7 Guideline on Boiler Registration and Management System

1 Guideline on Boiler Registration and Management System

1.1 Purpose of Boiler Registration and Management System (BRMS)

Boiler Registration and Management System (BRMS) is a system to register HOBs and to enhance administration of HOBs which burns 50 to 5,000 tons of coal per year of coal. The target of the regulation is the boilers located in the central 6 districts[1] of Ulaanbaatar. Input data for the emission inventory and simulation are to be calculated based on this registration data. Boiler usage permissions or excellent boiler certifications are planned to be issued based on this data.

1.2 Target Boilers

Potential target boilers and stoves were identified based on the existing boiler databases, as follows;

1. Ger Stoves — Approximately 150,000 stoves
2. CFWH (10~100kW) — Approximately 1,000 boilers
3. HOB (0.1~3.15MW) — Approximately 200 boilers
4. Boilers for Electricity and Industrial Production

The purpose of BRMS is to monitor air pollutant emission, and to restrict using boilers if emission is over than standards. In order to monitor emission, it is necessary to maintain boiler database, to manage stack gas measurement equipment and experts, and to measure stack gas. As the 1st step, boiler registration and management system is started for 200 HOBs.

1.3 Flow of Operation

Data to be reported by the boiler registration register the database. Project developed BRMS for data management. Role Relation between roles sharing by related organization on boiler registration and the boiler registration database system is shown in Figure 1 and Figure 2. Related figures in Figure 1 and Figure 2 mean as follows.

Operation by user

Data (document, Excel file etc.)

Function of boiler registration database system

[1] Khan-Uul, Bayanzurkh, Songinokhairkhan, Sukhbaatar, Chingeltei and Bayangol districts

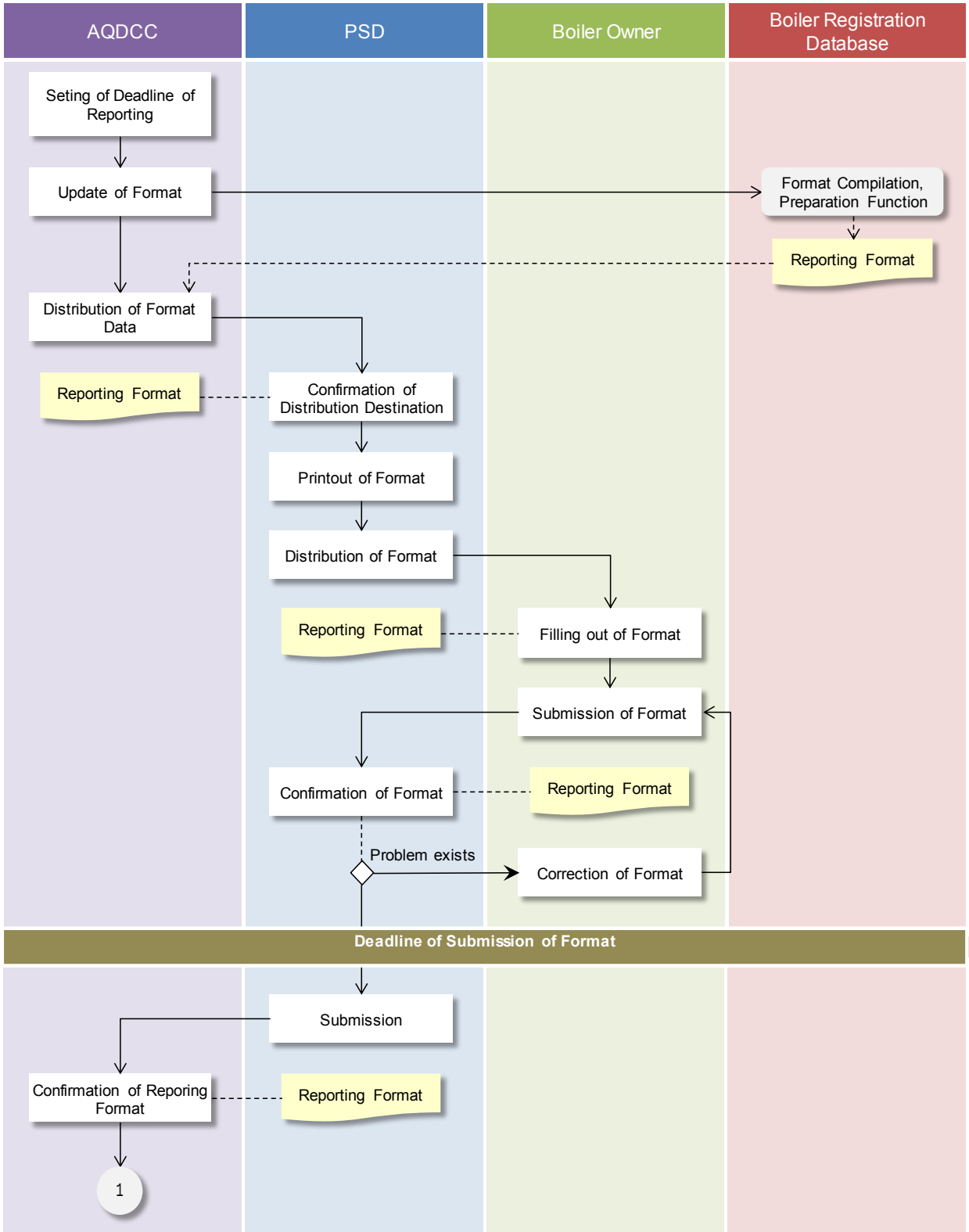


Figure 1 Operation Flow (1/2)

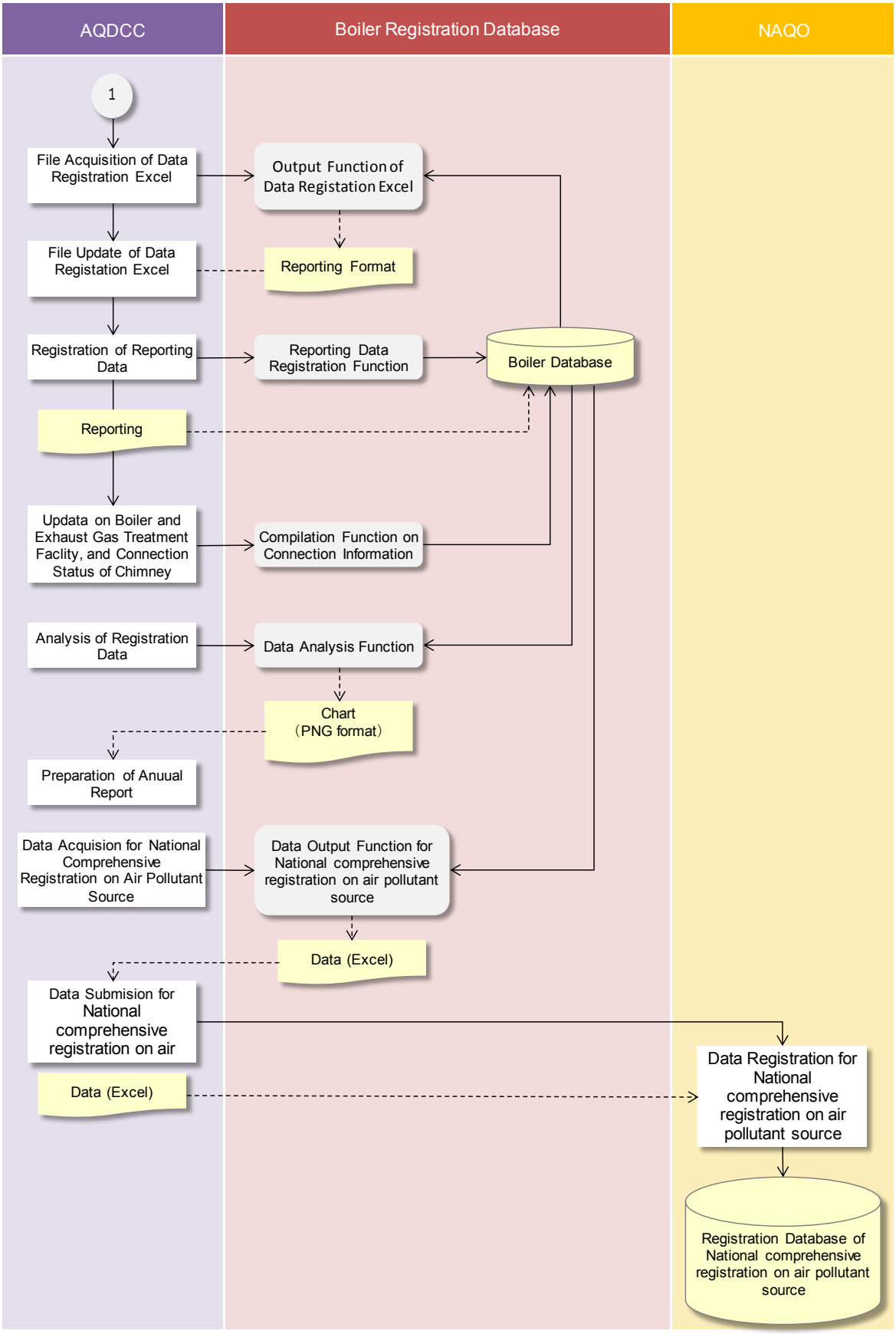


Figure 2 Operation Flow (2/2)

2 Features of Boiler Registration Database System

2.1 Adoption of Simple Embedded Database

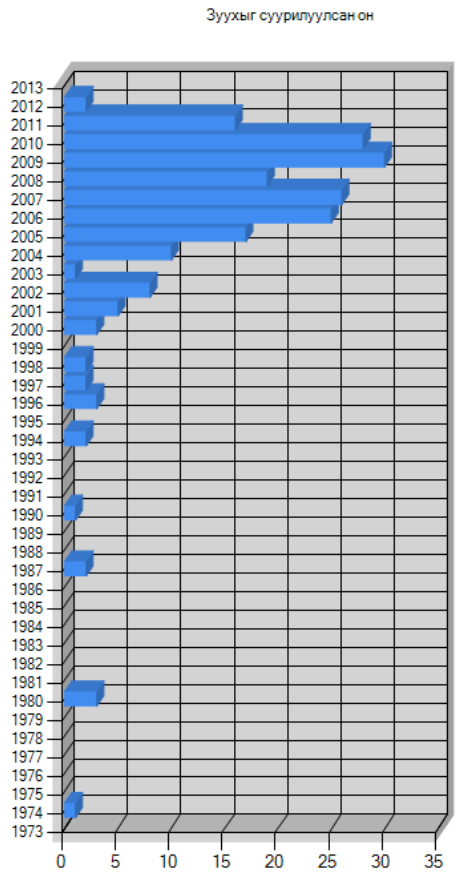
The database has necessary function as relational database, embedded database without server and network is adopted. All data can store in a file, it is easy for user to submit data and backup.

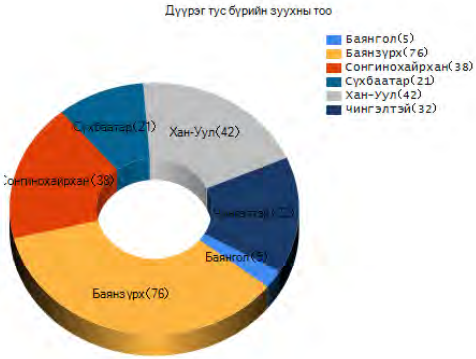
2.2 Input and Output System by Using Excel

Excel is used for input and output of data, preparation of many input screens are not necessary, modification of system is easy. Excel file for data input by each HOB facility is prepared. Modification of the data from second years registration is only updated based on previous year's file, the design of database is developed for lessening of burden of input user.

2.3 Analysis Function

System is already installed simple analyzing function (nine kinds). Also, data are registered as database (SQLite[2]), SQLite which corresponds to access utility and SQL language is used, talkative analysis can be implemented. Sample chart to be prepared by analysis function is shown as below.





[2] http://www.sqlite.org/

3 Utilization of Boiler Registration Data

3.1 Collaboration of Related Organizations

Related organization such as Engineering Facilities Department of the Ulaanbaatar City and Inspection Agency of the Capital City, the organizations have to prepare policies and implements audit, then needs boiler list. Also, Heating Stoves of the Capital City has examined new boiler registration system. Each organization registers respectively, data to be updated annually by the boiler registration database should be share by each organization.

3.2 Collaboration of National Comprehensive Registration on Air Pollutant Source

National comprehensive registration on air pollutant source is managed by NAQO and operated by AQDCC, which is not target source for HOB to be managed by BRMS, so it is agreement which HOB data of BRMS is provided to the national registration.

3.3 Collaboration of Inventory and Simulation System

Information such as boiler type, coal consumption, chimneys and exhaust gas treatment facilities must be reported to BMRS, update of inventory and simulation can be utilized. Also, data is annually managed, so previous registered data can be updated based on precision improvement of data.

Нийслэлийн Засаг даргын 2011 оны 8 сарын 2-ны өдрийн 585 тоот захирамжаар
УСХ-ны даргын 2011 оны 9 сарын 9-ний өдрийн 01131 тоот тушаалаар зөвшөөрөн батлав.

Маягт ЗББ-1

ЗУУХНЫ БАЙГУУЛАМЖИЙН БҮРТГЭЛ 2011 он

Байгууллагын нууцын тухай Монгол Улсын хуулийн 5 дугаар зүйлийн 2 дугаар заалт, "Статистикийн тухай" Монгол Улсын хуулийн 22 дугаар зүйлийн 3 дугаар заалтын дагуу тус тус нууцлан хадгална.

I.ХАЯГИЙН ХЭСЭГ

I-1.Зуухны байгууламжийн нэр .....

I-2.Зуухны байгууламжийн мэдээлэл (кодыг хавсралтаас харна уу.)

Байршил	Нэр	Код
Дүүрэг		
Хороо		
Гудамж, хороолол		
Байшин, байр		
Хашаа, хаалганы дугаар		

1. Зуухны байгууламж эзэмшигч нь маягтыг нөхөж, 9 дүгээр сарын 30-ны дотор харьяа дүүргийн Үйлдвэр, үйлчилгээний хэлтэст;

2. Үйлдвэр, үйлчилгээний хэлтэс маягтыг 10 дүгээр сарын 5-ны дотор Нийслэлийн Агаарын чанарын албанд маягтаар ирүүлнэ.

I-3.Эзэмшигчийн мэдээлэл

ААНБ-ын нэр	
Улсын бүртгэлийн	
Тусгай зөвшөөрлийн	
Үйл ажиллагааны	

I-4. Зуухны байгууламж хариуцагч

Овог, нэр	
Албан, тушаал	
Утас	
Гар утас	
Факс	
Цахим шуудан	

I.5.Зуух эзэмшигчийн хариуцлагын хэлбэр (кодыг дугуйлна уу.)

Нэр	Код
Хувьцаат компани	10
Хязгаарлагдмал хариуцлагатай компани	11
Бүх гишүүд нь бүрэн хариуцлагатай нөхөрлөл	20
Зарим гишүүд нь бүрэн хариуцлагатай нөхөрлөл	21
Хоршоо	30
Төрийн өмчит аж ахуйн тооцоотой үйлдвэрийн газар	40
Орон нутгийн өмчит аж ахуйн тооцоотой үйлдвэрийн газар	41
Бусад /иргэн/	80

I.6.Зуух эзэмшигчийн өмчийн хэлбэр

Нэр		Хувь	код
Төрийн	өмчийн		11
	өмчийн оролцоотой	.....%	12
	хамтарсан	.....%	13
Орон нутгийн	өмчийн		30
	өмчийн оролцоотой	.....%	31
	хамтарсан	.....%	32
Хувийн	Монгол улсын иргэний		21
	хамтарсан	.....%	22
	гадаад улсын		23

II.ЕРӨНХИЙ АСУУЛГА

- Яндангийн мэдээлэл, утаа цэвэрлэх төхөөрөмжийн мэдээлэл, түлш болон үнсний хяналт
- Зуухны байгууламж
- Халаалт, хэрэглээний халуун ус, уурын хэрэглэгчдийн мэдээлэл, зуухны галчийн мэдээлэл, зуух, яндан, утаа цэвэрлэх төхөөрөмжийн холбогдсон байдал

II. Яндангийн үндсэн үзүүлэлт

Д/д	Яндангийн дугаар	Өндөр (м)	Дотоод хөндлөн огтлол			Малгайтай эсэх	Сорьцын цэгтэй эсэх
			дугуй	тэгш өнцөгт			
			диаметр(мм)	урт(мм)	өргөн(мм)	1.Тийм, 2.Үгүй	
А	Б	1	2	3	4	5	6
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

III. Утаа цэвэрлэх төхөөрөмжийн мэдээлэл

Д/д	Утаа цэвэрлэх төхөөрөмжийн дугаар	Нэр болон марк	Анх суурилуулсан он, сар	АҮК(%)		
				SOx	NOx	тоосонцор
А	Б	1	2	3	4	5
1			____/____			
2			____/____			
3			____/____			
4			____/____			
5			____/____			
6			____/____			
7			____/____			
8			____/____			
9			____/____			
10			____/____			

IV. Хатуу түлш болон үнсний хяналт

1.Хатуу түлш хадгалах арга (нэгээс илүү код дугуйлж болно.)	1. Задгай овоолох 2. Агуулахад хадгалах 3. Бусад (тодорхойлж бичнэ үү.)	
2.Үнс хадгалах арга (нэгээс илүү код дугуйлж болно.)	1. Задгай овоолох 2. Агуулахад хадгалах 3. Бусад (тодорхойлж бичнэ үү.)	
3.Үнс зайлуулах арга (нэгээс илүү код дугуйлж болох ба зайлуулах хэмжээний хамт бичнэ үү.)	1. Шороогоор булах 2. Эрх бүхий байгууллагаар ачуулах 3. Дахин ашиглах (хэрэглээний аргыг бичнэ үү.) ..... 4. Бусад (тодорхойлж бичнэ үү.)	Зайлуулах нийт хэмжээ _____ тонн _____ тонн _____ тонн _____ тонн

V. Зуухны мэдээлэл

* тайлбар: Зуухны мэдээллийг зуух тус бүрээр нехне.

V.1. Зуухны үндсэн үзүүлэлт

Д/д	Үзүүлэлт	
1	Зуухны дугаар	
2	Марк	
3	Үйлдвэрлэсэн улс	
4	Анх суурилуулсан он	
5	Дулааны хүчин чадал /кВт/	
6	Халах гадаргуугийн талбай /М^2/	
7	Ажиллах хугацаа (ажилладаг сарыг дугуйлна уу.)	IX X XI XII I II III IV V VI VII VIII
8	Зуухны төрөл (тохирох зуухны төрлийг дугуйлна уу.)	1. Усан халаалтын зуух 2. Уурын зуух 3. Халаалтын бә уурын зуух
9	Агаар өгөх арга (тохирох агаар өгөх аргыг дугуйлна уу.)	1. Ердийн 2. Үлээх салхилууртай 3. Утаа сорогчтой 4. Үлээх салхилуур ба утаа сорогчтой

V.2. Зууханд ашигладаг түлшний төрөл, усан хангамж

1. **Ашигладаг түлшний төрөл, жилийн зарцуулалт** (тохирох түлшний төрлийг дугуйлж, зарцуулалтын хэмжээг бичнэ үү.)	1. Нүүрс 2. Хагас кокс 3. Үртсэн шахмал түлш 4. Мод 5. Хийн 6. Бусад (хэмжих нэгжийн хамт тодорхойлж бичнэ үү.)	тонн тонн тонн М^3 М^3 .....
2. **Нүүрсний нийлүүлэлт, уурхайгаар** (нэгээс илүү код дугуйлж болно.)	1. Алаг толгойн 2. Багануурын 3. Налайхын 4. Шарын голын 5. Шивээ овоо 6. Бусад	
3. **Зуухны усан хангамж** (нэгээс илүү код дугуйлж болно.)	1. Хотын усан хангамжид холбогдсон 2. Гүний худаг 3. Зөөврийн ус 4. Бусад (ус хангамжийн аргыг бичнэ үү.)	

V.3. Тухайн оны засвар, техникийн үйлчилгээний тэмдэглэл

Хийсэн он, сар	Засвар үйлчилгээний агуулга
____/___	
____/___	
____/___	
____/___	

VI. Халаалт, хэрэглээний халуун ус, уурын хэрэглэгчдийн мэдээлэл

Д/д	Хэрэглэгч /ААНБ, нийтийн эзэмшлийн сууц/	Хэрэглээний хэмжээ		
		Халаалтын эзэлхүүн /$М^3$/	Халуун ус (ундны болон хэрэглээний) /$М^3$/	Уур /тонн/
А	Б	1	2	3
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

VII. Зуухны галчийн мэдээлэл

Д/д	Механикчийн, Зуухны галчийн Овог Нэр (овгийн эхний үсгийг бичнэ)	Сургалтад хамрагдсан батламжийн дугаар	Д/д	Механикчийн, Зуухны галчийн Овог Нэр (овгийн эхний үсгийг бичнэ)	Сургалтад хамрагдсан батламжийн дугаар
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

VIII. Зуух, яндан, утаа цэвэрлэх төхөөрөмжийн бүдүүвч зураг

Харилцан зөвшилцөх санамж бичиг

Зуухны байгууламжийн хяналтын мэдүүлэг гаргахад доорхи зүйлийг зөвшөөрсний үндсэн дээр харилцан үүрэг хүлээнэ.

Агуулга

1. Зуухны ашиглалт явуулдаг байгууллага болон хувь хүн өөрийн хариуцсан обьектийн байгаль орчинд үзүүлэх нөлөөллийн үнэлгээний нэг үзүүлэлт болох утааны хийн найрлагыг НАЧА-аар шинжилгээ хийлгэж, албан ёсны дүгнэлтийг зуухны "Техникийн паспорт"–д хавсаргасан сонгосон байрлалд "сорьцийн цэг"-ийг хавсралт зургийн дагуу бэлдсэн байна. (Агаарын тухай хууль 7.1-р зүйл, 7.2-р зүйл)
2. Утааны хийн шинжилгээ хийх зориулалтын "сорьцийн цэг"-ийг НАЧА-ны зааврааар сонгосон байрлалд, зургийн дагуу хийсэн байх ба сорьц авах үед хүн зогсож ажиллах шат, тавцанг бэлдсэн байна.
3. Зуух үнс баригч, яндангийн хувийн дугаар болон бусад үзүүлэлтийг Мэдүүлгийн хуудас-ны холбогдох хэсэгт тодорхой бичиж тэмдэглэнэ.
4. Батлагдсан графикийн дагуу дүүрэг тус бүр дээр зохиогдох сургалтанд галч, засварчдыг бүрэн хэмжээгээр хамруулна.
5. Агаарын бохирдлын эсрэг авах арга хэмжээний талаар мэргэжлийн байгууллагаас зөвлөмж авах, харилцан зөвлөлдөх мөн тэднээс дэмжлэг хүсэх.Агаарын тухай хууль 7.6-р зүйл

Утааны хийн "сорьцийн цэг"-тэй болох утааны хийн найрлагыг шинжлэхтэй холбогдож гарах зардлыг зарчмын хувьд зуухны үйл ажиллагаа эрхлэгч нь бүрэн хариуцна.

ТАМГА

Дарга/захирал, эзэмшигч ...../ /

Бүртгэл хийсэн : _____ / _____ / _____ (Он/сар/өдөр)

8 Guideline on Preparing and Revision of Emission Inventory

Mongolia
The Air Quality Department of Capital City
(AQDCC)

Capacity Development Project
for
Air Pollution Control in Ulaanbaatar City
Mongolia

Guideline on Preparing and Revision of Emission Inventory

March 2013

Japan International Cooperation Agency

SUURI-KEIKAKU CO., LTD

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1 Emission Inventory

Emission Inventory is the record that shows the amount of air pollutant discharged within a specific period of time and location of the emission source. It is an indispensable tool widely used when making policy in anti-pollution measures.

The objective of emission inventory use is as follows[1]

(1) Knowing the actual emission volume

The quantitative emission estimates provided by an inventory promote a better understanding of the actual emissions and help to raise awareness of both policy makers and the general public. Through this process, the major emission sources can be identified, and the priorities for emission reduction and any data gaps requiring additional work are revealed.

(2) Input to simulation model and its application

Emission data allocated spatially and temporally can be used as input data for atmospheric transport and deposition models. The simulation model is developed by comparing and verifying the calculated results and ground monitoring data. By comparing the model's calculated result for future years and current environment standard, it is possible to evaluate effective air pollution policy required to achieve environment standard, and also the effect to human, animal, agricultural product, and natural ecosystem.

(3) Forecasting and anti-pollution measure policy

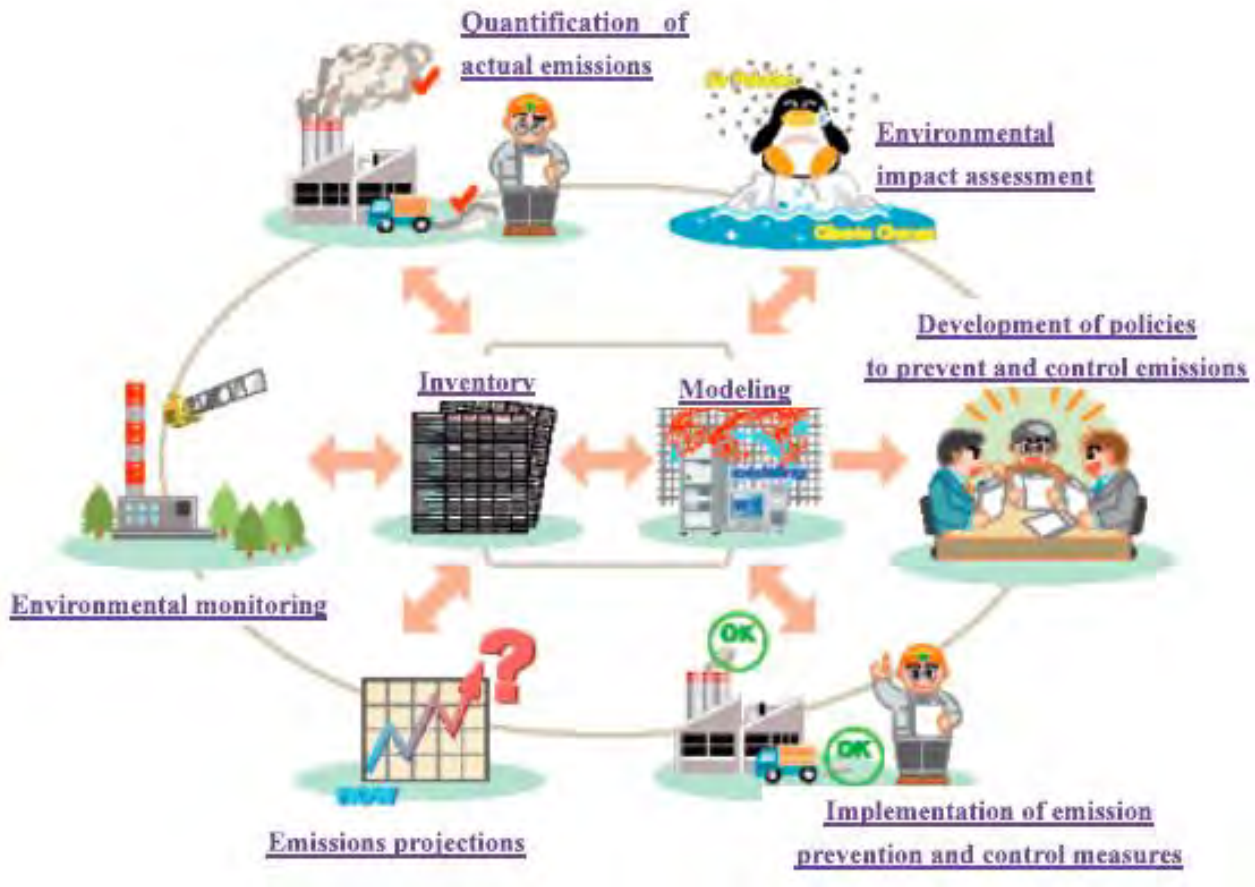
The inventory data is estimated from the active data and emission factor of socio-economic statistics. The future emission is estimated based on forecast of socio-economic indices (for example population growth, economic growth, changes in energy use per activity data) lower emission factors fuel switching and so forth. The estimated future emissions provide important information for setting air pollution prevention plan.

(4) Consideration of possible reduction measures

An emission inventory enables easy comparison of emission before and after introduction of control measures as a result of introduction of various prevention technologies. Furthermore by evaluating and comparing the cost of various prevention technologies and the result of emission reduction, prevention technology with higher cost effectiveness can be selected.

Emission inventory is used by clarification of emission situation and future forecast. With air simulation model, it is used by environmental assessment, measurement of emission sources and review of policy and measurement (Figure 1-1).

[1] What is an Emission Inventory?, Asia Center for Air Pollution Research, http://www.acap.asia/publication/pdf/emissioneng.pdf



Source: http://www.acap.asia/publication/pdf/emissioneng.pdf

Figure 1-1 Roles of the emission inventory for air quality management

2 Preparation and Updating Method of Emission Inventory

2.1 Stationary Sources

2.1.1 Estimation Method of Emission

Activities data by emission source, emission factors and emission sources and assignment index for stationary source is Table 2-1.

Target stationary emission sources are power plant, HOB, factories, CFWH, Ger stove and wall stove.

Emission amount of stationary source is basically estimated by following equation.

Air pollutants emission amount = Activity data × Emission Factor

Activity data for combustion facilities in Ulaanbaatar is used coal consumption or wood consumption. Activities data was calculated by reported value of power plants, boiler registration data, population and household data and related statistics data.

Emission factors were basically used measurement data of exhaust monitoring data by this project, other index was used supplementary.

Type of emission source, power plants and HOB is treated as point source, CFWH, Ger stove and wall stove is treated as area source by khoroo, emission inventory was prepared.

Table 2-1 Emission Amount Estimation Method by Source Type, Activity Data, Emission Factor, and Emission Source Type and Assignment Index

	Emission Amount Estimation Method	Activity Data	Emission Factor	Emission Source Type and Assignment Index
Power Plant	Emission Amount=Coal Consumption ×Emission Factors by Air Pollutants	Monthly coal consumption to acquire from each power plant by interview	Emission factors to be set by measurement results exhaust gas monitoring of this project. Conversion TSP into PM_{10} used PM_{10}/TSP=0.65 from 2nd Detailed Planning Survey	Emission Source Type : Point Source
HOB	Emission Amount=Coal Consumption ×Emission Factors by Air Pollutants	Coal consumption data from information by boiler field survey and boiler registration system	Emission factors to be set by measurement results exhaust gas monitoring of this project. Conversion TSP into PM_{10} used PM_{10}/TSP=0.65 from 2nd Detailed Planning Survey	Emission Source Type : Point Source

CFWH	Emission Amount=Coal Consumption ×Emission Factors by Air Pollutants	Coal consumption of HOB Market Study by World Bank	Emission factors to be set by measurement results exhaust gas monitoring of this project. Results of 2nd Detailed Planning Survey was Used	Emission Source Type : Area Source Assignment by resident area for non-apartment area by mesh
Ger	Emission Amount=Coal Consumption ×Coal Emission Factors of Ger + Wood Consumption ×Wood Emission Factors of Ger	Multiply number of Ger stove and wall stove by district and by Khoroo, and annual coal and wood consumption	Emission factors to be decided by exhaust measurement data and statistics data such as Forum Manual were used	Emission Source Type : Area Source Assignment by Ger area by mesh Coal and wood consumption par a stove is estimated by sampling survey and World Bank Ger Area Heating.

2.1.2 Updating Method of Emission Inventory

2.1.2.1 Power Plant

Emission amount by chimney was estimated. Case of centralized smoke stack, emission amount of each boiler is estimated, and the total is emission from centralized smoke stack. Necessary items of power plant inventory are shown in Table 2-2.

Fuel consumption is acquired monthly consumption from power plants by inquiry. Case of update, raw of [FuelConsumption_TPY] is updated.

Emission factors are used exhaust gas monitoring data, and if new emission factor is acquired, row of [EF_SO2_kgpt] is updated.

Emission Amount is automatically calculated by fuel consumption and emission factor.

Location coordination of chimney, height of chimney for power plants, inner diameter, exhaust gas temperature and monthly operation pattern is used for simulation model.

Table 2-2 Necessary Items for Power Plants Emission Inventory

Name	StackDiameter mm	StackHeight m	GasTemp_degree	GasSpeed mps	Latitude_degree	Longitude degree	Longitude_m	Latitude_m	FuelConsumption TPY
PowerPlant 2	4200	100	146	18.644	47.904845	106.80716	635105.448	5309428.65	189,997
PowerPlant 3-1	4600	100	84	19.75	47.896736	106.86612	639535.012	5308631.95	345,906
PowerPlant 3-2	6000	150	98	11.376	47.895564	106.86503	639456.811	5308499.68	690,047
PowerPlant 4	8000	250	154	23.3	47.894719	106.80387	634885.725	5308297.05	2,885,514

Name	EF_SO2_kgpt	EF_NOx_kgpt	EF_TSP_kgpt	EF_PM10 kgpt	EF_CO_kgpt	SO2_TPY	NOx_TPY	TSP_TPY	PM10_TPY	CO_TPY	Ptn_
PowerPlant 2	3.30	0.97	23.00	14.95	41.00	626.9901	184.2971	4369.931	2840.455	7789.877	1.3
PowerPlant 3-1	6.10	1.99	8.60	5.59	124.37	2110.024	688.3523	2974.789	1933.613	43020.55	1.7
PowerPlant 3-2	6.10	1.99	3.00	1.95	0.00	4209.286	1373.193	2070.141	1345.592	0	1.6
PowerPlant 4	2.20	3.90	2.90	1.89	0.00	6238.131	11058.5	8222.991	5344.944	0	1.2

Name	Ptn_Jan	Ptn_Feb	Ptn_Mar	Ptn_Apr	Ptn_May	Ptn_Jun	Ptn_Jul	Ptn_Aug	Ptn_Sep	Ptn_Oct	Ptn_Nov	Ptn_Dec
PowerPlant 2	1.304357	1.189282	1.248083	1.12606	0.945552	0.738075	0.094423	0.812855	0.936267	1.15246	1.138313	1.314273
PowerPlant 3-1	1.764412	1.496212	1.533283	1.192722	0.681039	0.258538	0	0.004826	0.772664	1.346039	1.269828	1.680437
PowerPlant 3-2	1.649418	1.271409	1.172063	0.993973	0.674061	0.404345	0.700435	0.692796	0.635536	0.916325	1.285232	1.604408
PowerPlant 4	1.287513	1.125151	1.106965	0.955095	0.913511	0.877204	0.857072	0.824511	0.883463	1.023637	1.07294	1.07294

Calculation sample for operation pattern for power plants is shown in Table 2-3. Monthly operation pattern is calculated to use monthly coal consumption of power plants as follows.

January Operation Pattern = January Fuel Consumption / Annual Fuel Consumption×12

Table 2-3 Calculation sample for operation pattern for power plants

	4	5	6	7	8	9	10	11	12	1	2	3	Total
No1		22776	4633	45970	46084	12410	34211	40604	40604	41244	39377	35041	
No2	43176	26995	44672			11639	33113	42939	42939	24075	10934	36153	
No3						149	30396	27351	27351	24178	31903	25948	
No4	46859	44240	48975	26237	17760	27697	5983	18850	18850	44913	37958		
No5	15915	17977		23622	28460	46830	46302	26651	26651	37925	43992	48020	
No6	46328	46169	56263		10464	55670	46250	57627	57627	51788	51154	42934	
No7	26084		47508	53377	39777					28151	50547	39825	
No8	47320	57699	5226	53314	52281	54361	45623	39506	39506	51956		33647	
Total	225682	215856	207277	202520	194826	208756	241878	253528	253528	304230	265865	261568	2835514
Pattern	0.95509	0.91351	0.8772	0.85707	0.82451	0.88346	1.02364	1.07294	1.07294	1.28751	1.12515	1.10697	

2.1.2.2 HOB

Emission amount by chimney was estimated. Case of centralized smoke stack, emission amount of each boiler is estimated, and the total is emission from centralized smoke stack. Necessary items of HOB inventory is shown in Table 2-4.

Fuel consumption is acquired monthly consumption from HOB by inquiry. Case of update, raw of [HOBEmission] sheet is updated information such as fuel consumption and boiler types based on boiler registration management system.

Emission factors are used exhaust gas monitoring data, and if new emission factor is acquired, row of [EF_SO2_kgpt] is updated.

Emission Amount is automatically calculated by fuel consumption and emission factor.

Location coordination of chimney, height of chimney for HOB, inner diameter, exhaust gas temperature and monthly operation pattern is used for simulation model.

Table 2-4 Necessary Items of HOB Emission Inventory

	A	J	K	P	Q	R	V	W	Y	Z	AA	AE
1	Num	Boiler_Type	Number_of_Emission_Factor	StackDiameter_mm	StackHeight_m	GasTemp_degree	Latitude_degree	Longitude_degree	Longitude_m	Latitude_m	FuelConsumption_tpy	Oper n_Pa n
2	1	BNEB	14	220	3.4	182.71	47.86656389	106.8295528	636880.429	5305211.9	96	
3	2	Carborobot 150	14	250	18.92	182.71	47.868075	106.8117111	635541.685	5305348.44	180	
4	3	HP -18- 54	1	250	18.92	149.82	47.868075	106.8117111	635541.685	5305348.44		
5	4	HP -18-54	1	300	35.43	149.82	47.86739444	106.8338056	637196.403	5305311.78	576	
6	5	HP -18-54	1	300	35.43	149.82	47.86743056	106.8338528	637199.841	5305315.88	576	
7	6	Carborobot -300	14	250	11.03	182.71	47.86756111	106.8337556	637192.223	5305330.23	256	
8	7	Carborobot -300	14	250	11.03	182.71	47.86756667	106.83375	637191.793	5305330.83	256	
9	8	Carborobot -300	14	250	11.03	182.71	47.86759722	106.8337306	637190.257	5305334.2	256	
10	9	Hyatad-1200	14	150	12.85	182.71	47.86753333	106.8293889	636865.615	5305319.39	35.5	
11	10	Hyatad-900	14	150	12.85	182.71	47.86753333	106.8293889	636865.615	5305319.39	315	
12	11	KWZ-0.7	14	338.5	17.95	182.71	47.87070278	106.8183778	636033.55	5305652.32	216	

HOBEmission_original | HOBEmission | EF_ByBoiler — Ready — 115%

	A	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY
1	Num	Loading_Days	Ptn_Jan	Ptn_Feb	Ptn_Mar	Ptn_Apr	Ptn_May	Ptn_Jun	Ptn_Jul	Ptn_Aug	Ptn_Sep	Ptn_Oct	Ptn_Nov	Ptn_Dec	EF_SO2_kgpt	EF_NOx_kgpt	EF_TSP_kgpt	EF_PM10_kgpt	EF_CO_kgpt	SOx_tpy	NOx_tpy	TSP_tpy	PM10_tpy	CO_tpy
2	1	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	0.67	0.16	3.16	2.05	7.00
3	2	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	1.25	0.30	5.92	3.85	13.12
4	3														15.77	2.75	11.21	7.29	25.65	0.00	0.00	0.00	0.00	0.00
5	4	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	15.77	2.75	11.21	7.29	25.65	9.09	1.58	6.46	4.20	14.77
6	5	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	15.77	2.75	11.21	7.29	25.65	9.09	1.58	6.46	4.20	14.77
7	6	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	1.78	0.43	8.42	5.47	18.66
8	7	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	1.78	0.43	8.42	5.47	18.66
9	8	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	1.78	0.43	8.42	5.47	18.66
10	9	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	0.25	0.06	1.17	0.76	2.59
11	10	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	2.19	0.53	10.36	6.73	22.96
12	11	210	1.00	1.00	1.00	0.75	0.25	0.00	0.00	0.00	0.25	0.75	1.00	1.00	6.96	1.69	32.88	21.37	72.89	1.50	0.37	7.10	4.62	15.74

HOBEmission_original | HOBEmission | EF_ByBoiler — Ready — 115%

Emission factors of representative boiler is described in 「EF_ByBoiler」 sheet (see Table 2-5). Boilers not to be described are applied average emission factors. If exhaust gas monitoring for boilers not to be described is implemented, emission factors to be calculated by exhaust gas monitoring insert line of 「Access」,value of 「Average」 recalculate. After insertion, about the boilers, row value of「Number_of_Emission_Factor」 of Table 2-5 is updated.

Table 2-5 Emission Factors of Representative Boilers

No.	Type of Boiler	Capacity	Condition		Emission Factor				
			Stack gas temperature (degree)	Stack gas speed (m/s)	Dust (kg/t)	PM10 (kg/t)	SO2 (kg/t)	NOx (kg/t)	CO (kg/t)
1	HP-18-54	0.73	150	5.29	11.21	7.29	15.77	2.75	25.65
2	RJG-18	0.25	250	7.32	228.84	148.75	3.86	1.17	24.24
3	MDZ-0.25	0.25	241	4.55	3.68	2.39	13.06	1.16	2.86
4	MUHT	0.25	230	14.85	2.36	1.54	1.01	0.24	2.56
5	KCR-300	0.70	218	11.02	1.49	0.97	1.84	0.44	138.44
6	DZL 1,4-0,7/95/70A	0.70	110	6.15	0.48	0.31	2.41	0.65	3.63
7	WWGS 035	0.70	124	4.82	0.59	0.39	0.85	0.71	238.61
8	LSG-0.2	1.40	323	5.18	7.60	4.94	28.57	4.91	65.10
9	Thrmocholor-0.3	0.35	69	5.68	53.37	34.69	1.26	1.76	389.71
10	MWB-1	1.00	161	6.50	35.88	23.32	6.82	0.83	9.47
11	DLIIRSH 170-80/55-AII*AII	0.17	220	4.72	4.47	2.90	1.75	2.13	6.46
12	MDZ-800	0.80	90	6.24	13.23	8.60	6.82	4.25	34.86
13	BZUI-100	0.85	190	13.98	64.23	41.75	6.46	1.02	5.95
14	Average		183	7.41	32.88	21.37	6.96	1.69	72.89

2.1.2.3 CFWH

Necessary items of CFWH emission inventory is shown inTable 2-6.

「CFWHEmission」 sheet is calculated each CFWH emission amount. [Ratio] is modified fuel consumption, if [Ratio] uses new fuel consumption, and [Ratio] is set to 1. Also, if fuel consumption increases by population growth rate, the value inputs the [Ratio].

If new emission factors are acquired, row of [EF_SO2] is updated.

Emission amount is automatically calculated by multiplying fuel consumption and emission factors.

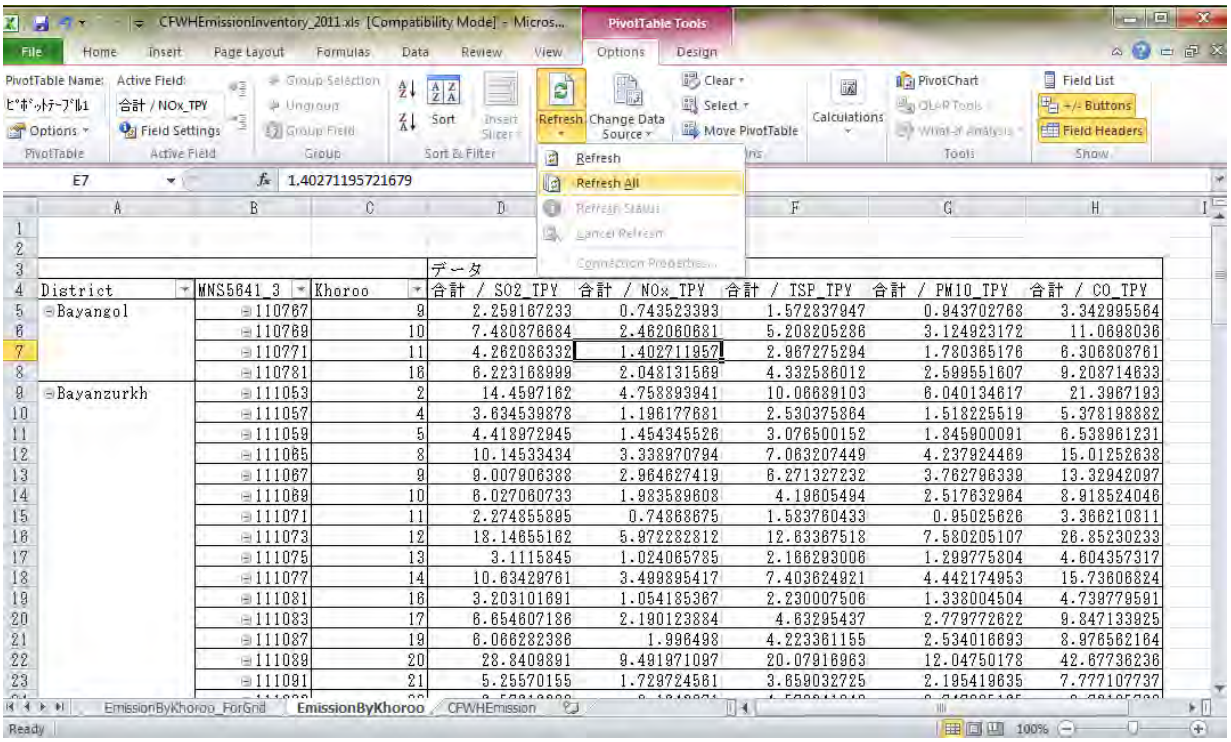
Table 2-6 Necessary Items for CFWH Emission Inventory

MNS5641_2	District	sequence	Khoroo	FuelConsumption	Ratio	Corr_FuelConsumption	EF_TSP	EF_PM10	EF_SO2	EF_NOx	EF_CO	TSP_TPY	PM10_TPY	SO2_TPY	NOx_TPY	CO_TPY
110767	Bayangol	16	9	8	1.65	13.24	11.0	6.6	15.8	5.2	28.38	0.146	0.087	0.209	0.069	0.310
110767	Bayangol	17	9	7.2	1.65	11.92	11.0	6.6	15.8	5.2	28.38	0.131	0.079	0.188	0.062	0.279
110767	Bayangol	18	9	2.4	1.65	3.97	11.0	6.6	15.8	5.2	28.38	0.044	0.026	0.063	0.021	0.093
110767	Bayangol	19	9	6	1.65	9.93	11.0	6.6	15.8	5.2	28.38	0.109	0.066	0.157	0.052	0.232
110767	Bayangol	20	9	16	1.65	26.48	11.0	6.6	15.8	5.2	28.38	0.291	0.175	0.418	0.138	0.619
110767	Bayangol	21	9	5	1.65	8.27	11.0	6.6	15.8	5.2	28.38	0.091	0.055	0.131	0.043	0.193
110767	Bayangol	22	9	5	1.65	8.27	11.0	6.6	15.8	5.2	28.38	0.091	0.055	0.131	0.043	0.193
110767	Bayangol	23	9	6	1.65	9.93	11.0	6.6	15.8	5.2	28.38	0.109	0.066	0.157	0.052	0.232
110767	Bayangol	24	9	4.8	1.65	7.94	11.0	6.6	15.8	5.2	28.38	0.087	0.052	0.126	0.041	0.186
110767	Bayangol	25	9	8	1.65	13.24	11.0	6.6	15.8	5.2	28.38	0.146	0.087	0.209	0.069	0.310
110767	Bayangol	26	9	12	1.65	19.86	11.0	6.6	15.8	5.2	28.38	0.218	0.131	0.314	0.103	0.464
110767	Bayangol	27	9	6	1.65	9.93	11.0	6.6	15.8	5.2	28.38	0.109	0.066	0.157	0.052	0.232
110769	Bayangol	28	10	14	1.65	23.17	11.0	6.6	15.8	5.2	28.38	0.255	0.153	0.366	0.120	0.542
110769	Bayangol	29	10	4.8	1.65	7.94	11.0	6.6	15.8	5.2	28.38	0.087	0.052	0.126	0.041	0.186
110769	Bayangol	30	10	8	1.65	13.24	11.0	6.6	15.8	5.2	28.38	0.146	0.087	0.209	0.069	0.310
110769	Bayangol	31	10	10	1.65	16.55	11.0	6.6	15.8	5.2	28.38	0.182	0.109	0.261	0.086	0.387
110769	Bayangol	32	10	12	1.65	19.86	11.0	6.6	15.8	5.2	28.38	0.218	0.131	0.314	0.103	0.464
110769	Bayangol	33	10	2.5	1.65	4.14	11.0	6.6	15.8	5.2	28.38	0.046	0.027	0.065	0.022	0.097
110769	Bayangol	34	10	4	1.65	6.62	11.0	6.6	15.8	5.2	28.38	0.073	0.044	0.105	0.034	0.155
110769	Bayangol	35	10	12	1.65	19.86	11.0	6.6	15.8	5.2	28.38	0.218	0.131	0.314	0.103	0.464
110769	Bayangol	36	10	14	1.65	23.17	11.0	6.6	15.8	5.2	28.38	0.255	0.153	0.366	0.120	0.542
110769	Bayangol	37	10	4	1.65	6.62	11.0	6.6	15.8	5.2	28.38	0.073	0.044	0.105	0.034	0.155
110769	Bayangol	38	10	8	1.65	13.24	11.0	6.6	15.8	5.2	28.38	0.146	0.087	0.209	0.069	0.310
110769	Bayangol	39	10	4	1.65	6.62	11.0	6.6	15.8	5.2	28.38	0.073	0.044	0.105	0.034	0.155
110769	Bayangol	40	10	30	1.65	49.65	11.0	6.6	15.8	5.2	28.38	0.546	0.328	0.784	0.258	1.161
110769	Bayangol	41	10	5	1.65	8.27	11.0	6.6	15.8	5.2	28.38	0.091	0.055	0.131	0.043	0.193
110769	Bayangol	42	10	4	1.65	6.62	11.0	6.6	15.8	5.2	28.38	0.073	0.044	0.105	0.034	0.155

[EmissionByKhoroo] sheet is total of emission amount by Khoroo to be calculated by [CFWHEmission] sheet.

If [CFWHEmission] sheet is updated, cell of [EmissionByKhoroo] sheet is selected, click [Option]-[Refresh]-[Refresh All], emission amount by Khoroo (Table 2-7).

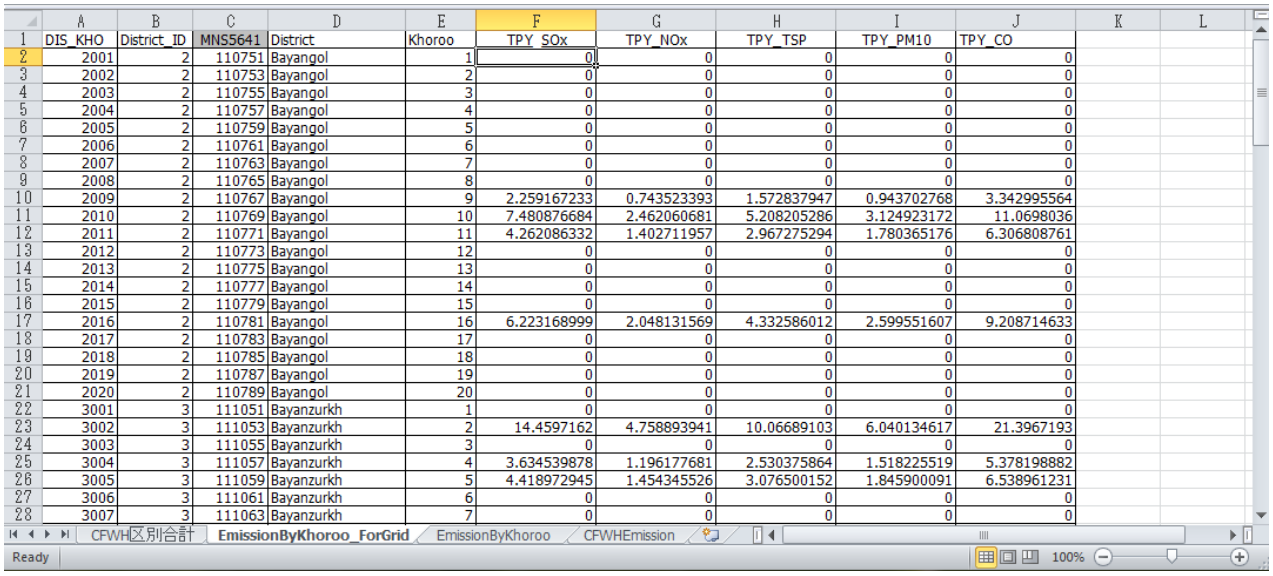
Table 2-7 Update of CFWH Emission Amount by Khoroo



			データ					
District	MNS5841_3	Khoroo	合計 / SO2_TPY	合計 / NOx_TPY	合計 / TSP_TPY	合計 / PM10_TPY	合計 / CO_TPY	
Bayangol	110767	9	2.259167233	0.743523393	1.572837947	0.943702768	3.342995564	
	110769	10	7.480876684	2.462060681	5.208205286	3.124923172	11.0698036	
	110771	11	4.262086332	1.402711957	2.967275294	1.780365176	6.306808761	
	110781	16	6.223168999	2.048131569	4.332586012	2.599551607	9.208714633	
Bayanzurkh	111053	2	14.4597162	4.758893941	10.06689103	6.040134617	21.3967193	
	111057	4	3.634539878	1.196177681	2.530375864	1.518225519	5.378198882	
	111059	5	4.418972945	1.454345526	3.076500152	1.845900091	6.538961231	
	111065	8	10.14533434	3.338970794	7.063207449	4.237924469	15.01252638	
	111067	9	9.007906388	2.964627419	6.271327232	3.762796339	13.32942097	
	111069	10	8.027080733	1.983589608	4.19605494	2.517632984	8.918524046	
	111071	11	2.274855895	0.74868675	1.583760433	0.95025626	3.366210811	
	111073	12	18.14655162	5.972282812	12.63387518	7.580205107	26.85230233	
	111075	13	3.1115845	1.024065785	2.166293006	1.299775804	4.604357317	
	111077	14	10.63429761	3.499895417	7.403624921	4.442174953	15.73606824	
	111081	16	3.203101691	1.054185367	2.230007506	1.338004504	4.739779591	
	111083	17	6.654607186	2.190123884	4.63295437	2.779772622	9.847133925	
	111087	19	6.066282386	1.996498	4.223361155	2.534016693	8.976582164	
	111089	20	28.8409891	9.491971097	20.07916963	12.04750178	42.67736236	
	111091	21	5.25570155	1.729724581	3.659032725	2.195419635	7.777107737	

[EmissionByKhoroo] sheet to be updated copies target Khoroo of [EmissionByKhoroo_ForGrid] sheet (see Table 2-8).

Table 2-8 Update of CFWH Emission Inventory



DIS_KHO	District_ID	MNS5641	District	Khoroo	TPY_SOx	TPY_NOx	TPY_TSP	TPY_PM10	TPY_CO
2001	2	110751	Bayangol	1	0	0	0	0	0
2002	2	110753	Bayangol	2	0	0	0	0	0
2003	2	110755	Bayangol	3	0	0	0	0	0
2004	2	110757	Bayangol	4	0	0	0	0	0
2005	2	110759	Bayangol	5	0	0	0	0	0
2006	2	110761	Bayangol	6	0	0	0	0	0
2007	2	110763	Bayangol	7	0	0	0	0	0
2008	2	110765	Bayangol	8	0	0	0	0	0
2009	2	110767	Bayangol	9	2.259167233	0.743523393	1.572837947	0.943702768	3.342995564
2010	2	110769	Bayangol	10	7.480876684	2.462060681	5.208205286	3.124923172	11.0698036
2011	2	110771	Bayangol	11	4.262086332	1.402711957	2.967275294	1.780365176	6.306808761
2012	2	110773	Bayangol	12	0	0	0	0	0
2013	2	110775	Bayangol	13	0	0	0	0	0
2014	2	110777	Bayangol	14	0	0	0	0	0
2015	2	110779	Bayangol	15	0	0	0	0	0
2016	2	110781	Bayangol	16	6.223168999	2.048131569	4.332586012	2.599551607	9.208714633
2017	2	110783	Bayangol	17	0	0	0	0	0
2018	2	110785	Bayangol	18	0	0	0	0	0
2019	2	110787	Bayangol	19	0	0	0	0	0
2020	2	110789	Bayangol	20	0	0	0	0	0
3001	3	111051	Bayanzurkh	1	0	0	0	0	0
3002	3	111053	Bayanzurkh	2	14.4597162	4.758893941	10.06689103	6.040134617	21.3967193
3003	3	111055	Bayanzurkh	3	0	0	0	0	0
3004	3	111057	Bayanzurkh	4	3.634539878	1.196177681	2.530375864	1.518225519	5.378198882
3005	3	111059	Bayanzurkh	5	4.418972945	1.454345526	3.076500152	1.845900091	6.538961231
3006	3	111061	Bayanzurkh	6	0	0	0	0	0
3007	3	111063	Bayanzurkh	7	0	0	0	0	0

Operation pattern by season and by time zone for CFWH is calculated by number of throwing by season and by time zone from World Bank ”Mongolia Heating in Poor, Peri-urban Ger Areas of Ulaanbaatar”(2009) (Table4.3) (see Table 2-9)

Table 2-9 Operation Pattern Calculation Table for CFWH

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1		Ger & Wall Stove & CFWH																
2													5.21002931					
3		count for throwing coal to ger stove (by WB Report)																
4	時間	Sep, Oct, Mar, Apr					時間	Nov, Dec, Jan, Feb						WINTER	SPRING	SUMMER	AUTUMN	
5	1			0.090	0.090					0.180	0.180	0.675		0.675	0.225	0.000	0.450	
6	2			0.090	0.090					0.180	0.180	0.675		0.675	0.225	0.000	0.450	
7	3			0.090	0.090					0.180	0.180	0.675		0.675	0.225	0.000	0.450	
8	4			0.090	0.090					0.180	0.180	0.675		0.675	0.225	0.000	0.450	
9	5			0.090	0.090					0.180	0.180	0.675		0.675	0.225	0.000	0.450	
10	6	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
11	7	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
12	8	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
13	9	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
14	10	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
15	11	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
16	12	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
17	13	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
18	14	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
19	15	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
20	16	0.088			0.088			0.158			0.158	0.593		0.593	0.220	0.000	0.418	
21	17		0.118		0.118				0.267		0.267	1.000		1.000	0.296	0.000	0.629	
22	18		0.118		0.118				0.267		0.267	1.000		1.000	0.296	0.000	0.629	
23	19		0.118		0.118				0.267		0.267	1.000		1.000	0.296	0.000	0.629	
24	20		0.118		0.118				0.267		0.267	1.000		1.000	0.296	0.000	0.629	
25	21		0.118		0.118				0.267		0.267	1.000		1.000	0.296	0.000	0.629	
26	22		0.118		0.118				0.267		0.267	1.000		1.000	0.296	0.000	0.629	
27	23			0.090	0.090					0.180	0.180	0.675		0.675	0.225	0.000	0.450	
28	24			0.090	0.090					0.180	0.180	0.675		0.675	0.225	0.000	0.450	
29																		

Sheet1 Sheet2 Sheet3

Ready 85%

2.1.2.4 Ger Stove

Estimation method for number of Ger stove to be used, percentage of household to have multiple Ger is “minimum case” and “expert judgment case” 2%, and “maximum 25% by survey results of World Bank 2010 for Ger stove and wall stove. Update 2010 and 2011, number of Ger in some Khoroo is counted by satellite pictures, based on relation between number of household and Ger, percentage of household to have multiple Ger is set to 20%.

Necessary items of emission inventory for Ger stove and wall stove is shown inTable 2-10.

Resident population and number of household in Ger and building by Khoroo are updated. Then, number of Ger stove is estimated by considering household to have multiple stoves.

Annual fuel consumption and emission factors are updated by results of exhaust gas monitoring.

Emission amount is automatically calculated by annual fuel consumption and emission factors par a stove.

Table 2-10 Necessary Items of Emission Inventory for Ger Stove

District Name	MNS5641	Khoroo ID	Ger				Ger Stove	Fuel Consumption per one ger stove (ton/year)	Fuel Consumption_TPY	TSP
			family	corr_family	Population	Corr_Population	Unit			
Bayangol	110751	1	51	53.1165	183	190.5945	54.2	3.49	189.3	5
	110753	2		0		0	0.0	3.49	0.0	5
	110755	3	23	23.9545	75	78.1125	24.5	3.49	85.4	5
	110757	4		0		0	0.0	3.49	0.0	5
	110759	5		0		0	0.0	3.49	0.0	5
	110761	6	22	22.913	80	83.32	23.4	3.49	81.6	5
	110763	7	43	44.7845	190	197.885	45.7	3.49	159.6	5
	110765	8		0		0	0.0	3.49	0.0	5
	110767	9	1288	1341.452	5277	5495.9955	1369.6	3.49	4780.0	5
	110769	10	1853	1929.8995	6460	6728.09	1970.4	3.49	6876.8	5

TotalEmissionByKhoroo | Emission_Ger_Coal | Emission_Ger_Wood | Emission_Wall_Coal | Emission_Wall_Wood

Ready 100%

District Name	MNS5641	Khoroo ID	Coal									
			Emission Factor (kg/ton)					Emission (ton_year)				
			TSP	PM10	SOx	NOx	CO	TSP	PM10	SOx	NOx	CO
Bayangol	110751	1	5.4	3.3	7.5	2.4	173.34	1.0	0.6	1.4	0.5	32.8
	110753	2	5.4	3.3	7.5	2.4	173.34	0.0	0.0	0.0	0.0	0.0
	110755	3	5.4	3.3	7.5	2.4	173.34	0.5	0.3	0.6	0.2	14.8
	110757	4	5.4	3.3	7.5	2.4	173.34	0.0	0.0	0.0	0.0	0.0
	110759	5	5.4	3.3	7.5	2.4	173.34	0.0	0.0	0.0	0.0	0.0
	110761	6	5.4	3.3	7.5	2.4	173.34	0.4	0.3	0.6	0.2	14.2
	110763	7	5.4	3.3	7.5	2.4	173.34	0.9	0.5	1.2	0.4	27.7
	110765	8	5.4	3.3	7.5	2.4	173.34	0.0	0.0	0.0	0.0	0.0
	110767	9	5.4	3.3	7.5	2.4	173.34	25.8	15.8	35.8	11.5	828.6
	110769	10	5.4	3.3	7.5	2.4	173.34	37.1	22.7	51.6	16.5	1192.0

TotalEmissionByKhoroo | Emission_Ger_Coal | Emission_Ger_Wood | Emission_Wall_Coal | Emission_Wall_Wood

Ready 100%

Emission amount is prepared sheet by stove type and fuel type, it is updated for the total to be calculate 「TotalEmissionByKhoroo」 sheet (see Table 2-11).

For example, to update conversion traditional ger stove into Turkey stove, new sheet is prepared and emission inventory of Turkey stove is prepared.

Table 2-11 Calculation of Emission Inventory by Khoroo

F2 =Emission_Ger_Coal!P4+Emission_Ger_Wood!P4+Emission_Wall_Coal!P4+

DIS_KHO	District_ID	MNS5641	DISTRICT_NAME	KHOROO_ID	TSP_TPY	PM10_TPY	SO2_TPY	NOx_TPY	CO_TPY
2001	2	110751	Bayangol	1	1.7	1.3	1.4	0.7	45.1
2002	2	110753	Bayangol	2	0.0	0.0	0.0	0.0	0.0
2003	2	110755	Bayangol	3	0.8	0.6	0.7	0.3	22.4
2004	2	110757	Bayangol	4	0.0	0.0	0.0	0.0	0.0
2005	2	110759	Bayangol	5	0.0	0.0	0.0	0.0	0.0
2006	2	110761	Bayangol	6	0.7	0.6	0.6	0.3	19.4
2007	2	110763	Bayangol	7	2.9	2.2	2.8	1.2	90.4
2008	2	110765	Bayangol	8	0.0	0.0	0.0	0.0	0.0
2009	2	110767	Bayangol	9	82.4	63.7	80.5	34.8	2,596.8
2010	2	110769	Bayangol	10	117.0	90.5	114.0	49.3	3,677.7
2011	2	110771	Bayangol	11	89.6	69.3	88.0	37.9	2,842.0
2012	2	110773	Bayangol	12	0.0	0.0	0.0	0.0	0.0
2013	2	110775	Bayangol	13	0.0	0.0	0.0	0.0	0.0
2014	2	110777	Bayangol	14	0.0	0.0	0.0	0.0	0.0
2015	2	110779	Bayangol	15	0.1	0.1	0.1	0.0	1.8
2016	2	110781	Bayangol	16	49.3	38.3	50.9	21.4	1,651.4

TotalEmissionByKhoroo | Emission_Ger_Coal | Emission_Ger_Wood | Emission_Wall_Coal | Er

Ready 100%

Calculation process of operation pattern by season and by time zone for Ger stove is shown in Table 2-12. Operation pattern of Ger stove is estimated difference SO_2 concentration between Ger area and apartment area (Table 2-12's row L through row O).

Table 2-12 Operation Pattern of Ger Stove

V3 =L3/SUM($L$27:$O$27)*24*4

Ger	Use SO2 concentration pattern at UB5 monitoring station					Use SO2 concentration at UB2 as not-ger area concentration					UB5-UB2 concentration (Minimum is 0)								
Time	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb		Mar-May	Jun-Aug	Sep-Oct	Nov-Feb		Mar-May	Jun-Aug	Sep-Oct	Nov-Feb		Mar-May	Jun-Aug	Sep-Oct	Nov-Feb
1	40.054348	8.6333333	27.6875	112.65		26.493827	4.3098592	18.428571	55.842105		13.560521	4.3234742	9.2589286	56.807895		0.67	0.21	0.46	2.82
2	35.358696	8.0111111	22.387097	111.55556		27.1875	3.4861111	15.95122	56.678261		8.1711957	4.525	6.4358773	54.877295		0.41	0.22	0.32	2.72
3	30.835165	7.0786517	18.25	99.779661		24.365854	2.630137	13.439024	53.219298		6.4693112	4.4485147	4.8109756	46.560363		0.32	0.22	0.24	2.31
4	27.460674	6.4673913	15.21875	89		21.6375	2.4935065	10.926829	48.965217		5.8231742	3.9738848	4.2919207	40.034783		0.29	0.20	0.21	1.99
5	23.955556	5.9456522	11.84375	78.663866		19.555556	2.2857143	9.047619	42.965217		4.4	3.6599379	2.796131	35.698648		0.22	0.18	0.14	1.77
6	21.606742	5.7582418	10.75	68.168067		18.5	2.1025641	8.195122	39.33913		3.1067416	3.6556777	2.554878	28.828937		0.15	0.18	0.13	1.43
7	22.888889	7.4891304	11.193548	63.389831		18.682927	2.3333333	7.7560976	37.791304		4.2059621	5.1557971	3.4374508	25.598526		0.21	0.26	0.17	1.27
8	32.333333	10.25	14.6875	66.588235		23.560976	4.2435897	10.902439	38.434783		8.7723577	6.0064103	3.785061	28.153453		0.43	0.30	0.19	1.40
9	53.373626	14.293478	26.354839	87.208333		32.1125	8.0789474	16.707317	44.964602		21.261126	6.2145309	9.6475216	42.243732		1.05	0.31	0.48	2.09
10	65.208791	14.836957	34.833333	129.25		35.5	13.025974	19.829268	50.321429		29.708791	1.8109825	15.004065	78.928571		1.47	0.09	0.74	3.91
11	63.472527	14.76087	31.25	177.33333		40.641975	18.223684	27.297297	58.267857		22.830552	0	3.9527027	119.06548		1.13	0.00	0.20	5.90
12	58.155556	17.644444	31.78125	167.49167		46.594937	21.272727	29.175	68.221239		11.560619	0	2.60625	99.270428		0.57	0.00	0.13	4.92
13	52.868132	16.098901	32.484848	130.95798		42.407407	18.833333	28.255814	65.269565		10.460724	0	4.2290345	65.688418		0.52	0.00	0.21	3.26
14	47.25	13.945055	30.40625	116.68067		35.597561	18.171053	30.317073	66.350877		11.652439	0	0.0891768	50.329795		0.58	0.00	0.00	2.50
15	40.965909	12.912088	29.5625	103.91525		31.6875	18.589744	30.238095	60.147826		9.2784091	0	0	43.767428		0.46	0.00	0.00	2.17
16	38	12.233333	23	94.125		29.292683	17.842105	24.325	53.403509		8.7073171	0	0	40.721491		0.43	0.00	0.00	2.02
17	36.747253	11.280899	23.727273	85.956522		25.493976	16.065789	19.6	47.964602		11.253277	0	4.1272727	37.99192		0.56	0.00	0.20	1.88
18	37.714286	12.224719	28.909091	82.016807		24.950617	14.933333	19.15	42.713043		12.763668	0	9.7590909	39.303763		0.63	0.00	0.48	1.95
19	38.978022	11.988889	63.65625	101.91597		23.108434	13.907895	18.341463	44.2		15.869588	0	45.314787	57.715966		0.79	0.00	2.25	2.86
20	50.155556	10.956044	80.25	116.27119		23.698795	11.909091	28.435897	56.044643		26.45676	0	51.814103	60.226544		1.31	0.00	2.57	2.99
21	68.444444	11.318681	56.25	116.52101		27.891566	10.064103	34.97561	54.20354		40.552878	1.2545788	21.27439	62.317469		2.01	0.06	1.05	3.09
22	64.695652	11.494505	45.606061	113.82203		35.180723	8.6625	30.952381	59.59292		29.514929	2.8320055	14.65368	54.229114		1.46	0.14	0.73	2.69
23	52.5	10.912088	39.939394	112.93333		30.650602	6.7179487	26.27907	58.330435		21.849398	4.1941392	13.660324	54.602899		1.08	0.21	0.68	2.71
24	47.793478	9.4111111	33.69697	114.19167		29.650602	5.1216216	23.488372	57.424779		18.142876	4.2894895	10.208598	56.766888		0.90	0.21	0.51	2.81
Total	1050.8166	265.94557	743.7262	2540.386		694.44402	245.30466	502.01458	1260.6562		356.37262	56.344423	243.71222	1279.7298					

Sheet1 | 2011-12-22 | Sheet2 | Sheet3

Ready 85%

2.2 Mobile Sources

2.2.1 Estimation Method of Emission

Table 2-13 shows activity data, emission factor, emission model type for air pollution dispersion model and spatial distribution parameter.

Target of mobile source air pollutant emission inventory is exhaust gas of vehicles.

Air pollutants emission amount of mobile source is basically calculated by the following equation;

Air Pollutants Emission Amount = Activity data × Emission Factor

Activity data on major road is major road traffic volume. Traffic volume was calculated as "Traffic Volume = Link Traffic Count x Link Length". Link traffic count data is basically equals to the traffic count survey carried out by this project. Some additional link traffic count data is estimated by traffic count data of this project and VDS data of Traffic Control Center of the Ulaanbaatar City.

Activity data of non-major road vehicles is estimated fuel consumption used on non-major road. Total fuel consumption in UB is estimated from total fuel import dealt by Ulaanbaatar Custom, and then fuel consumption on major road is subtracted.

Emission factor on major road vehicle is calculated as follows; At 1st, emission factor of Japanese vehicles are modified by differences between Japan and Ulaanbaatar; 2nd, their weighted average is calculated according to estimated annual driving distances for each vehicle class and emission regulation, based on all the registration data of vehicles which passed inspection in Ulaanbaatar.

Emission factor of non-major road vehicles is air pollutant emission amounts per fuel consumption, calculated by total emission amounts and total fuel consumption of major road emission inventory.

Emission inventory of major roads is calculated for each link, as line-type emission inventory. Emission inventory of non-major road is distributed from total emission to grid emission, using population statistics per Khoroo and built-up area boundary as distribution index, as grid-type emission inventory.

Technical details were written in Sector Report (Air Pollutant Emission Inventory from Mobile Sources) is shown (Appendix 2.1-12 in Final Report).

Table 2-13 Emission Calculation Equation, Activity Data, Emission Factor, Emission Model Type and Spatial Distribution Index

	Emission Calculation Equation	Activity Data	Emission Factor	Emission Model Type and Spatial Distribution Parameter
Vehicle Exhaust-Gas Emission on Major Roads	Emission = Traffic Volume by Vehicle Type x Emission Factor by Vehicle Type	Traffic count per link (basically equals to the traffic count data carried out by this project and some missing link data is estimated using traffic count survey data and VDS data of Traffic Control Center of the Ulaanbaatar City) x link length	At 1st, emission factor of Japanese vehicles are modified by differences between Japan and Ulaanbaatar; 2nd, their weighted average is calculated according to estimated annual driving distances for each vehicle class and emission regulation, based on all the registration data of vehicles which passed inspection in Ulaanbaatar	Line-type emission inventory

Vehicle Exhaust-Gas Emission from Non-Major Roads	Emission = Estimated Fuel Consumption Used on Non-Major Road x Air Pollutant Emission Amounts per Fuel Consumption	Estimated Fuel Consumption Used on Non-Major Road = Total Fuel Import dealt by Ulaanbaatar Custom x Fuel Consumption Rate in Ulaanbaatar (estimated) – Fuel Consumption on Major Road (one of the outputs of Vehicle Exhaust-Gas Emission on Major Roads calculation)	Air Pollutant Emission Amounts per Fuel Consumption = Calculated Total Air Pollutant Emission on Major Roads / Calculated Total Fuel Consumption on Major Roads	Area-type emission inventory Emission inventory of non-major road is distributed from total emission to grid emission, using population statistics per Khoroo and built-up area boundary as distribution index, as grid-type emission inventory.

2.2.2 Updating Method of Emission Inventory

2.2.2.1 Vehicle Exhaust-Gas Emission on Major Roads

Emission inventory was calculated link by link.

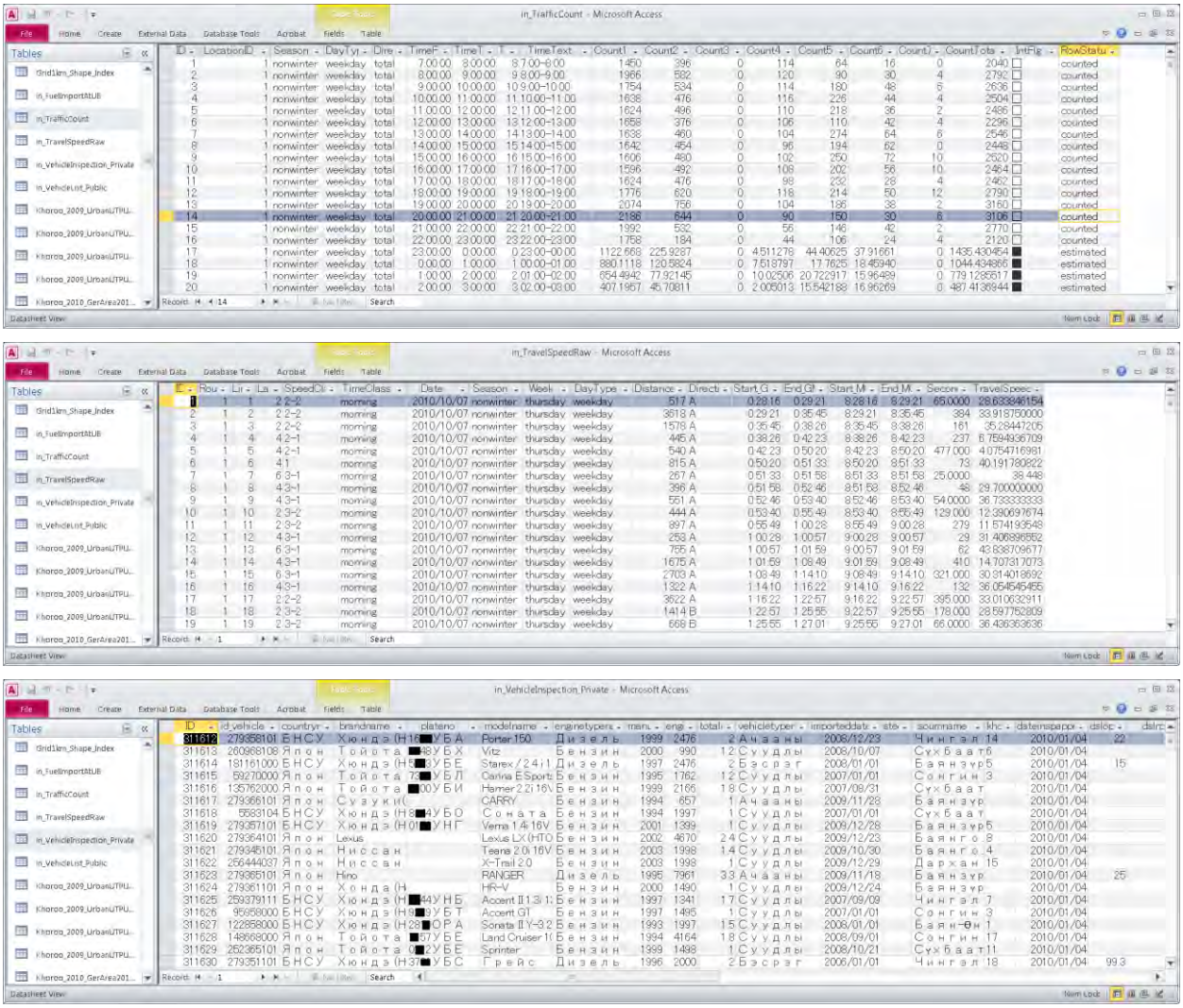
Input data are shown in Figure 2-1.

Traffic count was mainly calculated by multiplying “Traffic count in 2010 traffic count survey” by “traffic count increase ratio calculated by the data of VDS managed by Traffic Control Center of the Ulaanbaatar City”. Links where traffic is changed extraordinary (i.e. Narny Bridge road and its connecting roads in 2011) was counted by field survey.

Emission factor is calculated as follows; at 1st, emission factor of Japanese vehicles were justified by differences between Japan and Ulaanbaatar; 2nd, their weighted average was calculated according to estimated annual driving distances for each vehicle class and emission regulation.

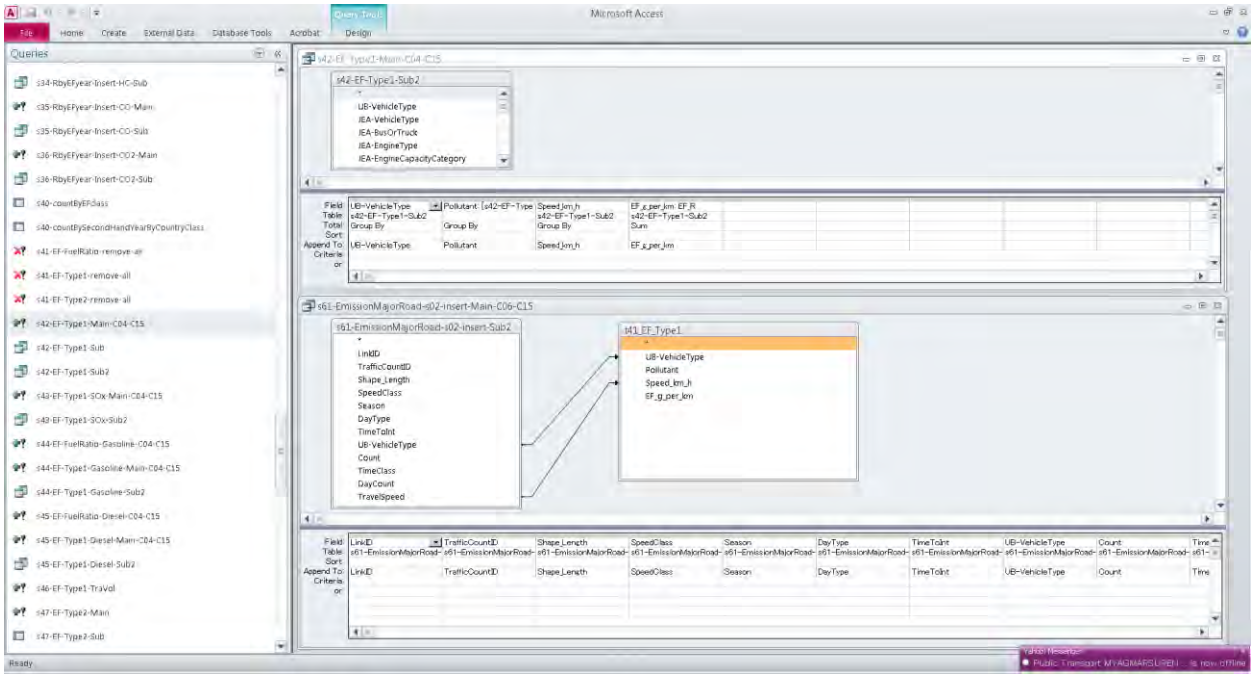
Annual driving distances for each vehicle class and emission regulation are to be calculated based on all the registration data of vehicles which passed inspection in Ulaanbaatar in the emission inventory year.

By executing queries one-by-one, emission inventory is calculated. Figure 2-2 shows a sample of queries. Figure 2-3 is a sample of emission inventory outputs.



Note: Top table is traffic count table. Middle table is travel speed table. Bottom table is vehicle inspection table.

Figure 2-1 Input Data for Updating Vehicle Exhaust-Gas Emission Inventory on Major Roads



Note: List of queries is shown in the left panel. Some of the query contents are shown in the right panel

Figure 2-2 Query Samples for Updating Vehicle Exhaust-Gas Emission Inventory on Major Roads

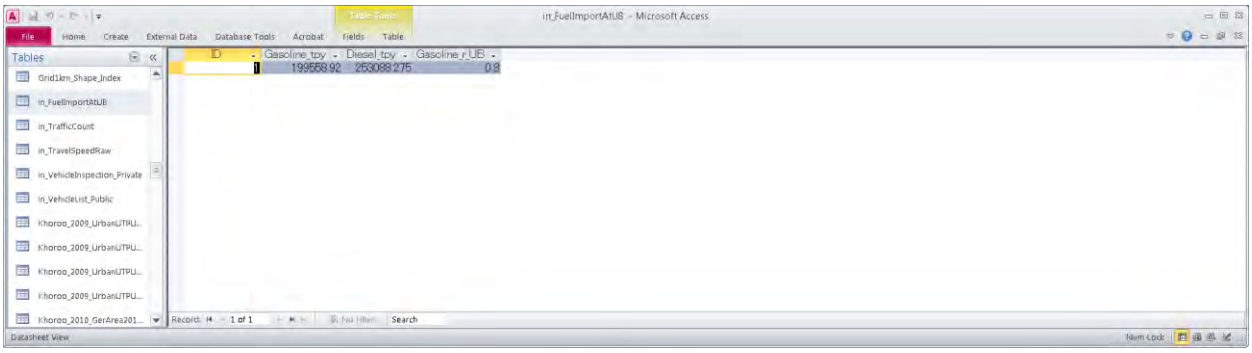
Figure 2-3 Sample Emission Inventory by Updating Vehicle Exhaust-Gas Emission Inventory on Major Roads

2.2.2.2 Vehicle Exhaust-Gas Emission on Non-major Roads

Emission inventory was calculated by 3 steps; to estimate total vehicle fuel consumption on non-major roads, to estimate total air pollutant emission, and then to allocate girds spatially.

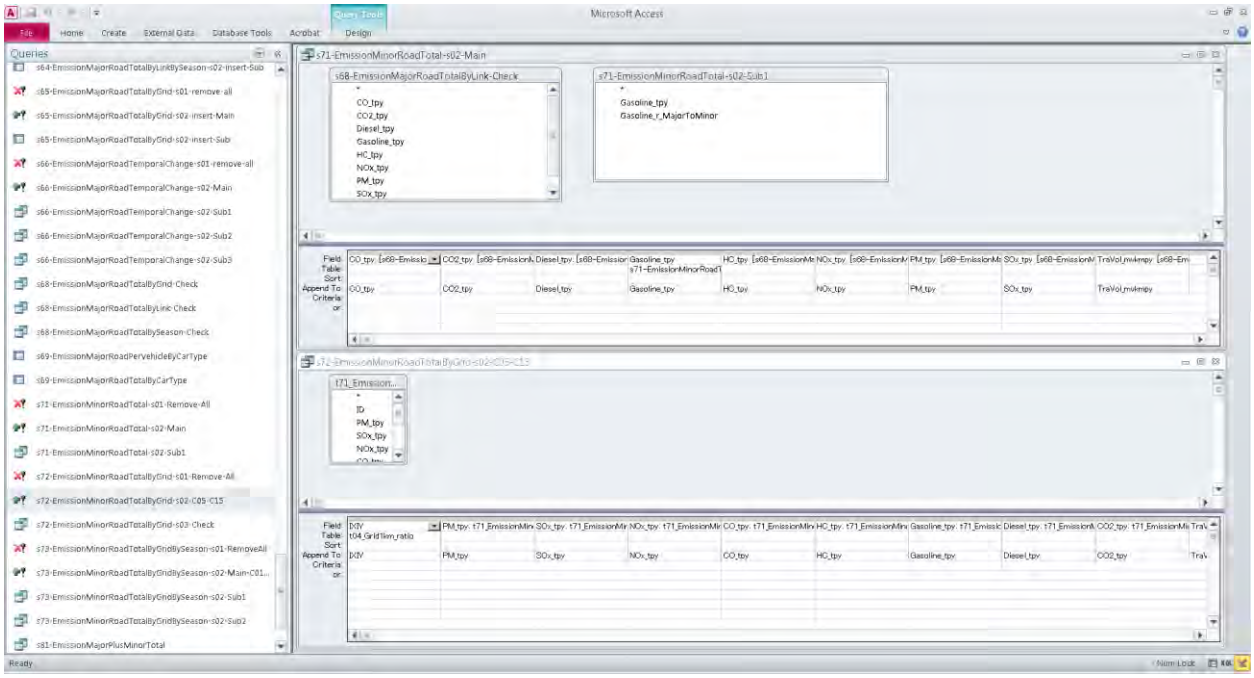
Total vehicle fuel consumption on non-major roads was calculated by subtracting "Total fuel consumption on major road (calculated in "Vehicle Exhaust-Gas Emission on Major Roads") from "Total fuel consumption in Ulaanbaatar". "Total fuel consumption in Ulaanbaatar" was estimated by multiplying "Total fuel import at Ulaanbaatar Custom" (Figure 2-4) with "Ulaanbaatar's share on fuel consumption assumed".

"Vehicle Exhaust-Gas Emission on Major Roads" is calculated by executing step-by-step "Queries". Figure 2-5 shows a sample of queries. Figure 2-6 is a sample of emission inventory outputs.



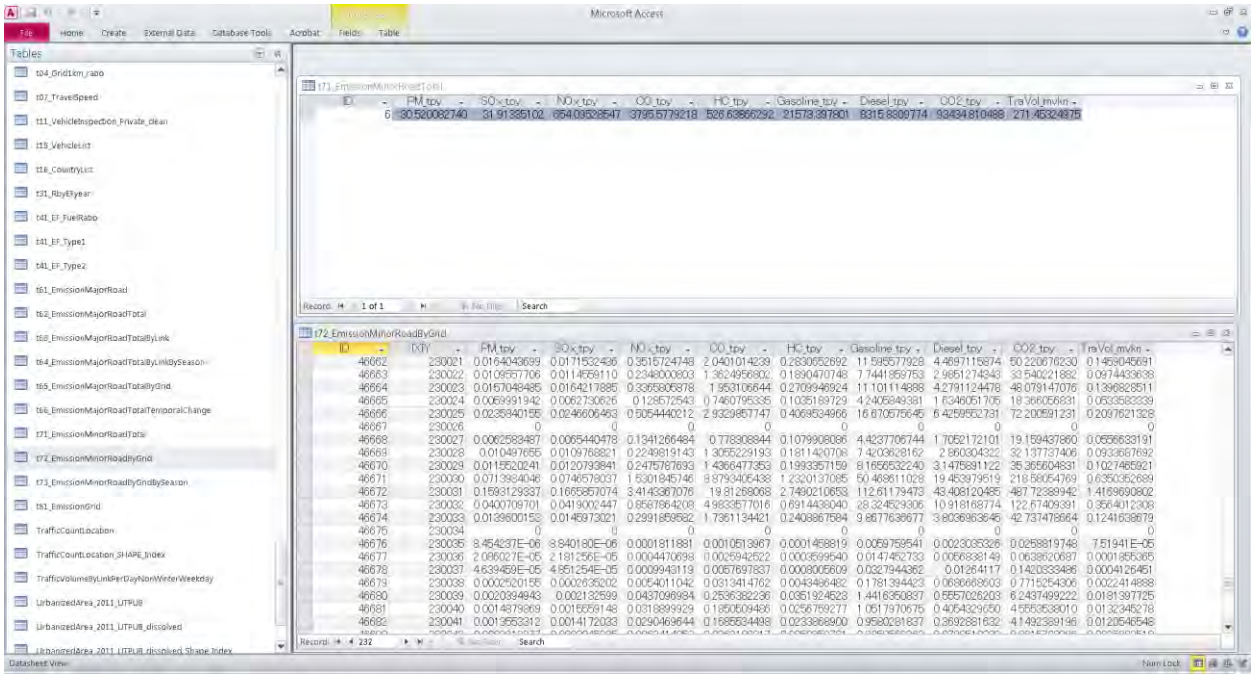
Note: This data is Total fuel import at Ulaanbaatar Custom

Figure 2-4 Input Data for Vehicle Exhaust-Gas Emission on Non-major Roads



Note: List of emission inventory queries is shown in the left panel. Query of calculating total emission and query of allocating emission to grid are shown in the right panel

Figure 2-5 Query Samples for Updating Vehicle Exhaust-Gas Emission Inventory on Non-major Roads



Note: List of emission inventory tables is shown in the left panel. Total emission and allocated grid emission are shown in the right panel

Figure 2-6 Sample Emission Inventory of Vehicle Exhaust-Gas Emission Inventory on Non-Major Roads

2.3 Other Area Source

2.3.1 Estimation Method of Emission

Table 2-14 shows activity data, emission factor and emission model type for air pollution dispersion model and spatial distribution parameter for "Other Area Source Air Pollutant Emission Inventory".

"Ash ponds of power plants" is only the one selected target source for "Other Area Source Air Pollutant Emission Inventory".

Air pollutants emission amount is calculated by the following equation;

Air Pollutants Emission Amount = Activity data × Emission Factor

Activity data for ash ponds is "Area of ash ponds parts where wind can fly up ash", measured by interview to power plants, site survey and satellite image survey. Emission factor is calculated from the output of lost ash volume survey carried out by this project.

Emission is summarized as area-type emission inventory.

Table 2-14 Emission Calculation Equation, Activity Data, Emission Factor, Emission Model Type and Spatial Distribution Index

	Emission Calculation Equation	Activity Data	Emission Factor	Emission Model Type and Spatial Distribution Index
Ash ponds of power plants	Air Pollutants Emission amount = Area of ash ponds parts where wind can fly up ash x Emission Factor	Area of ash ponds parts where wind can fly up ash	Emission factor is calculated by ash pond site survey on ash volume change survey carried out by this project. PM_{10} emission is calculated by TSP emission weight x PM_{10} share which is calculated particle size distribution test data	Area-type emission inventory

2.3.2 Updating Method of Emission Inventory

2.3.2.1 Ash Ponds of Power Plants

Emission was calculated for each ash pond cell.

Input data and calculation process data are shown in Table 2-15.

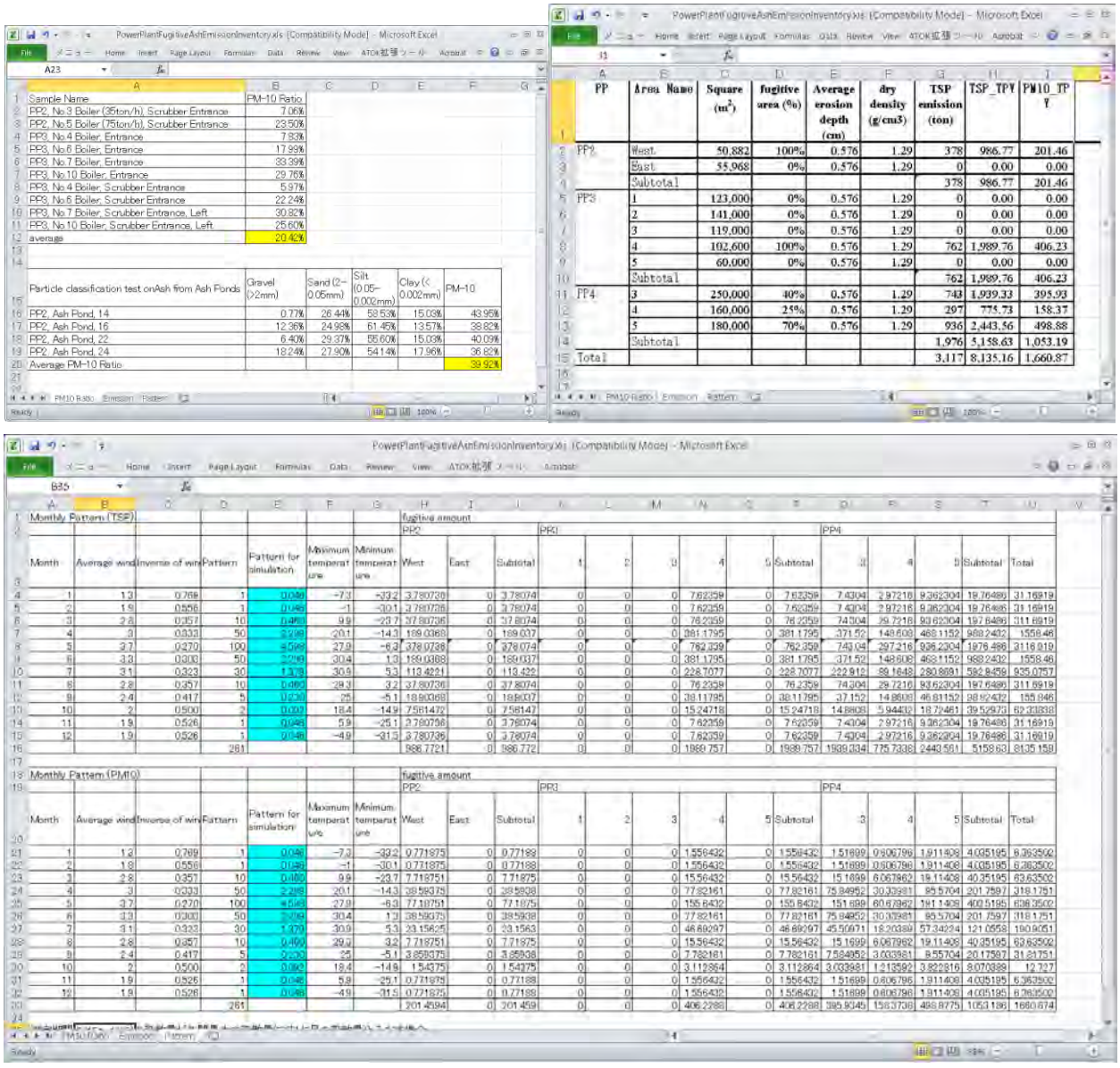
On “PM10 Ratio” Sheet, PM-10 share of ash are input, and summarized. It should be updated whenever combustion characteristics of power plants are changed.

On “Emission“ Sheet, source data, such as ash ponds area, share of area where wind may flown ash up, depth of wind-eroded ash depth, dry density of ash, were filled, then flown-up ash volume of the survey period was calculated. Additionally, monthly emission share was assumed on “Pattern” Sheet”, and then summed-up as yearly emission on “Emission” Sheet”. “Share of area ash surface is free” should be updated yearly because it is changed annually, according to soil cover and ground water resume. “Wind-eroded ash depth” and PM-10 Share should be updated whenever it is updated.

On “Pattern” Sheet, monthly emission share is assumed, and then monthly TSP and PM-10 emission are calculated. Monthly emission share should be updated whenever new information is available (For example, year-round ash erosion data).

By updating information above, “monthly emission” is calculated on “Pattern” Sheet, where and “Yearly total emission” is calculated pm “Emission”.

Table 2-15 Input Data for Updating Ash Pond Erosion Emission Inventory



Sample Name	PM-10 Ratio
PP2, No.3 Boiler (35ton/h), Scrubber Entrance	7.06%
PP2, No.5 Boiler (75ton/h), Scrubber Entrance	23.50%
PP3, No.4 Boiler, Entrance	7.83%
PP3, No.6 Boiler, Entrance	17.99%
PP3, No.7 Boiler, Entrance	33.39%
PP3, No.10 Boiler, Entrance	29.76%
PP3, No.4 Boiler, Scrubber Entrance	5.97%
PP3, No.6 Boiler, Scrubber Entrance	22.24%
PP3, No.7 Boiler, Scrubber Entrance, Left	30.82%
PP3, No.10 Boiler, Scrubber Entrance, Left	25.60%
average	20.42%

Particle classification test onAsh from Ash Ponds	Gravel (>2mm)	Sand (2~0.05mm)	Silt (0.05~0.002mm)	Clay (<0.002mm)	PM-10
PP2, Ash Pond, 14	0.77%	26.44%	58.63%	15.03%	43.95%
PP2, Ash Pond, 16	12.36%	24.98%	61.45%	13.57%	38.82%
PP2, Ash Pond, 22	6.40%	29.37%	55.60%	15.03%	40.09%
PP2, Ash Pond, 24	18.24%	27.90%	54.14%	17.96%	36.82%
Average PM-10 Ratio					39.92%

PP	Area Name	Square (m^2)	fugitive area (%)	Average erosion depth (cm)	dry density (g/cm3)	TSP emission (ton)	TSP_TPY	PM10_TPY
PP2	West	50,882	100%	0.576	1.29	378	986.77	201.46
	East	55,968	0%	0.576	1.29	0	0.00	0.00
	Subtotal					378	986.77	201.46
PP3	1	123,000	0%	0.576	1.29	0	0.00	0.00
	2	141,000	0%	0.576	1.29	0	0.00	0.00
	3	119,000	0%	0.576	1.29	0	0.00	0.00
	4	102,600	100%	0.576	1.29	762	1,989.76	406.23
	5	60,000	0%	0.576	1.29	0	0.00	0.00
	Subtotal					762	1,989.76	406.23
PP4	3	250,000	40%	0.576	1.29	743	1,939.33	395.93
	4	160,000	25%	0.576	1.29	297	775.73	158.37
	5	180,000	70%	0.576	1.29	936	2,443.56	498.88
	Subtotal					1,976	5,158.63	1,053.19
Total						3,117	8,135.16	1,660.87

9 Guideline on Implementing and Revision of Simulation

Mongolia
The Air Quality Department of Capital City
(AQDCC)

Capacity Development Project
for
Air Pollution Control in Ulaanbaatar City
Mongolia

Guideline on Implementing and Revision of Simulation

March 2013

Japan International Cooperation Agency

SUURI-KEIKAKU CO., LTD

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1 Simulation Model

Pollutant emitted in air from sources (e.g. Power plant, factory and vehicle) is intricately changed by wind transportation, diffusion, and generation and transubstantiation of secondary pollutant by photochemical reaction. Air diffusion model is to replicate condition of this change based on emission inventory and meteorology data.

Simulation model is constructed by using emission inventory and meteorology data as input data and comparing between calculation value and measurement value in air monitoring station. This is the tool for discussing effective air pollution measure from this model's result. Flow of formulation of simulation model is shown in Figure 1-1.

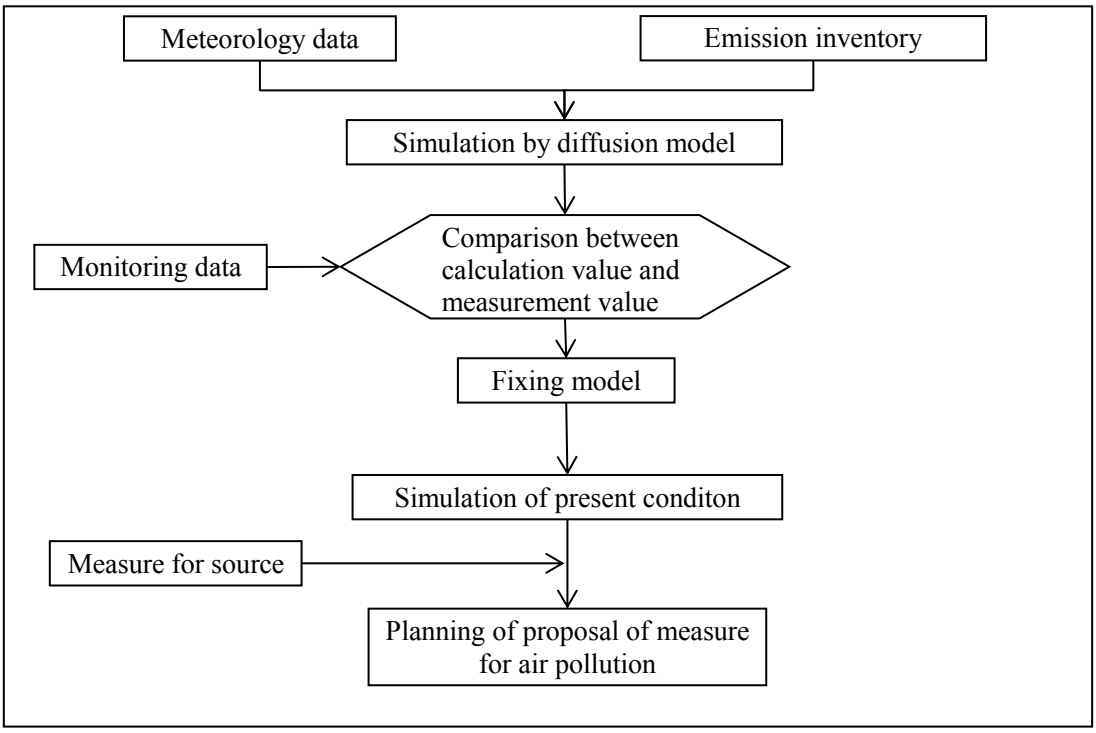


Figure 1-1 Flow of Formulation of Simulation Model

The first role of air diffusion simulation model is to quantitatively find the relation between pollutant emission and air pollutant concentration. By executing Air diffusion simulation, the following things are quantitatively find.

1) In what source has the cause of contamination brought the atmosphere influence how much? (evaluation of contribution by sources)
2) Prediction how future concentration changes (Future concentration prediction)
3) Effect of reduction of air pollutant concentration by measure for sources (evaluation of air pollution measure)

These can be used in control measure by source, environment assessment and development of policies.

Secondary role is to find the system of generation of complicated air pollution phenomena. Air pollution phenomena are constructed by complicated process, emission of pollutant, wind transportation, diffusion,

transubstantiation of secondary pollutant by photochemical reaction, and System of generation is predicted by air diffusion simulation.

The third role is usage of study of atmospheric chemistry. By executing air diffusion simulation of distribution of chemical substance in huge area scale (continental etc.), the global condition and circulation of chemical substance that it is difficult to understanding by only observation can be clarified and the budget of chemical substance in the global air can be estimated.

2 Abstract

The purpose of this guideline is to understand air pollutant structure in Ulaanbaatar by executing concentration diffusion simulation, view of concentration distribution map, comparison between calculation value and measurement value and making cross-section view of concentration by source types. Using concentration diffusion simulation, effect of concentration reduction by emission reduction based on measure for air pollution can be confirmed.

Flow of calculation of concentration diffusion simulation and analysis of calculation result is shown in Figure 2-1.

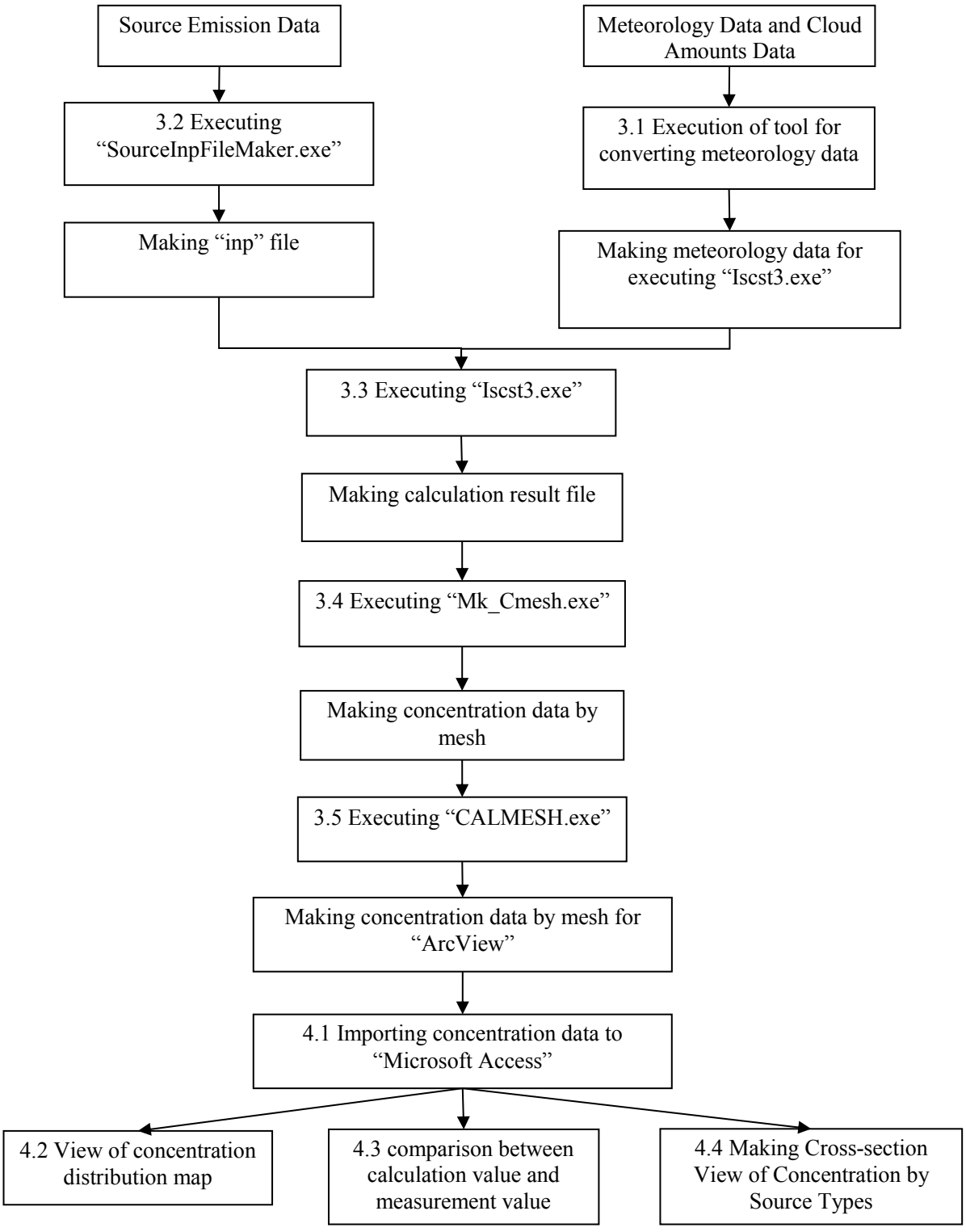


Figure 2-1 Flow of Calculation of Concentration Diffusion Simulation and Analysis of Calculation Result

Abstract of each process in above flow is follow.

3 Implementing and Revision Method of Simulation

3.1 Making Meteorology Data for Implementing of Simulation

Meteorology data and cloud cover data is got at NAMEM, error count is found out and aberrant values are detected and rejected. In case that available data is lower than 60% in calculation period, try to get other data (e.g. meteorology data which is measured in air monitoring station) because the accuracy of simulation result become worse. How to make arranging each data and meteorology data for executing simulation is referred to "7.1.2 Conversion to Simulation Data" in "Technical Manual (Inventory and Simulation)".

3.2 Making "inp" File Using Emission Data

Emission data in Microsoft Access (Hereinafter, it is referred to as "Access".) is exported to Excel and csv file is made from Excel data. Setting csv file and meteorology data made in 3.1, "inp" file is made by doing executing file to make "inp" file. The detailed setting method is referred to "8.1.1 Export emission data and conversion to csv file" and "8.1.2 Making "inp" File from Emission Data" in "Technical Manual (Inventory and Simulation)".

3.3 Executing "Iscst3.exe" (Executing File for ISC-ST3)

ISC-ST3 model is executed using "inp" file made in 3.2 and meteorology data. The detailed setting method is referred to "8.1.3 Executing "Iscst3.exe" in "Technical Manual (Inventory and Simulation)".

3.4 Making Concentration data by Mesh

Concentration data by mesh is made from calculation result file made in 3.3. The detailed setting method is referred to "8.1.4 Executing "Mk_Cmesh.exe" in "Technical Manual (Inventory and Simulation)".

3.5 Conversion to Format for Importing Access

Concentration data by mesh made in 2.4 is converted to format for importing Access. The detailed setting method is referred to "8.1.5 Executing "CALMESH.exe" in "Technical Manual (Inventory and Simulation)".

4 Usage Method of Calculation Result

4.1 Importing Calculation Result to Access

To view in ArcGIS, the file made in 3.5 is imported in Access. The detailed method of importing is referred to "8.2 Importing Simulation Result File to Access" in "Technical Manual (Inventory and Simulation)".

4.2 View of Concentration Distribution Map

The result data of simulation imported to Access is joined by feature class of mesh and concentration distribution map is made. Joining result data and setting legend are referred to "8.4 View of Concentration Distribution Map" in "Technical Manual (Inventory and Simulation)".

As examination case of air pollution measurement, concentration distribution maps in the case assumed replacing ger stove to HOB in Ger area are shown in Figure 4-1. Maximum ground concentrations before and after measure is shown in Table 4-1. In the area ger stove is replaced to HOB, concentrations of SO_2 and PM_{10} are significantly reduced. Each maximum ground concentration is reduced by 89% and 98% compared to before measure.

Table 4-1 Maximum Ground Concentrations of Before and After Measure

Unit: $\mu g/m^3$

	Before	After
SO_2	78.52	8.62
PM_{10}	59.10	1.21

As above example, executing simulation before implementing measure, validation for effect of measure can be done and simulation result can become criteria from various measures.

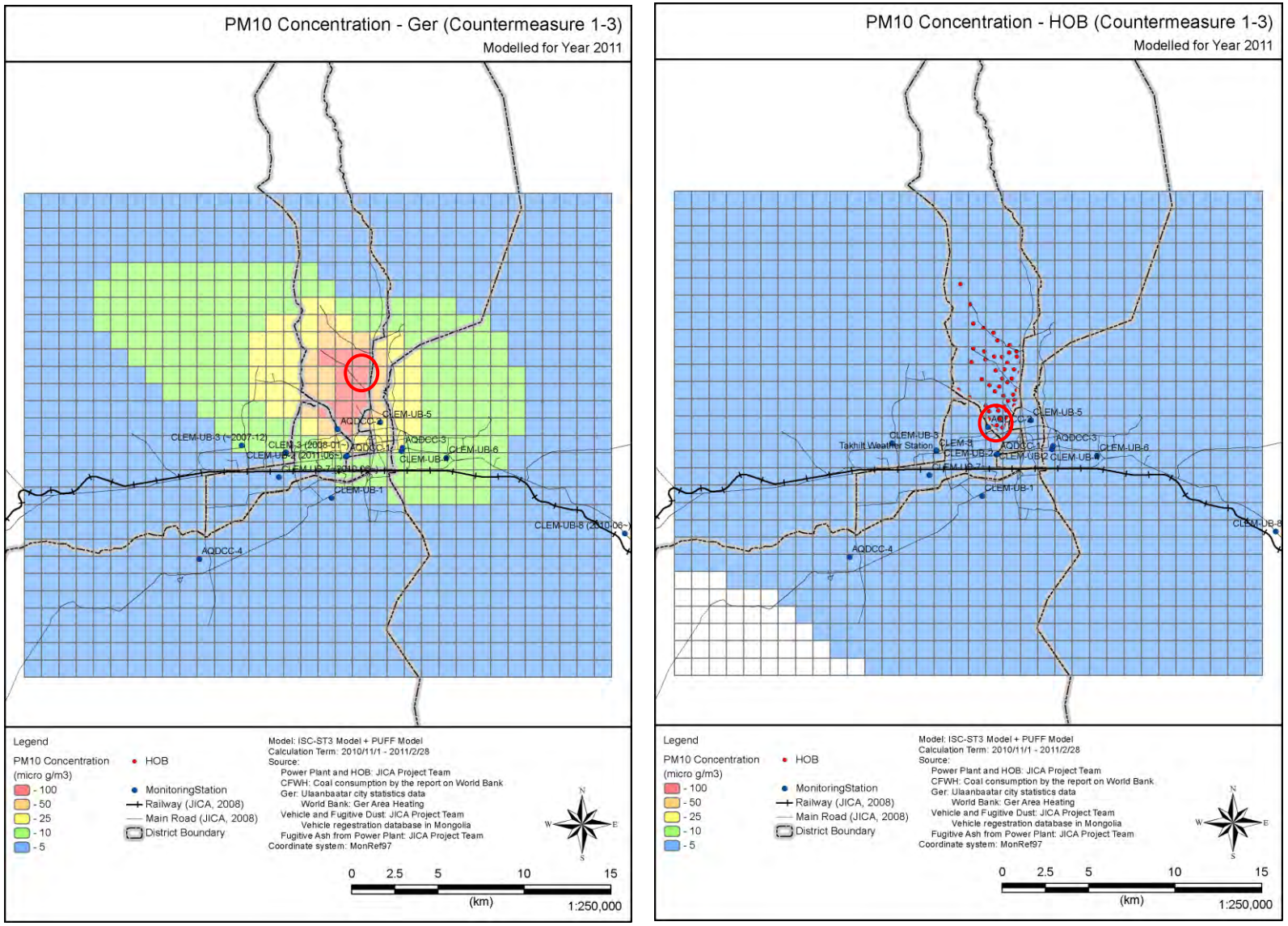


Figure 4-1 Comparisons of Distribution Maps of PM_{10} Ambient Concentrations of Before and After Measure (Left: Before, Right: After)

4.3 Comparison between Calculation Value and Measurement Value

To confirm accuracy of calculation result, correlation between calculation value and measurement value in air quality monitoring station should be verified. Example of result of comparison between calculation value and measurement value in each air monitoring station are shown in Figure 4-2 and Table 4-2. Monitoring station which available data is lower than 60% in calculation period is excluded because comparison between calculation value and measurement value is worse (monitoring point hatched gray in Table 4-2).

In correlation diagram in Figure 4-2, relation between calculation value and measurement value is one by one, correlation coefficient is very high. This result shows very highly accurate simulation is constructed.

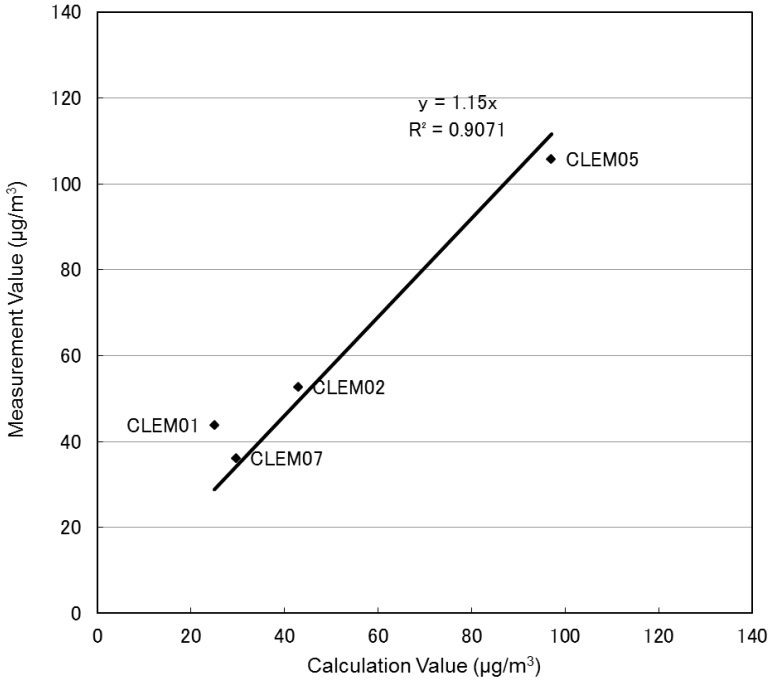


Figure 4-2 Example of Comparison Result between Calculation Value and Measurement Value (SO_2)

Table 4-2 Example of Calculation Concentration by Source Type at Ambient Monitoring Stations and HOB Highest Concentration Point

SO2

Monitoring Station / Point	Calculation Value							Measurement value	Calculation - Measurement	Number of Available Data	Rate of Available Data
	Power Plant	HOB	CFWH	Ger Stove	Major Road	Minor Road	Total				
AQDCC1	3.94	0.52	1.33	34.16	2.17	0.88	43	98.75	-55.75	2784	96.67%
AQDCC2	2.89	1.4	2.73	117.15	1.21	0.44	125.82	84.77	41.05	1939	67.33%
AQDCC3	2.18	1.21	1.81	49.19	2	1.31	57.7	55.43	2.27	2055	71.35%
AQDCC4	2.86	0.46	0.44	29.58	0.31	0.05	33.7	28.33	5.37	62	2.15%
HOB_Max	1.08	6.81	3.82	77.71	0.47	0.25	90.14		90.14		0.00%
CLEM01	6.17	0.36	0.55	16.4	1.11	0.44	25.03	43.86	-18.83	1847	64.13%
CLEM02	3.94	0.52	1.33	34.16	2.17	0.88	43	52.70	-9.70	2735	94.97%
CLEM03	4.23	0.48	1.67	73.88	1.07	0.43	81.76		81.76		
CLEM04	2.18	1.21	1.81	49.19	2	1.31	57.7		57.70	0	0.00%
CLEM05	2.27	1.45	2.62	87.57	2.12	1.05	97.08	105.73	-8.65	2852	99.03%
CLEM06	1.45	2.16	2.6	72.02	0.78	0.61	79.62		79.62		
CLEM07	6.08	0.3	0.71	21.82	0.56	0.19	29.66	36.04	-6.38	2277	79.06%
CLEM08								35.49	-35.49	2510	87.15%
								Correlation Coefficient (including AQDCC Stations)			0.677

4.4 Making Cross-section View of Concentration by Source Types

Only concentration distribution map made in 3.2 does not show in which area, by emission of which source and what rate it is. Then, cross-section view of concentration by source types crossed eastern to western or south to north. By making cross-section view, exceed value over annual environmental standard value by area, contribution concentration by source type and this rate can be grasped, and it is assumed that structure of air pollution and making proposal measure for sources matched in an area are helpful.

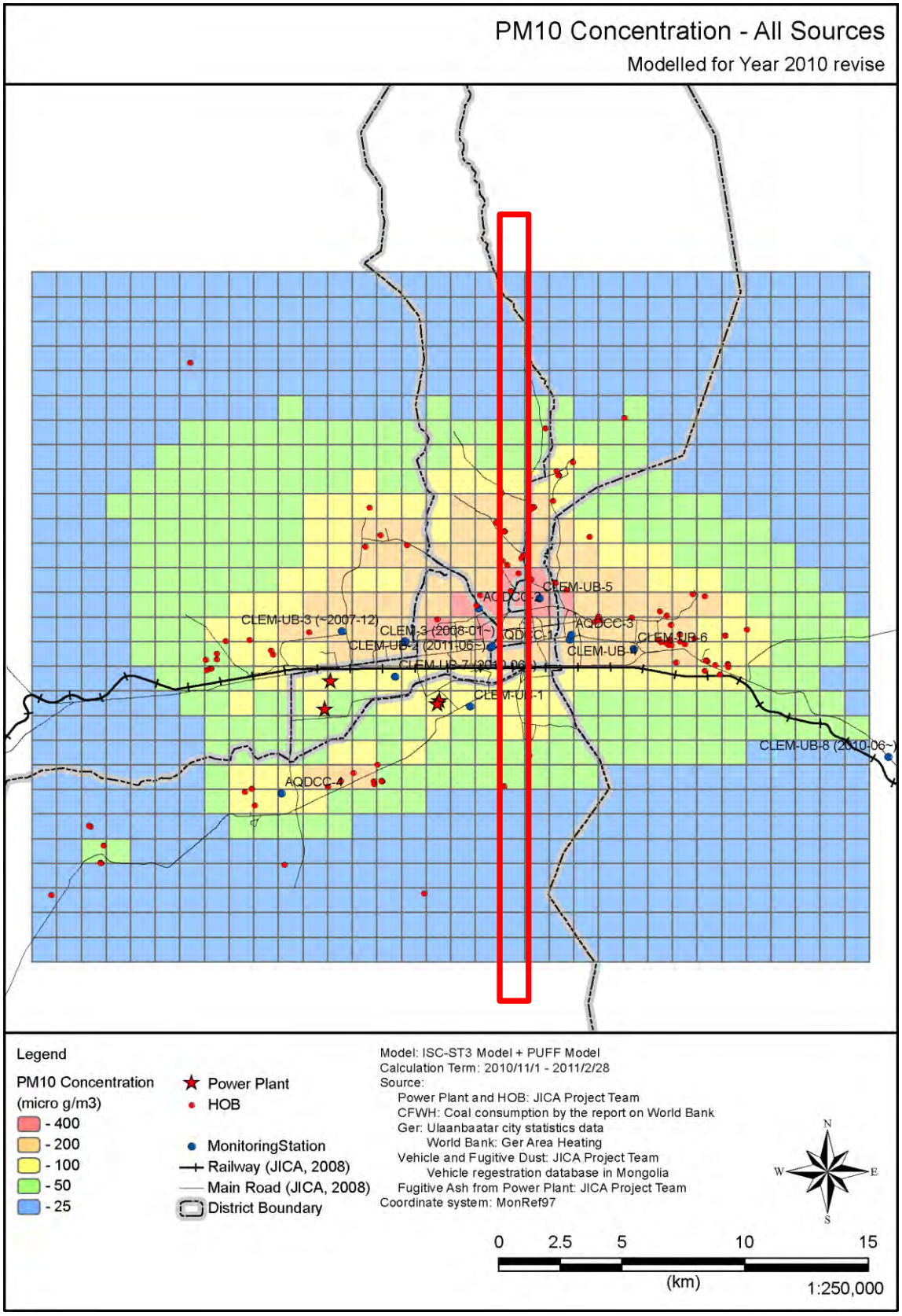
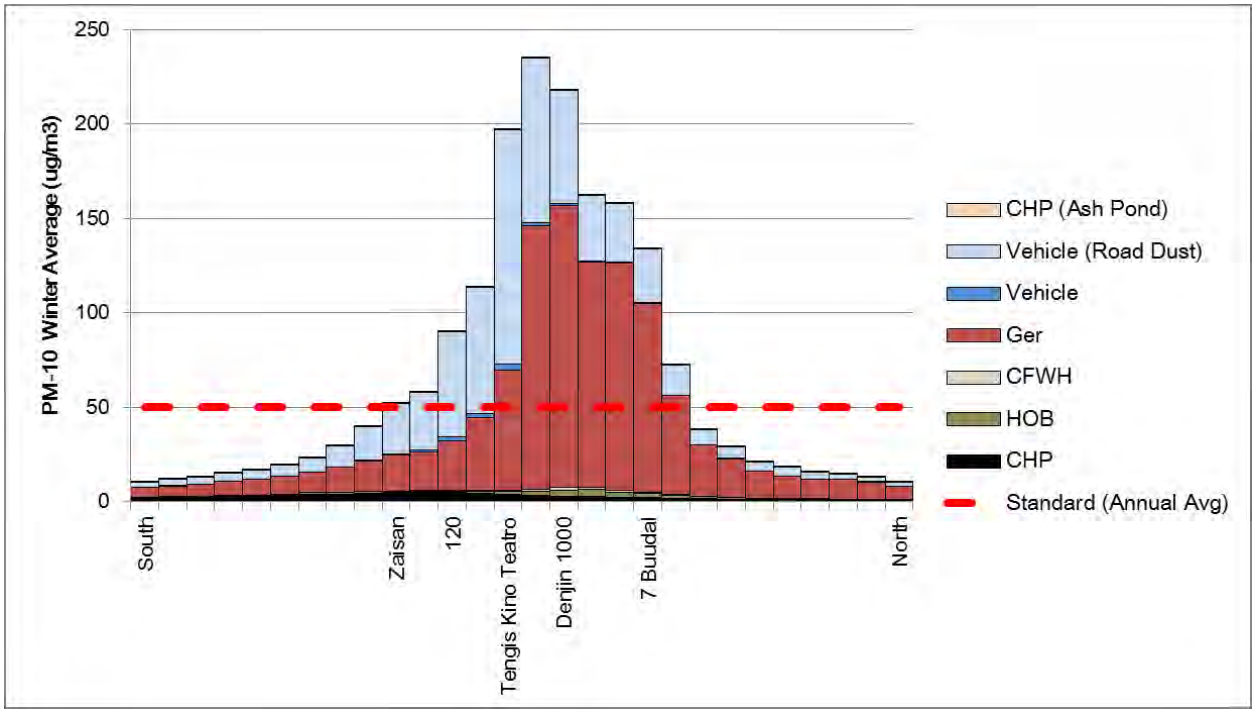


Figure 4-3 Example of PM_{10} Simulation Result



Target is red square area in Figure 4-3

Figure 4-4 PM_{10} Concentration Air Pollution Source Types Crossed South to North