheon	60,066	
	Cheongyang	32,613	
Pohang (LUZ)	Pohang city	509,475	1,300,503
	Geongju	267,466	
	Youngcheon	103,115	
	Cheongsong	26,917	
	Yeongyang	18,553	
	Yeongdeok	41,710	
	Uljin	52,529	
	Geongsan	236,459	
	Cheongdo	44,279	

File 62b SQS ref. [84]

C. To assess the plausibility a check was performed with the EU LUZ empirical calculations. The plausibility is done by comparing LUZ calculations done in the EU with official city population data and thereby determining an expansion factor to determine LUZ based on city inhabitant data. All cities of the Eurostat database are taken for this purpose. The figures in the Eurostat database are an attempt to reach a compromise between harmonised data for all of the European Union, and with availability of statistical data, making comparisons more accurate. The data used is from the 2006 Urban Audit III, which uses information collected for 2004¹. The database was made for all cities with > 500,000 inhabitants for which data was available. Eurostat published thereby data for 128 cities. The population of each city is based on national statistics (city population data). The expansion factor is defined as LUZ, namely population/city population. The average expansion factor taking the lower 95% confidence interval for the entire database was 2.1 i.e. to determine the LUZ population the city population number must be multiplied with the factor 2.1. This is based on the empirical relationship of all Eurostat cities between LUZ and city population taking the lower 95% confidence level (File 62b SQS ref. [84])

D. The metropolitan data calculated in the first table is thereafter compared with the LUZ population based on the LUZ expansion factor as determined in point C. The table below shows for the relevant cities the population data based on metropolitan population and a calculated LUZ based on empirical EU data for cities where no metropolitan area information is directly available by the National Statistical Authority and where the core city population is less than 1 million.

Population (year 2009) of Korean Cities

Urban Area	Population in millions metropolitan area	Population in millions LUZ
SNCA	24.38	Not determined
Busan Metropolitan City	3.54	Not determined
Daegu Metropolitan City	2.49	Not determined

¹ See Annex 6: Population information all cities.xls

Daejeon Metropolitan City	1.48	Not determined
Gwangju Metropolitan City	1.43	Not determined
Ulsan Metropolitan City	1.11	Not determined
Changwon (only city, 2010)	1.09	Not determined
Cheongju	1.15	1.38
Jeonju	1.39	1.35
Cheonan	1.25	1.20
Pohang	1.30	1.08

File 62b SQS ref. [84]

As can be seen with both approaches all included urban areas have a population of > 1 million. Therefore using 2 different approaches both coincide that the cities listed in the PDD have a population of > 1million in the larger urban area. Thus 11 cities in Korea have a LUZ of > 1 million of which 5 have a MRTS i.e. less than 50% thus proving that the project is not common practice in accordance with the methodology.

SQS concludes that the given common practice analysis is correct because it is based on the population of the LUZ at the time of the investment decision.

5) The DOE is requested to further substantiate how it has validated the identification of the baseline scenario as the DOE has validated only the baseline scenario as per "Step 2: Investment analysis" of the applied methodology while the methodology (page 5) requires to "conduct an investment comparison analysis for all alternatives that are remaining after Step 1" i.e. "realistic and credible alternative scenario(s) to the project activity that are in compliance with mandatory legislation and regulations. Please refer to VVM version 1.2 paragraphs 83-86, Tool for the demonstration and assessment of additionality version 05.2. Step 1 and 2..

DOE's response:

In Chapter B5 of the PDD the following alternatives are listed:

1. The establishment of a BRT (Bus Rapid Transit);
2. The establishment of another rail-based MRTS;
3. The continuation of the current public and individual transport systems, including (future) investments in road based infrastructure if applicable;
4. The proposed project activity being implemented at a later date in the future, without being registered as a CDM project activity;
5. The project proposal not implemented as a CDM project activity.

Alternatives 1 and 2 are assessed in Chapter B.4. of the PDD and have been discarded:

Alternative 1: Busan has already established 4 metro lines. Also the project is an extension of a metro line and thus it makes technically no sense to establish a different system i.e. passengers would need to change from underground metro to a BRT for travelling the last stations which would not be convenient. Also BRTs due to their limited phd capacity are also basically used for secondary lines in large metropolitan cities in which a rail-based MRTS have already been established. Also with Busan already having a metro line the connectivity is easier if the same system can be used and buses are thereafter used for secondary routes. For the area in which the metro is planned a BRT system is also considered as non-optimal basically due to the required passenger per hour capacity. BRT or bus lane systems have typical carrying capacities of less than 10,000 passengers per hour per direction (phd) (proven in Table 4 of the PDD). The median value for all included BRTs is 7,000 phd, which gives an indication that BRTs are basically used for secondary lines in large metropolitan cities and as main lines in smaller and medium-sized cities. Also the only operational Korean BRT in Seoul has a capacity of 7,000 passengers per hour and direction only. The capacity of the proposed metro line is for up to 49,000 passengers per hour per direction.

Alternative 2: The project is an extension of a metro line and thus it makes no technical sense for a 8km stretch to use a different rail-based system.

Alternative 3 is the baseline situation.

Alternative 4 has been discarded in Chapter B4 respectively is identical with the alternative 5.

Following alternatives are thus credible, realistic and comparable:

1. Continuation of the current situation (A3)
2. Project without CDM (A5)

The options BRT (A1), other rail-systems (A2) and the option project in the future without CDM (A4) are not considered credible, realistic or comparable alternatives as outlined in Chapter B.4. of the PDD. They are thus eliminated in Step 1 and not further considered. Step 2 conducts an investment comparison analysis for all alternatives that are **remaining** after Step 1 in accordance with page 6 of ACM0016:

“Apply Step 2 of the latest approved version of the “Tool for the demonstration and assessment of additionality”. Conduct an investment comparison analysis for all alternatives that are remaining after Step 1. Use the NPV as indicator.”

Step 1 is performed in B.4. of the PDD and Chapter B.5. then resumes the result of Chapter B.4. As only 1 alternative to the baseline remains after step 1 only for this alternative the financial analysis is performed.

6) The DOE is requested to clarify how it has validated the following values determined ex-ante:

a) specific fuel consumption of passenger cars, sourced from Korea Energy Economics Institute, 2009 as other similar projects validated by the same DOE sourced the data from Korea Energy Economics Institute, 2010;

DOE's response:

There has actually been a mistake made in the validation process. Due to the fact that Busan PDD was already written earlier compared to the other PDDs, data from a former year had been used and was not actualized later on. The PDD and the CER sheet (PDD tables) have been updated to the newest data source. The validation report has been adapted accordingly.

b) specific fuel consumption for motor cycles, Korea Energy Economics Institute, 2008, as it is not clear whether it was the most recent data available at the start of validation in November 2011; and

c) occupancy Rate of the passenger cars, sourced from Korea Transport Institute, 2010, as it appears that two other similar projects validated by the same DOE have used the same reference but different values of 1.21 and 1.25.

Please refer to VVM version 1.2 paragraph 91..

DOE's response:

The report is from 04/2009 based on data from the year 2008. Therefore the year of the CER sheet (PDD tables) and the PDD are wrong with data from 2008 and should be with 2009. No later report was available. The methodology states: “National or international data from studies not older than 3 years”. The project was entered for validation 11/2011 and therefore the report 04/2009 is less than 3 years and is in line with the methodology.

c) occupancy Rate of the passenger cars, sourced from Korea Transport Institute, 2010, as it appears that two other similar projects validated by the same DOE have used the same reference but different values of 1.21 and 1.25. Please refer to VVM version 1.2 paragraph 91.

DOE's response:

Occupation rates are different for each city. National values should not be used.

The report of the Korea Transport Institute has data for various cities in the same table. Following cities are included:

Seoul
Busan
Daegu
Incheon
Gwangju
Daejeon
Ulan
Gyeonggi
Gangwon
Chungbuk
Chungnam
Jeonbuk
Jeonnam
Gyeongbuk
Gyeongnam
Jeju

The data per city by logic is not the same, however the reference source or document is the same. See below the original table from the original document (see [Annex 5: KOTI_Brief_03_2010.xls.](#))

Classification	OC
Seoul	1.2
Busan	1.3
Daegu	1.21
Incheon	1.25
Gwangju	1.2
Daejeon	1.27
Ulan	1.34
Gyeonggi	1.27
Gangwon	1.38
Chungbuk	1.31
Chungnam	1.33
Jeonbuk	1.26

Jeonnam	1.32
Gyeongbok	1.3
Gyeongnam	1.31
Jeju	1.43
Average	1.26

For Busan an additional source (File 3a, Korea Society of Transportation, p.31, 2010, SQS ref. [3]) with a marginally (nearly identical) value of 1.31 instead of the above report of 1.30 was found and this value was used in the PDD as it is more conservative (the emissions per PKM are lower if the occupation rate is higher).

The PDD, finance file, PDD-tables and Validation Report have been amended to reflect the issues raised. The four documents are re-submitted in both clean and tracked-changes versions as part of the RfR process. If further information is required, Hanspeter Graf will be the contact person for the review process. He is available to address any questions the Executive Board may wish to clarify during its considerations.

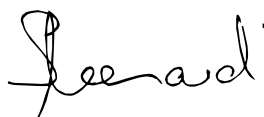
Thank you.

Yours sincerely,

Silvio Leonardi

Hanspeter Graf

Oliver Stankiewicz



Member of the Executive Board



Lead Auditor



Reviewer

Supporting documents:

- Annex 1: File 34 finance CDM Busan with risk factor fixed.xlsx (track change and clean version)
- Annex 2: Journal of Public Transportation, Vol. 8, No. 5, 2005.pdf
- Annex 3: Busan pax per line 2009.xlsx
- Annex 4: File Busan Operational Cost Evaluation (05.Nov.12)_1.xls
- Annex 5: KOTI_Brief_03_2010.xls
- Annex 6: Population information all cities.xlsx