



**Use of surrogate data in waste sector
estimation (China's Case)**

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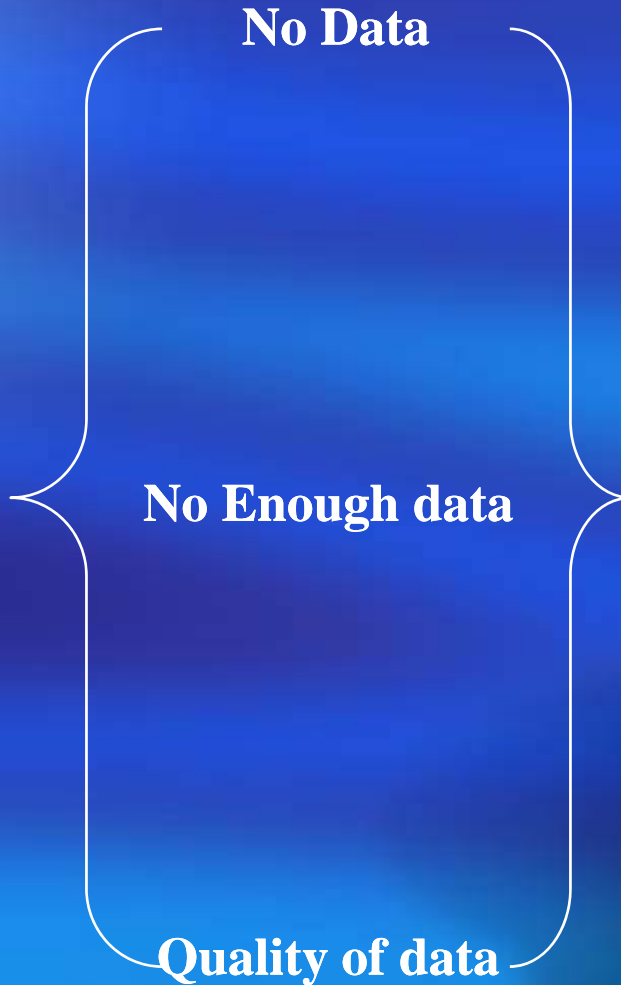
**Chinese Research Academy of Environmental
Science (CRAES)**

focusing on

- ▣ Purpose of using the surrogate data
- ▣ Methods and data used in estimation
- ▣ Results of estimation
- ▣ Useful advice / recommendation China's experience

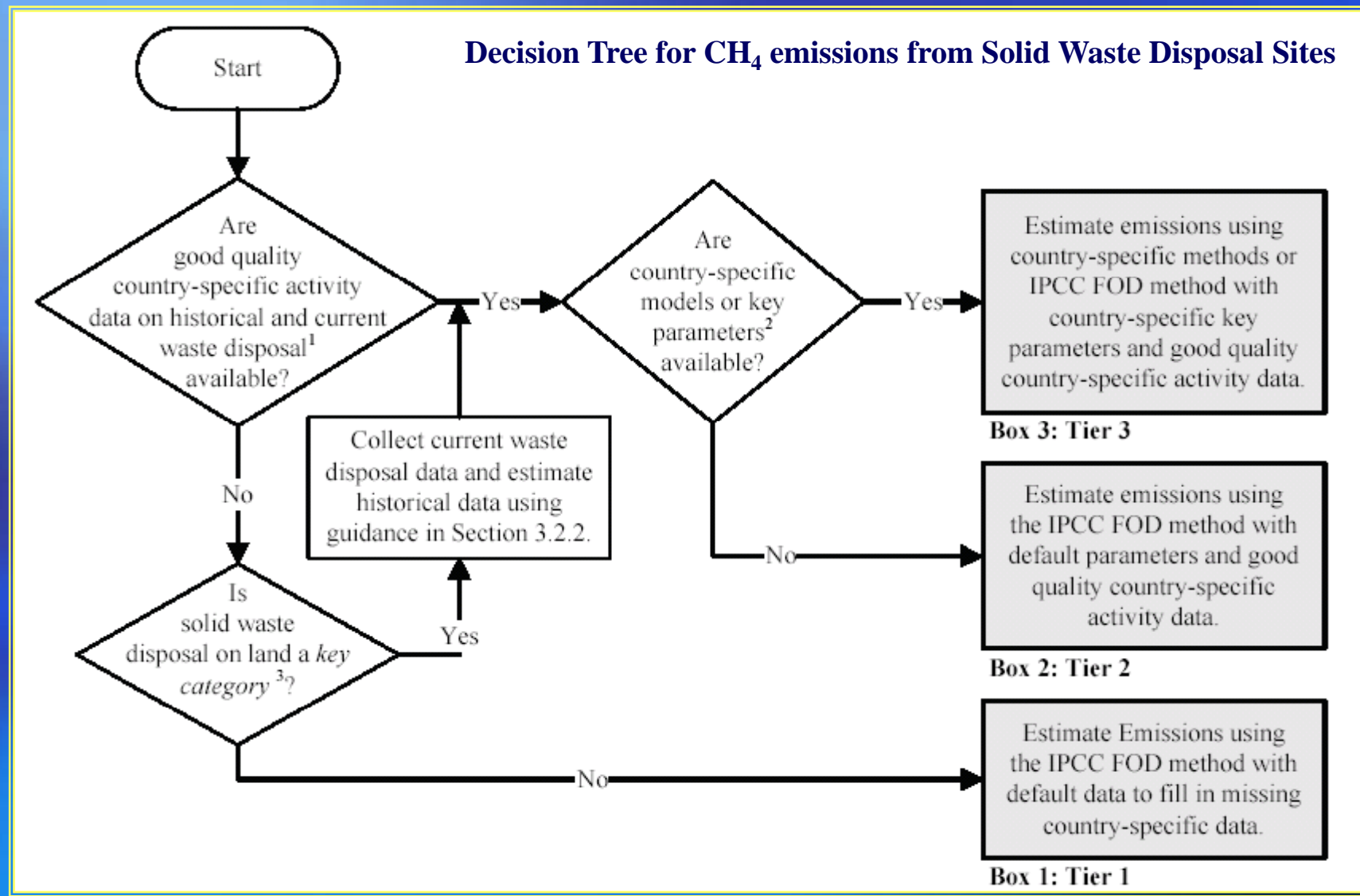
Purpose of using the surrogate data

Why Surrogate data needed?



Good quality country-specific activity data mean country-specific data on waste disposed in SWDS for 10 years or more

Purpose of using the surrogate data



Purpose of using the surrogate data

**data needed
(1/2)**

Total production of MSW and its composition

- ▣ **Municipal Solid Waste (MSW)**
(food waste, Garden, paper, wood and straw , textiles, disposable nappies)
- ▣ **Sewage sludge**
- ▣ **Industrial waste (Manufacturing Industries and Construction waste)**
- ▣ **Other waste (Clinical and Hazardous waste)**

The Ratio of treatment of MSW(%)

- ▣ **Resource Recovery**
- ▣ **Composting**
- ▣ **Incineration**
- ▣ **Disposal**

Purpose of using the surrogate data

data needed
(2/2)

The Methane Correction Factor (MCF)

- ▣ **Managed: anaerobic**
- ▣ **Managed: semi-aerobic**
- ▣ **Unmanaged: deep (>5 m) and /or high water table**
- ▣ **Unmanaged: shallow (<5 m)**
- ▣ **Uncategorised SWDS**

Oxidation factor (OX)

- ▣ **Managed, unmanaged and uncategorised SWDS**
- ▣ **Managed covered with CH₄ oxidizing material**

Methane Generation rate constant (k)

Fraction of DOC dissimilated (DOC_F)

Delay time (month)

Fraction of Methane (F)

Conversion factor

Methane Recovery (Gg/yr)

Purpose of using the surrogate data

No Data

The Methane Correction Factor (MCF)

- ▣ Managed: anaerobic
- ▣ Managed: semi-aerobic
- ▣ Unmanaged: deep (>5 m) and /or high water table
- ▣ Unmanaged: shallow (<5 m)
- ▣ Uncategorised SWDS

Expert judgment

Oxidation factor (OX)

- ▣ Managed, unmanaged and uncategorised SWDS
- ▣ Managed covered with CH₄ oxidizing material

Expert judgment

IPCC defaults

Methane Generation rate constant (k)

Fraction of DOC dissimilated (DOC_F)

Delay time (month)

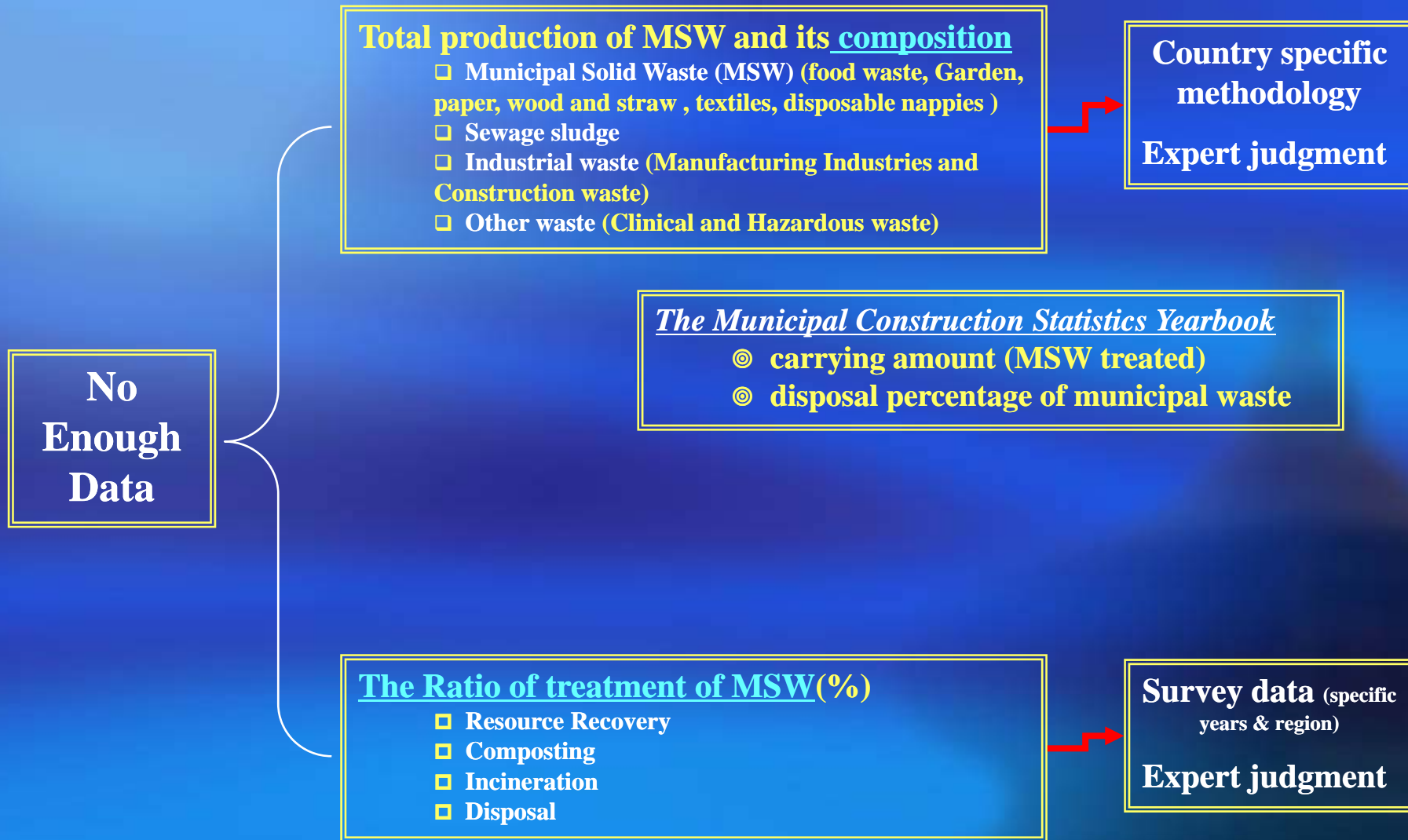
Fraction of Methane (F)

Conversion factor

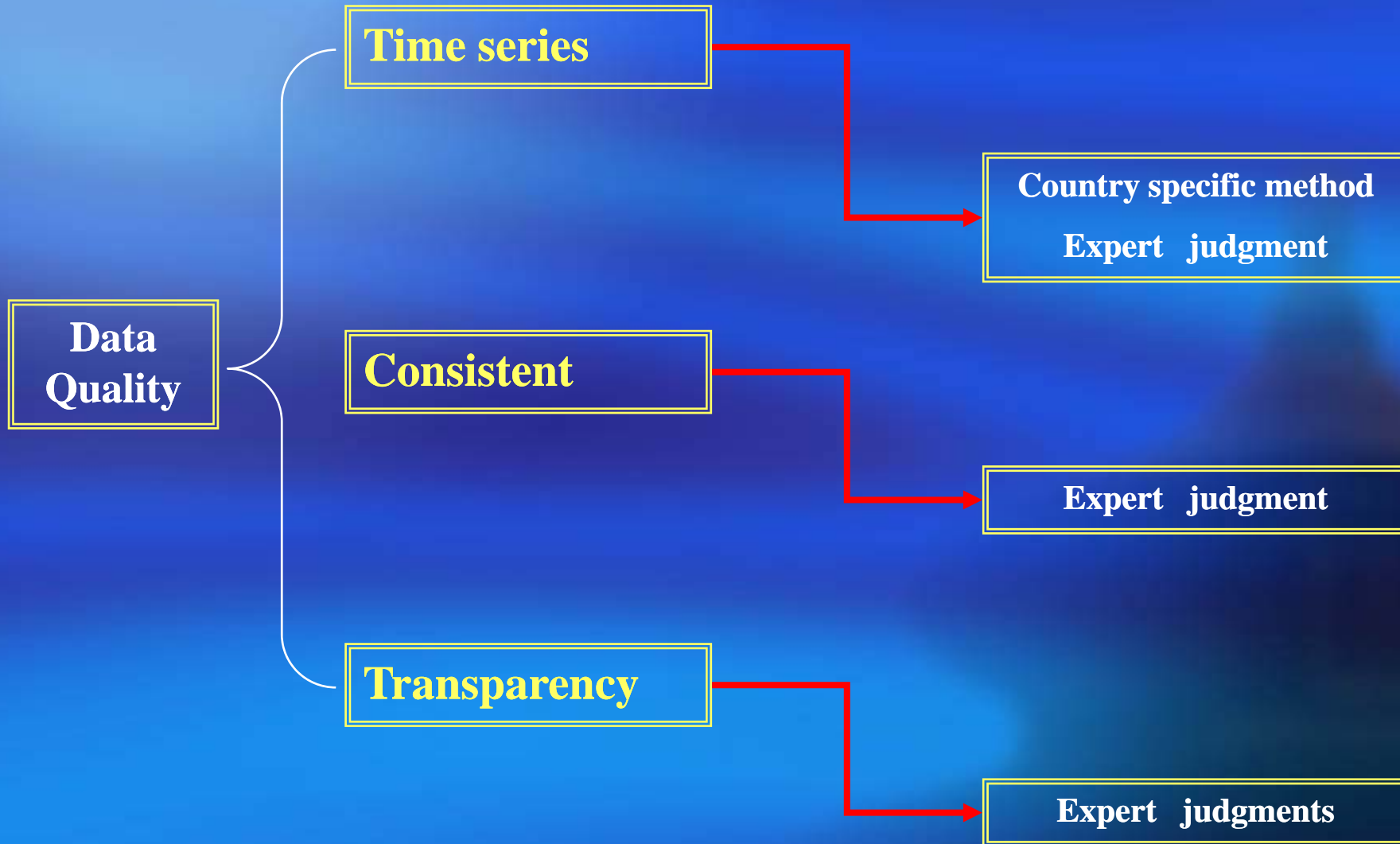
Methane Recovery (Gg/yr)

IPCC defaults

Purpose of using the surrogate data

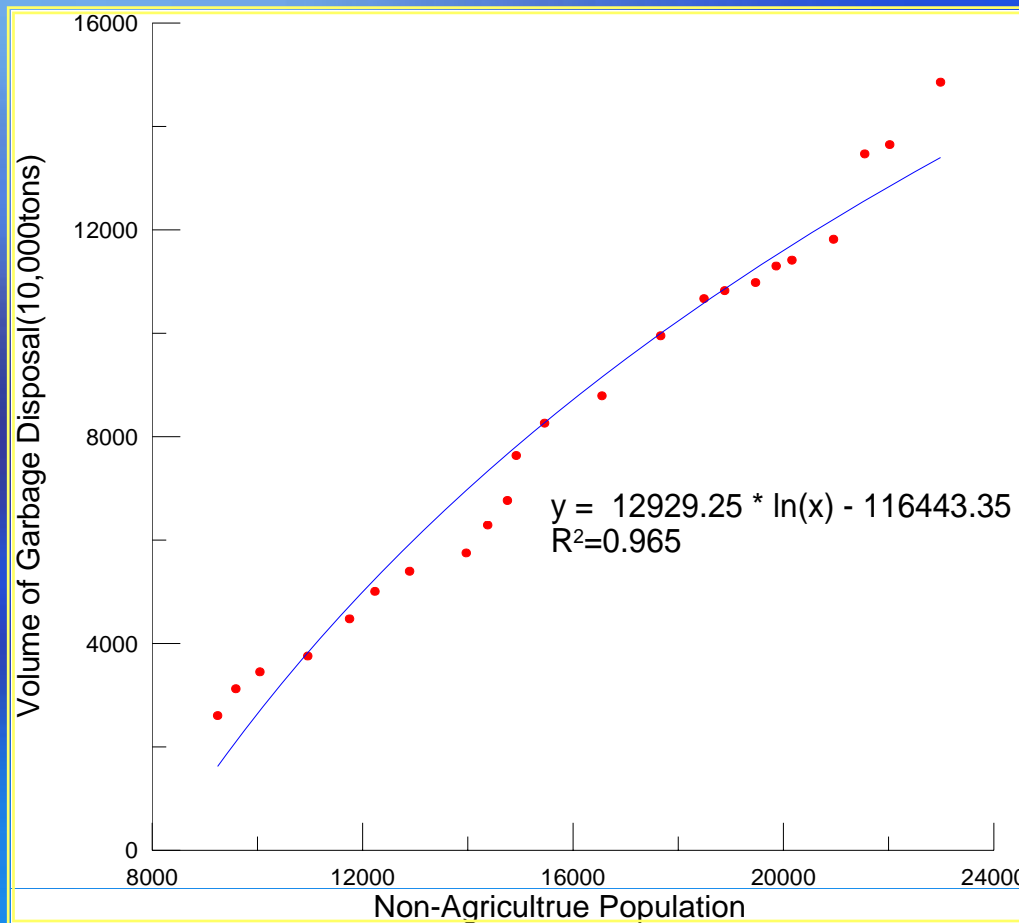


Purpose of using the surrogate data



Methods and data used in estimation

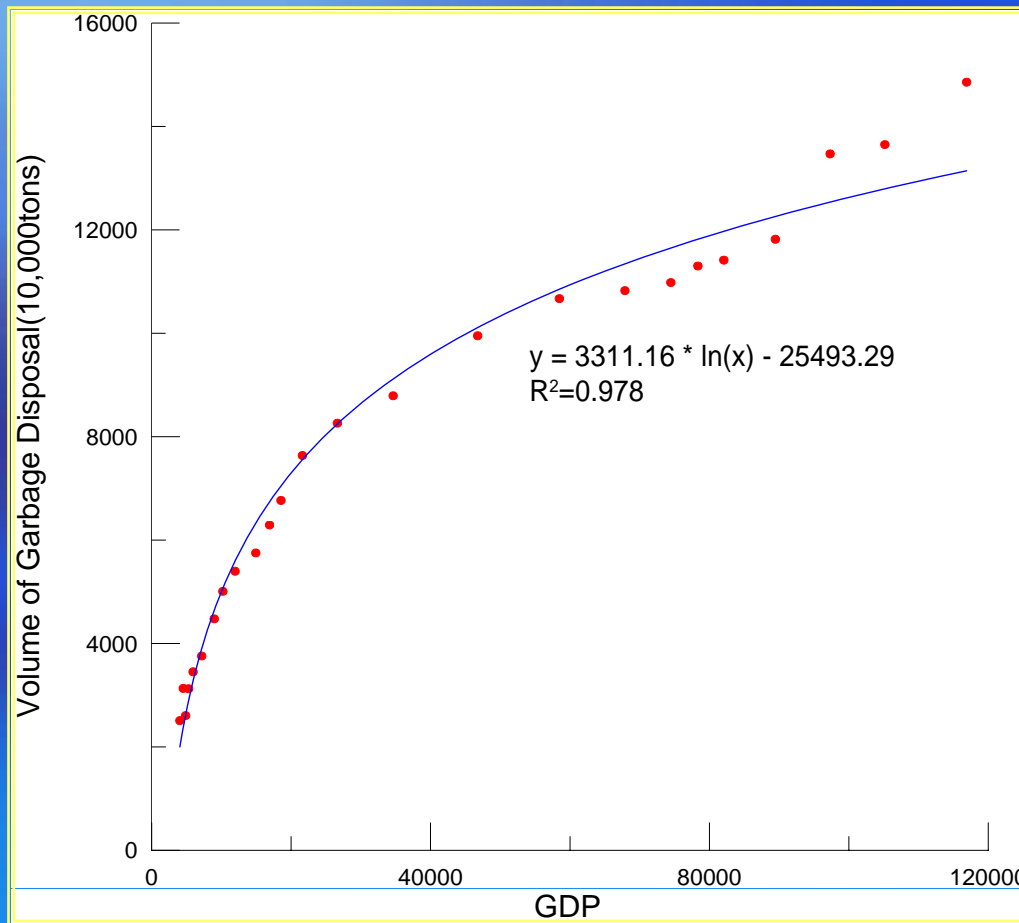
Urban non-agricultural population



The relation of non-agriculture population and the generate amount of MSW

Methods and data used in estimation

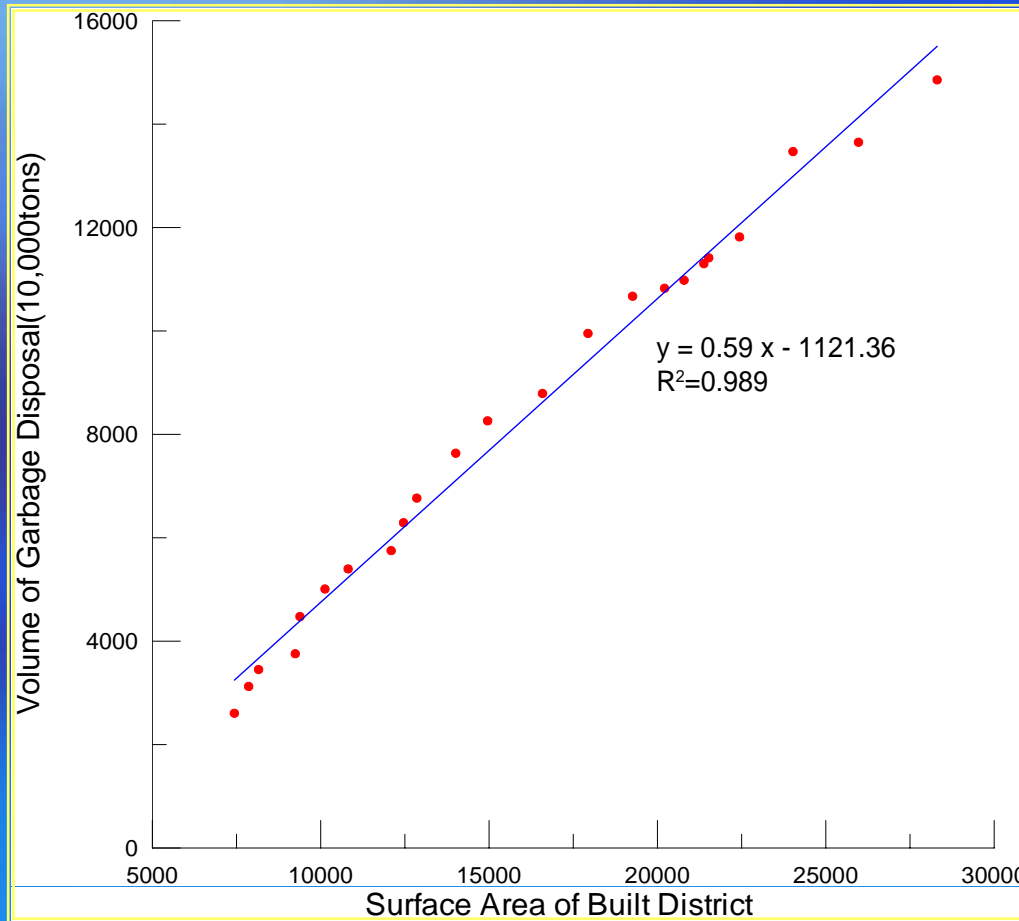
Gross Domestic Product (GDP)



The relation of GDP and the generate amount of MSW

Methods and data used in estimation

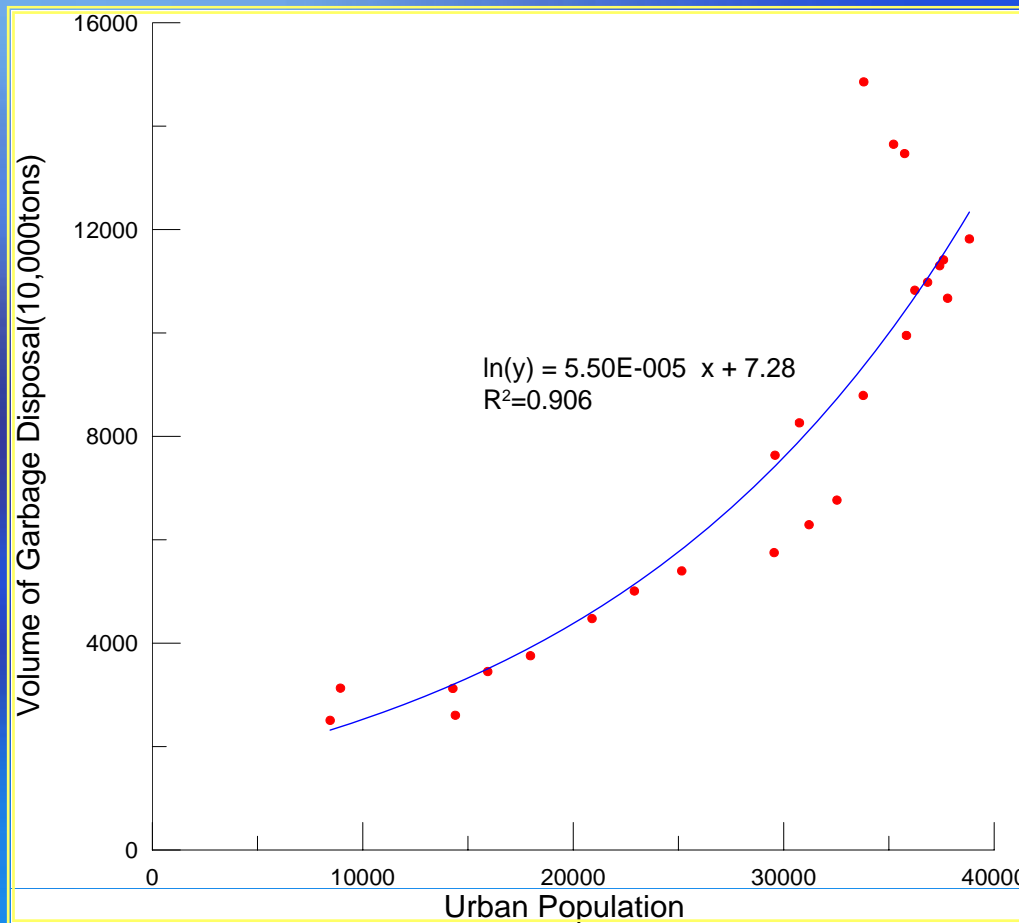
The area of city



The relation of area of city and the generate amount of MSW

Methods and data used in estimation

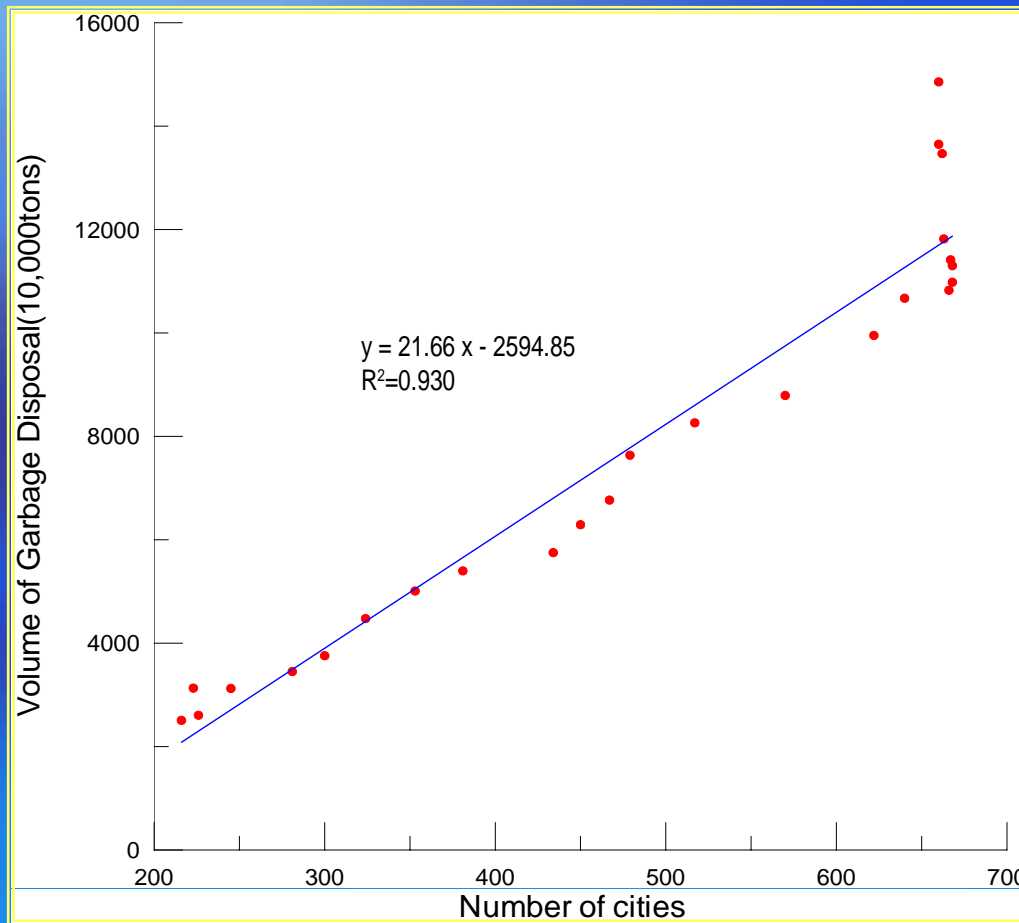
Urban population



The relation of urban population and the generate amount of MSW

Methods and data used in estimation

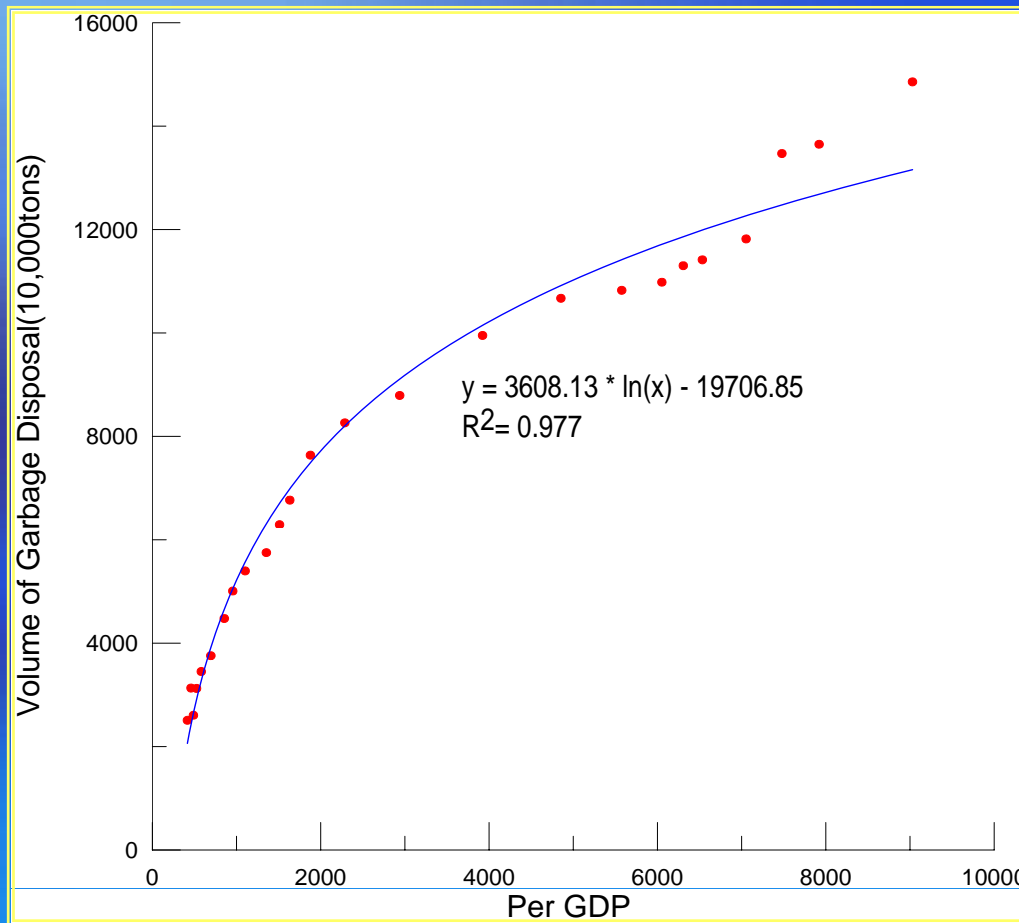
The number of city



The relation of city numbers and the generate amount of MSW

Methods and data used in estimation

GDP per capita



The relation of per GDP and the generate amount of MSW

Methods and data used in estimation

The relationship of MSW Generation amount and its driving forcing

◆ Estimate model for MSW

□ Non-agricultural population:

$$\text{MSW} = 12929.25 \ln(x) - 116443.35$$

Where, x represent non-agricultural population (ten thousand person)

□ GDP:

$$\text{MSW} = 3311.16 \ln(x) - 25493.29$$

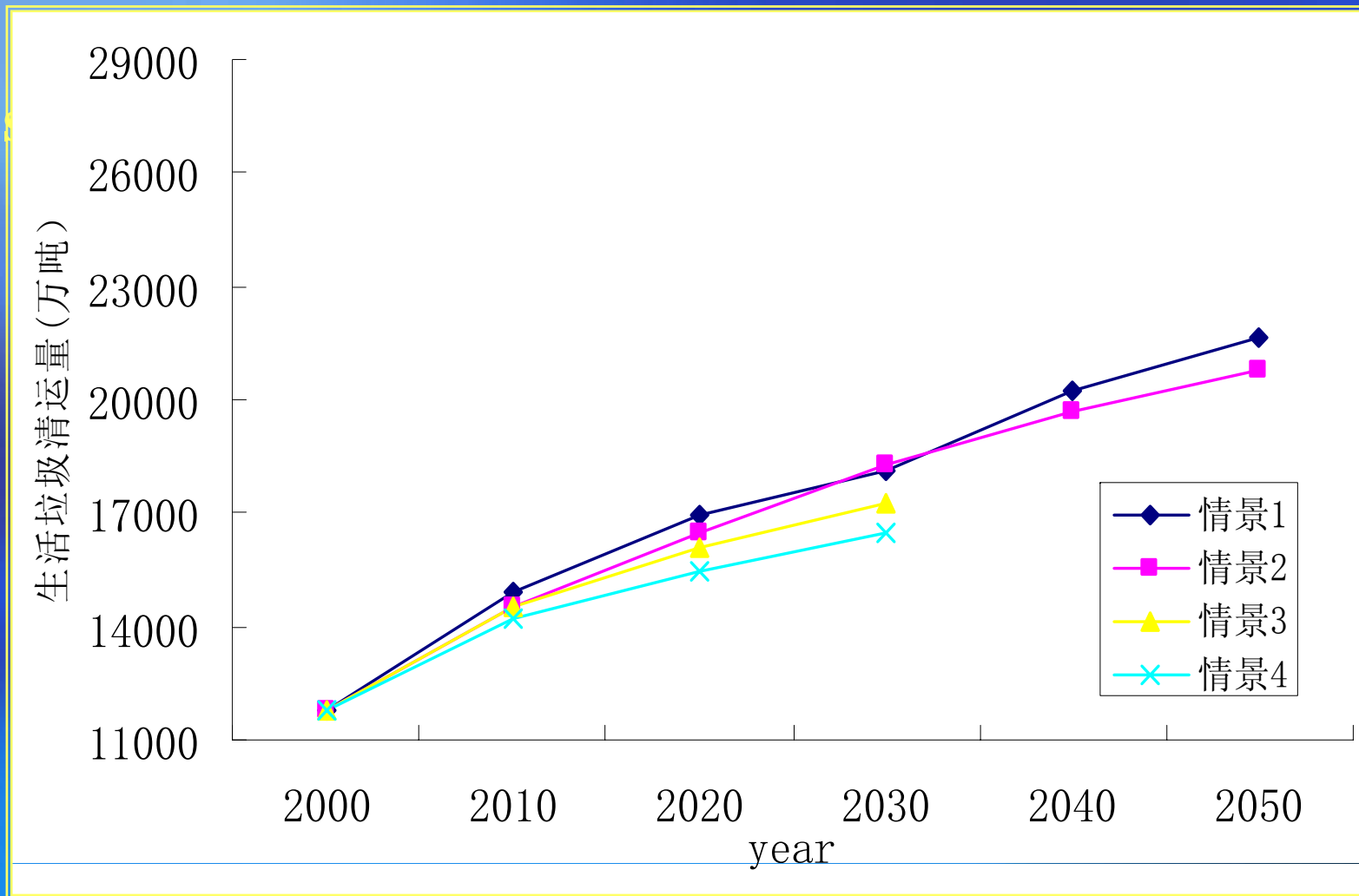
Where, x represent GDP (100 million Yuan RMB)

□ GDP per capita

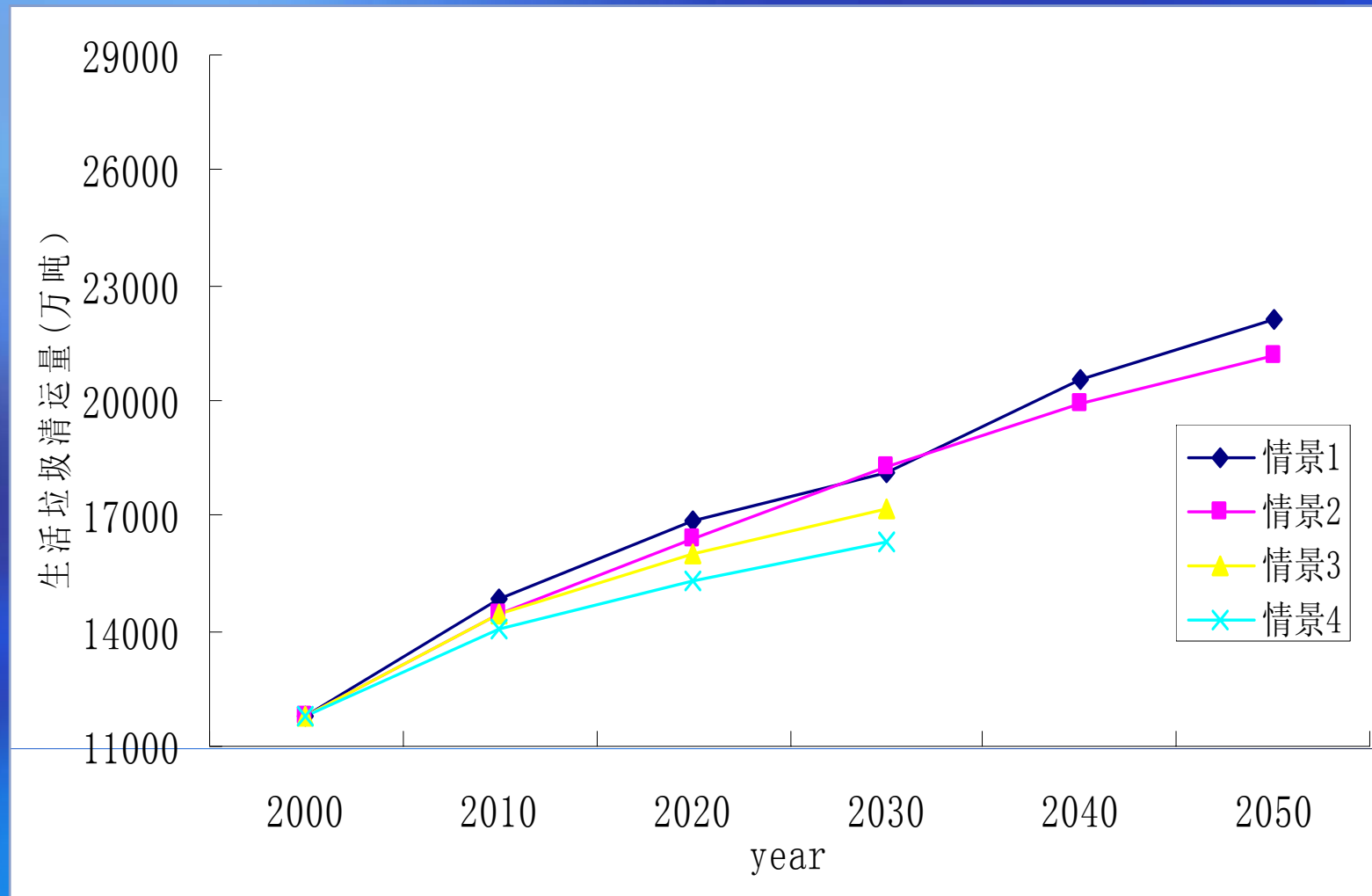
$$\text{MSW} = 3608.13 \ln(x) - 19706.85$$

Where, x represent GDP per capita (Yuan RMB)

Results of estimation



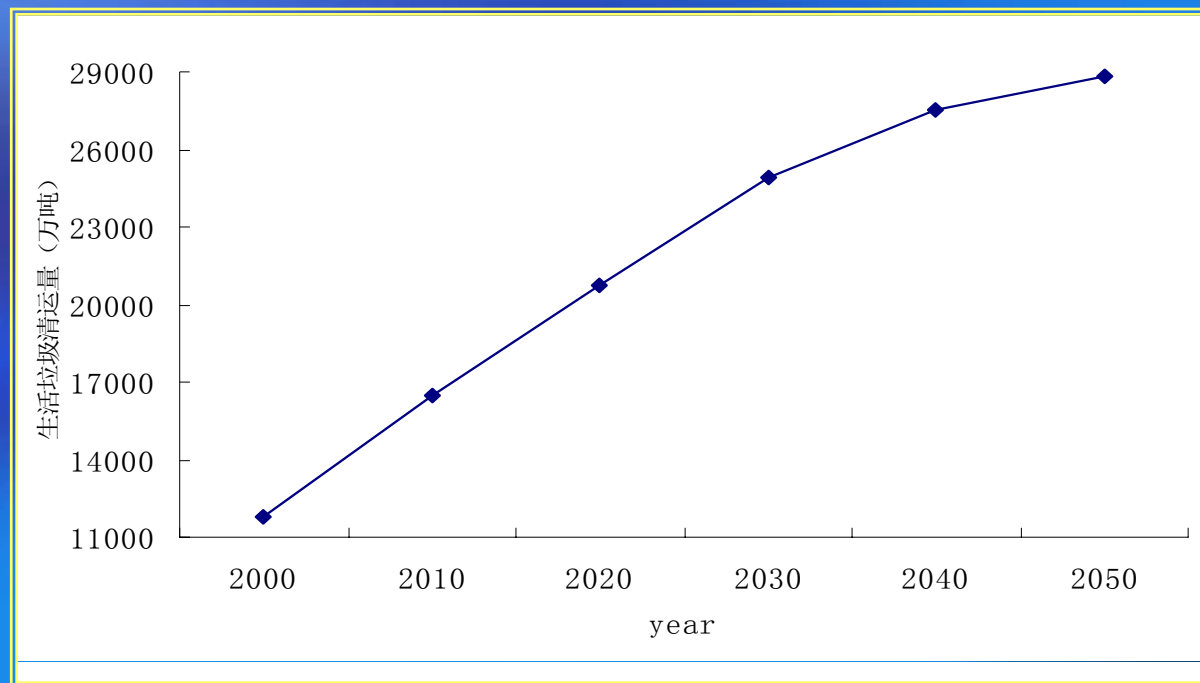
Results of estimation



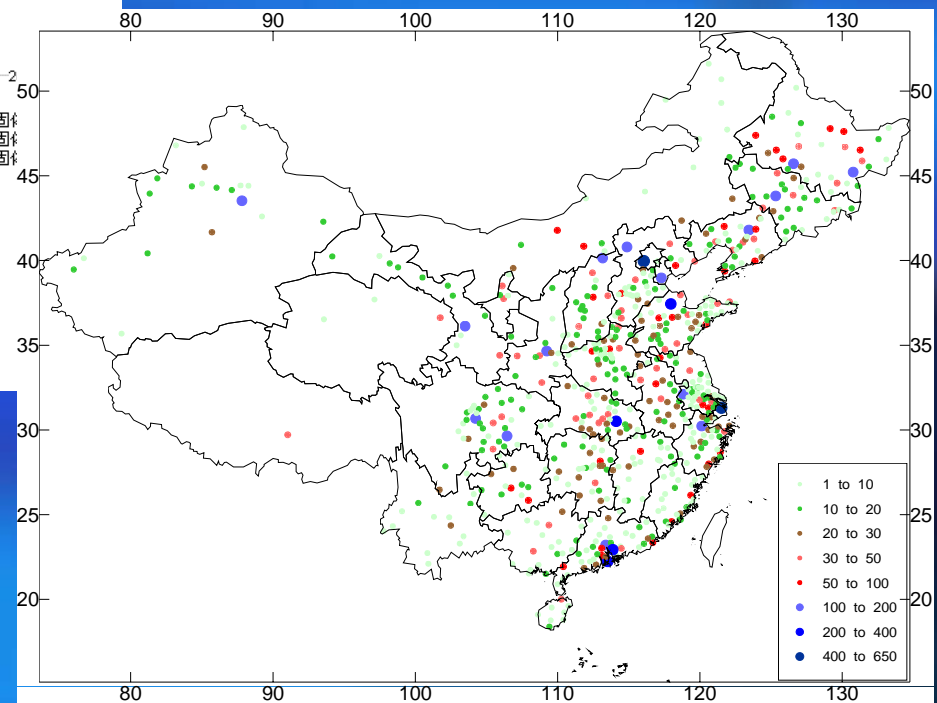
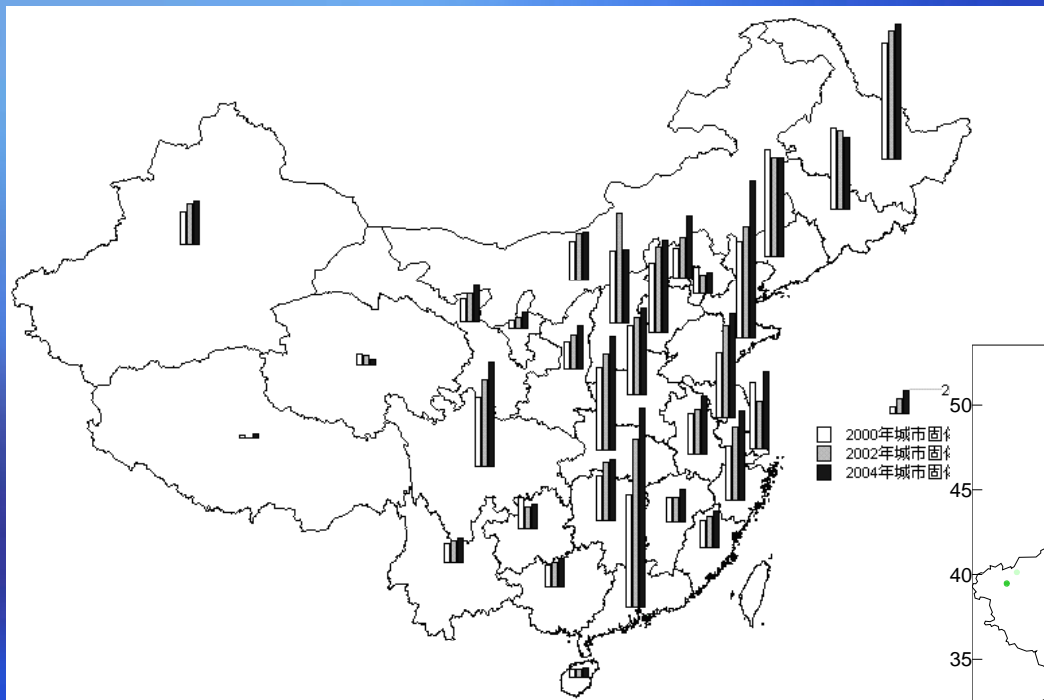
Results of estimation

Non-Agriculture Population Scenarios

Year	2000	2010	2020	2030	2040	2050
Non-A Population	20952.5	29101.4	40419.6	56139.6	68433.9	75593.6

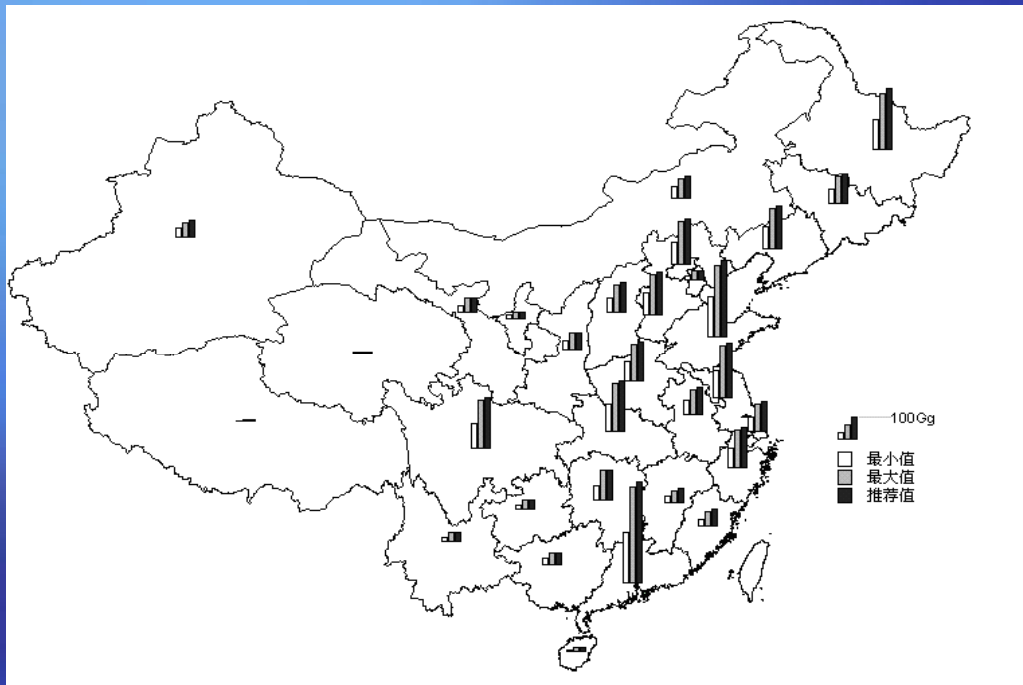


Results of estimation

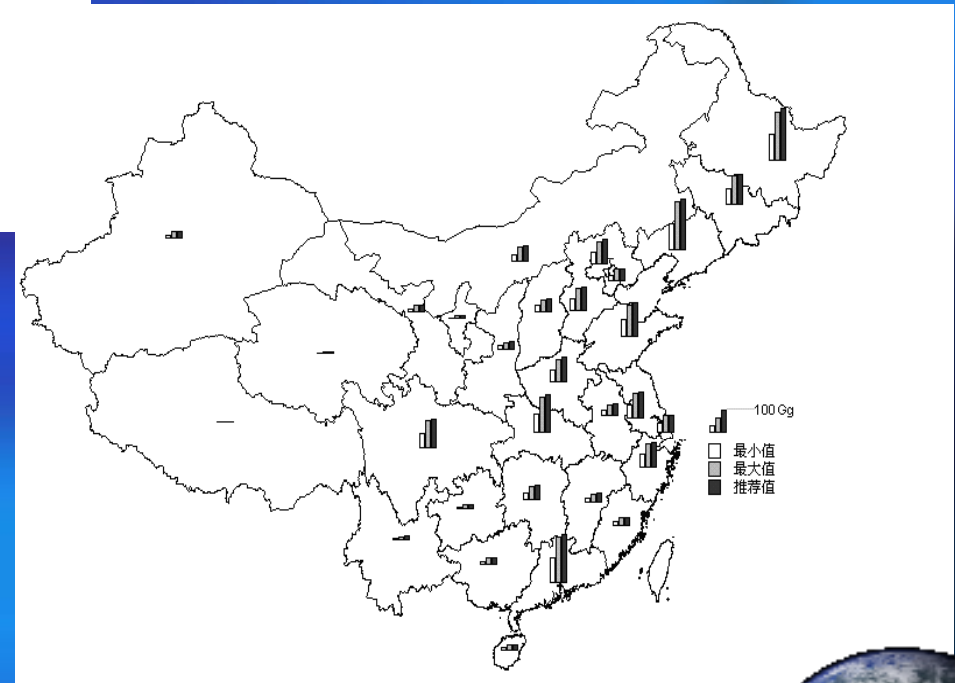


MSW Generation amount distribution
(2000,2002,2004)

Results of estimation

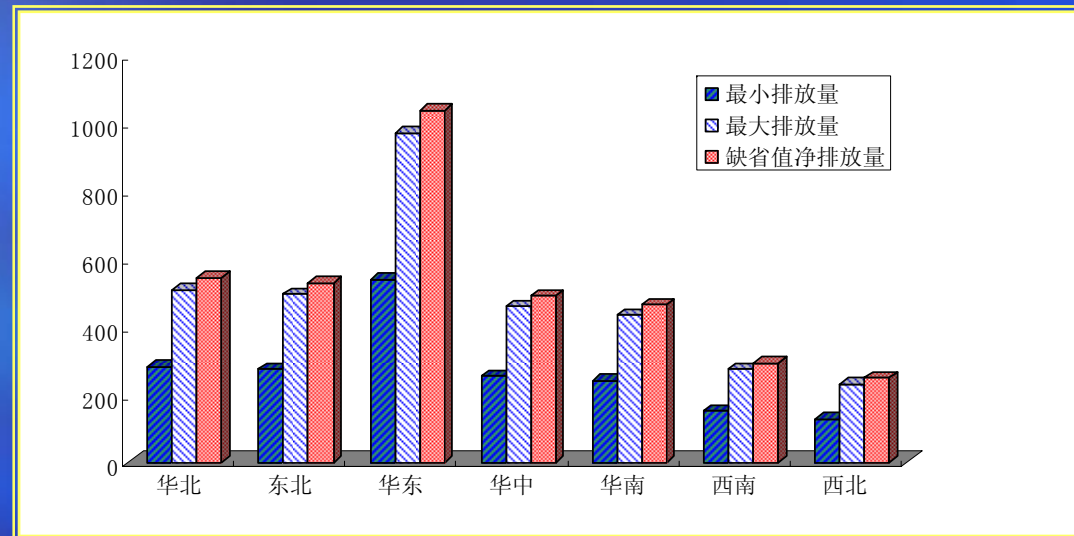


The methane emission of 2004

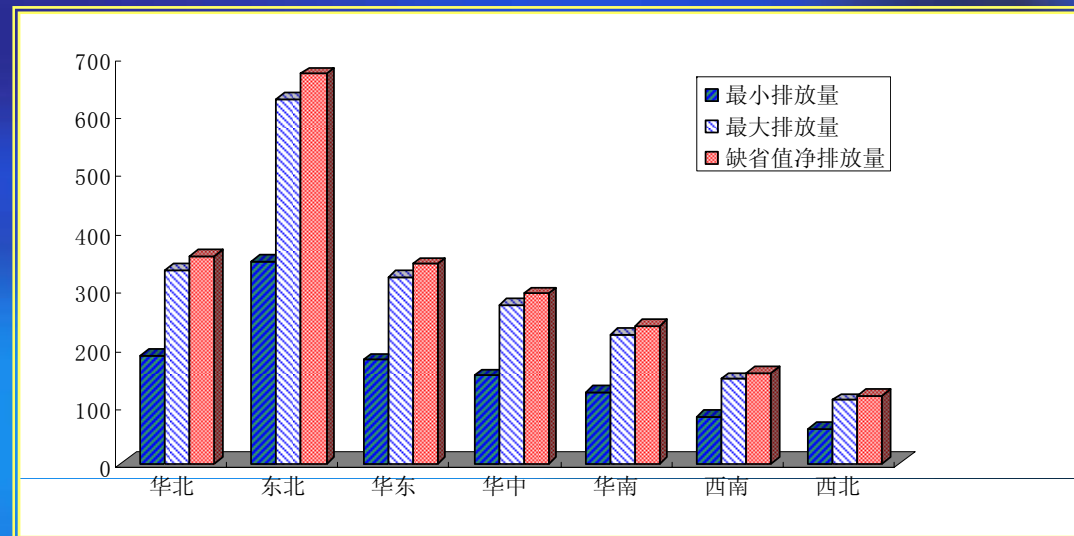


The methane emission of 1994

Results of estimation



1994



2004

Useful advice / recommendation China's experience

▣ Regional issues

▣ *economic level*

▣ *industrial level*

▣ *climate condition*

▣ *life style*

▣ Manage Issues

▣ *law and regulation as well as standard*

▣ *Statistics system*

▣ *Data sharing mechanism*

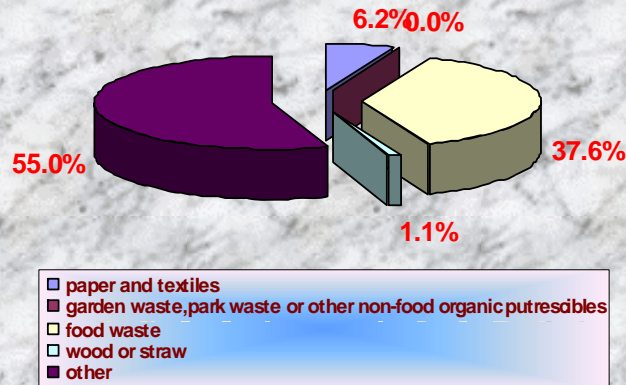


Thanks for your attention!

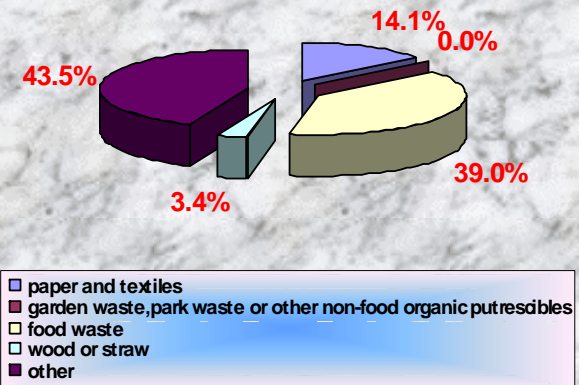
The Composition of MSW in China

The weighted average of carbon content of various components of waste stream

Beijing



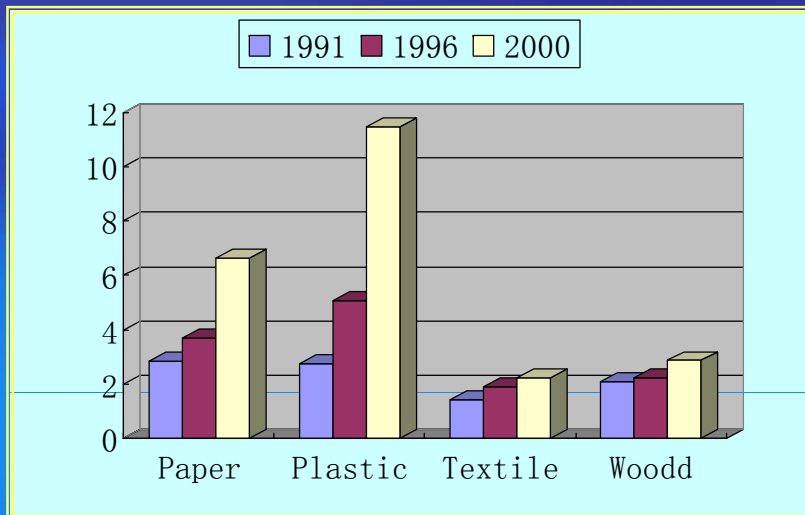
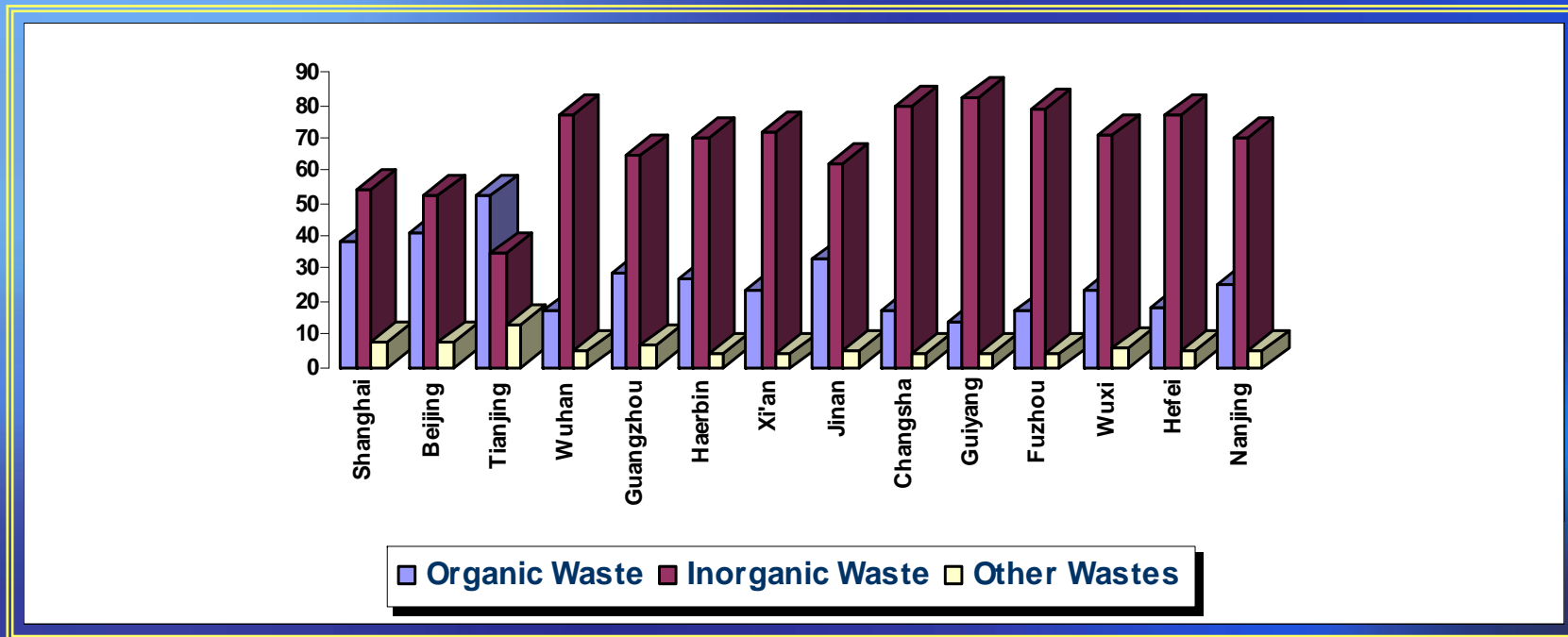
Tianjing



Sample	Tianjing	Beijing	Average
Paper and Textiles	14.08	6.24	10.16
Food waste	39.02	37.63	38.33
Wood and straw	3.4	1.15	2.28
Others	43.5	54.99	49.25

components of waste stream	Organic Caron percentage (Weight)
Paper	26
Wood and straw	28
Textiles	30
Food waste	7

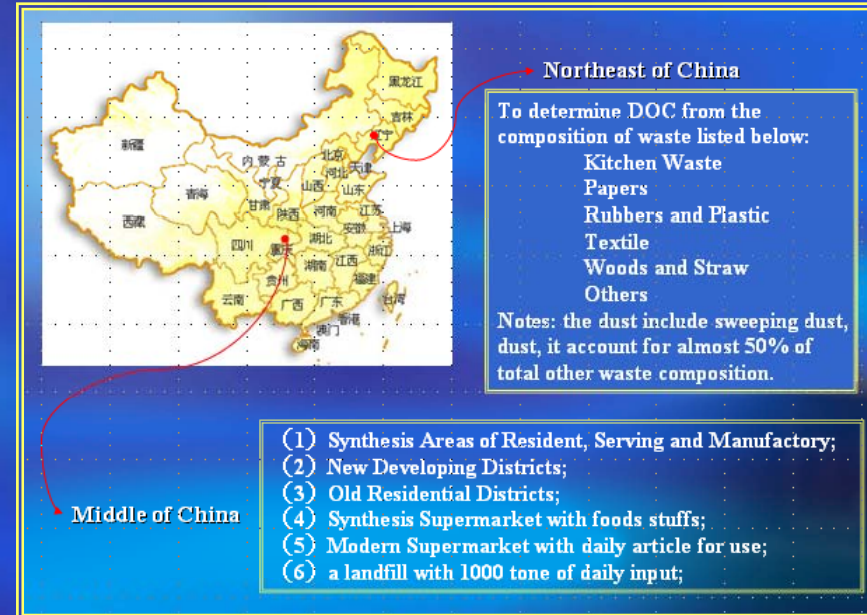
The Composition of MSW in China



- ① Organic waste increase (~50%);
- ② Inorganic Waste decrease (~23.34%);
- ③ Recycle waste increase (~26.6%);
- ④ Combustible waste increase.

The Composition of MSW in China

- ☑ Because there are more containing amount of moisture in kitchen waste in China, the DOC value of kitchen waste(10.2%) in China is lower than IPCC default value(15%).
- ☑ Due to the wood and straw waste in China mostly is dry, and there are not too much fresh woods and straw waste in China, so the DOC value of wood and straw (35.5%)in China is higher than IPCC default value(30%).



Waste Streams	DOC (Weight)
Papers	28.53
Wood and Straw	35.51
Textiles	27.68
Kitchen waste	10.19
Dust (Sweeping dust)	2.48

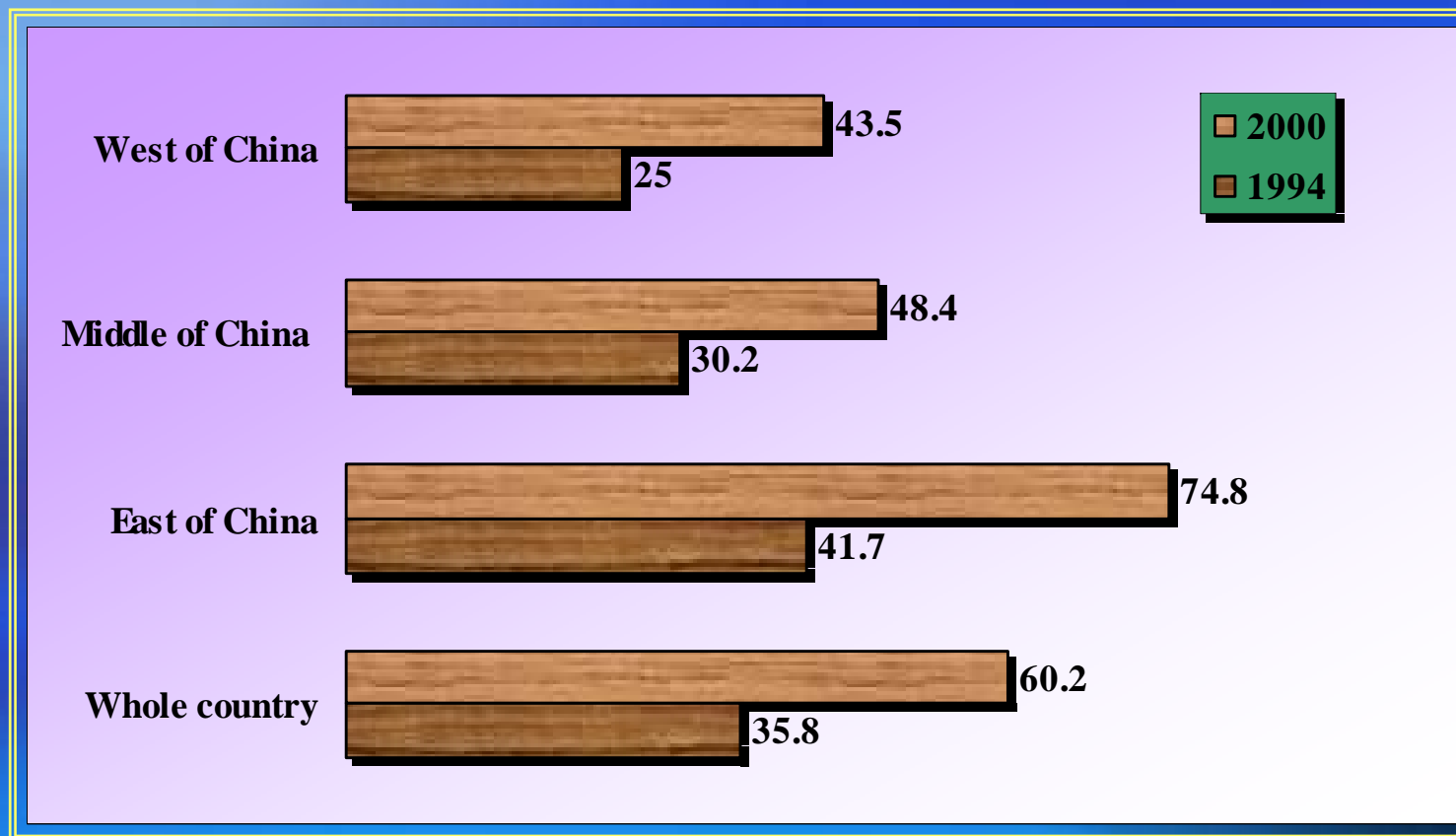
For fresh waste only

The Composition of MSW in China

Collect different city historical data

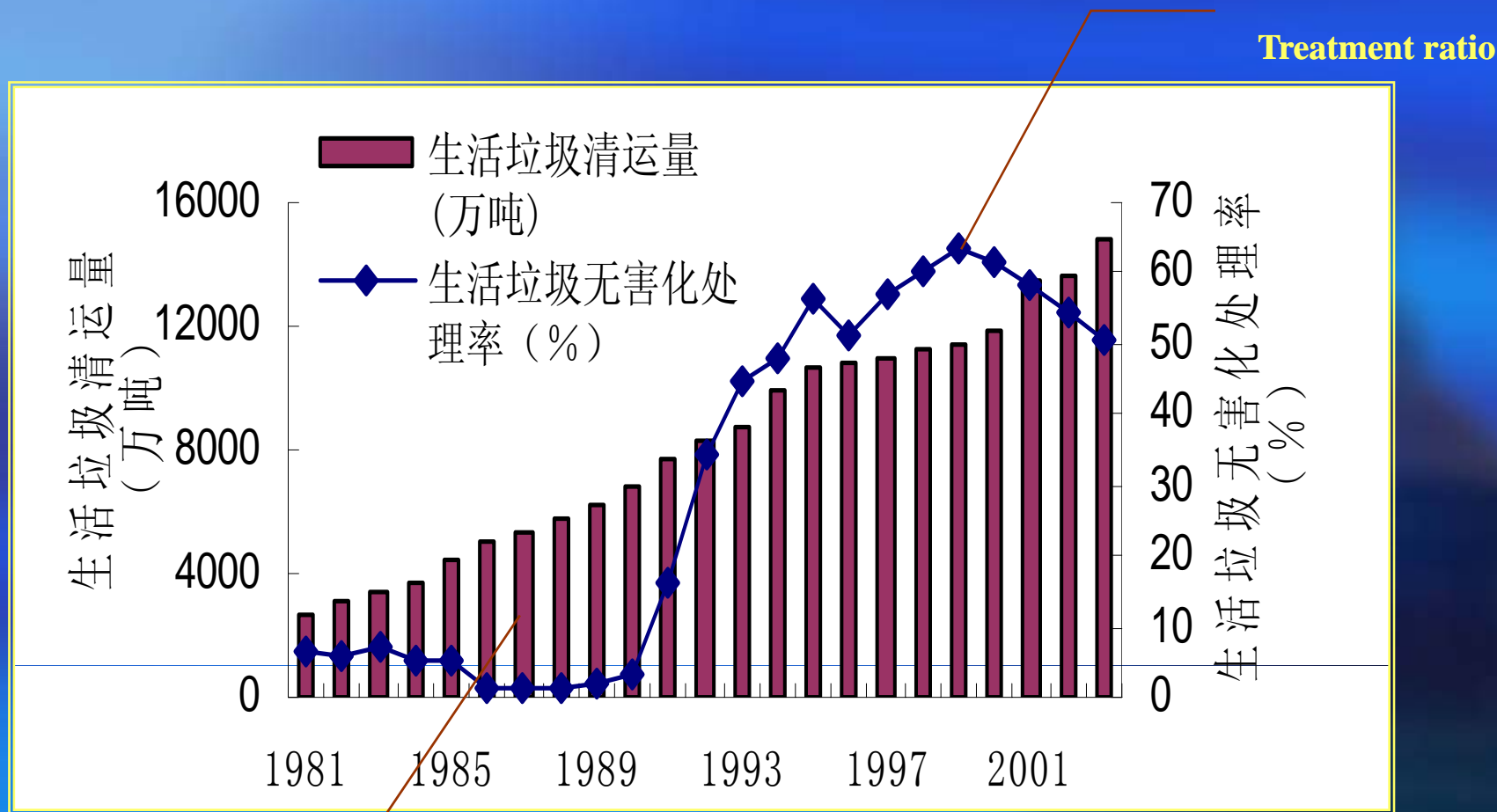
Sample cities	Year	Fresh MSW									humidity
		Kitchen	Paper	Plastic	Textile	Wood	Metal	Glass	Brick	Others	
57	1985—1990	27.54	2.02	0.68	0.7		0.54	0.78	67.76		
68	1991	59.86	2.85	2.77	1.43	2.1	0.95	1.6	25.03	3.41	41.06
72	1992	57.94	3.04	3.3	1.71	1.9	1.13	1.79	25.9	3.28	40.68
67	1993	54.25	3.58	3.78	1.71	1.83	1.08	1.69	27.76	4.32	41.61
75	1994	55.39	3.75	4.16	1.9	2.05	1.16	1.89	25.69	4	40.71
69	1995	55.78	3.56	4.62	1.98	2.58	1.22	1.91	23.71	4.64	39.05
82	1996	57.15	3.71	5.06	1.89	2.24	1.28	2.07	22.31	4.27	40.75
67	1999	49.17	6.72	10.73	2.1	2.84	1.03	3	21.58	3.26	48.15
73	2000	43.6	6.64	11.49	2.22	2.87	1.07	2.33	23.14	6.42	47.77

The Disposal Rate of MSW in China



The disposal rate in different region of China (1994 and 2000)

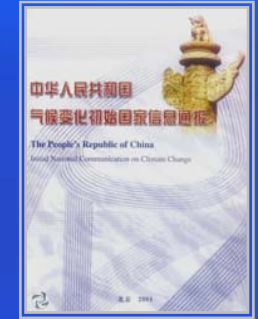
The Disposal Rate of MSW in China



Generate amount of MSW

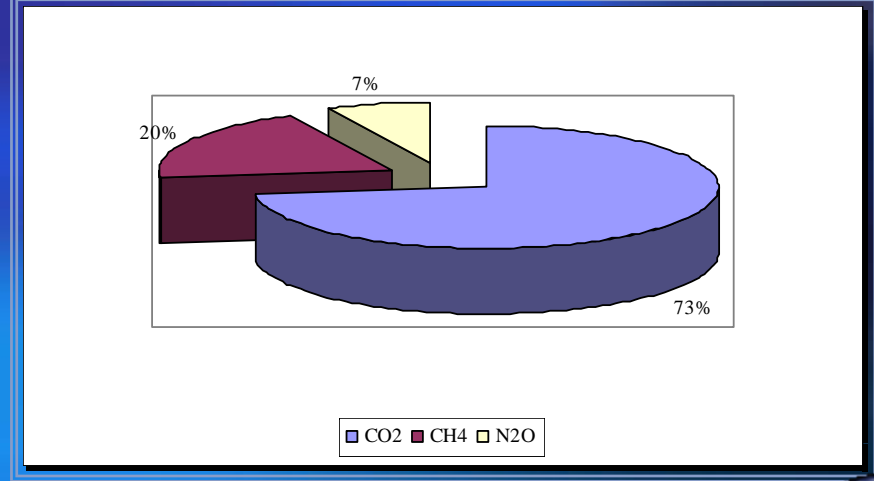
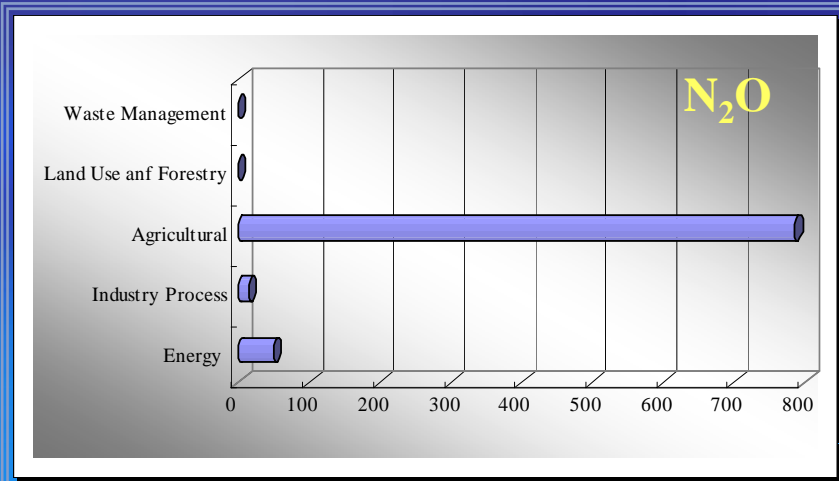
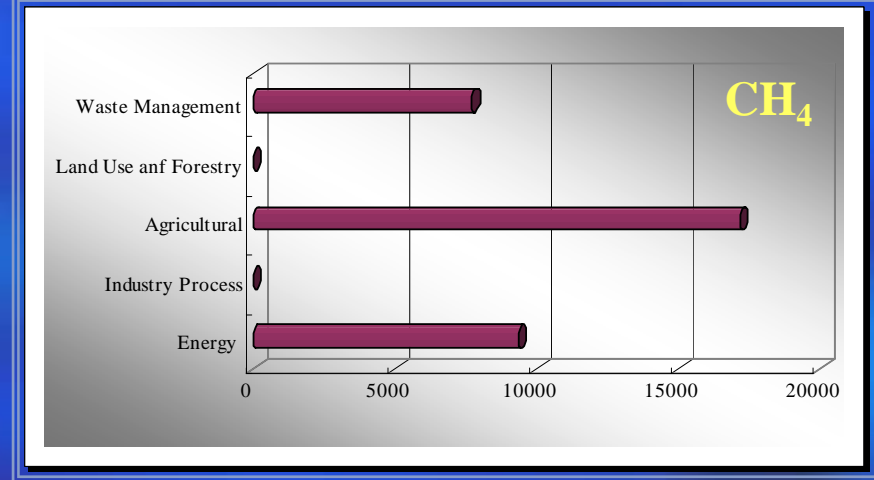
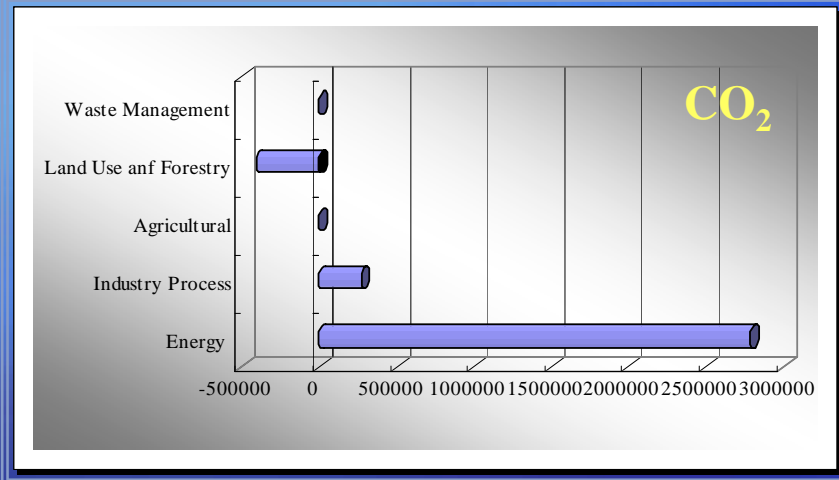
1981 - 2003

Information of SNC



- ▣ To submit lately National Greenhouse gases inventory
 - ▣ *INC: 1994*
 - ▣ *SNC: 2005*
- ▣ To add new gases sources
 - ▣ *INC: CO₂, N₂O, CH₄*
 - ▣ *SNC: CO₂, N₂O, CH₄, HFCs, PFCs, SF₆*
- ▣ Geographical Scope
 - ▣ *INC: China mainland*
 - ▣ *SNC: China Mainland + Hongkong SAR + Macao SAR*

The Greenhouse Gas Emission in different sector of China (1994)



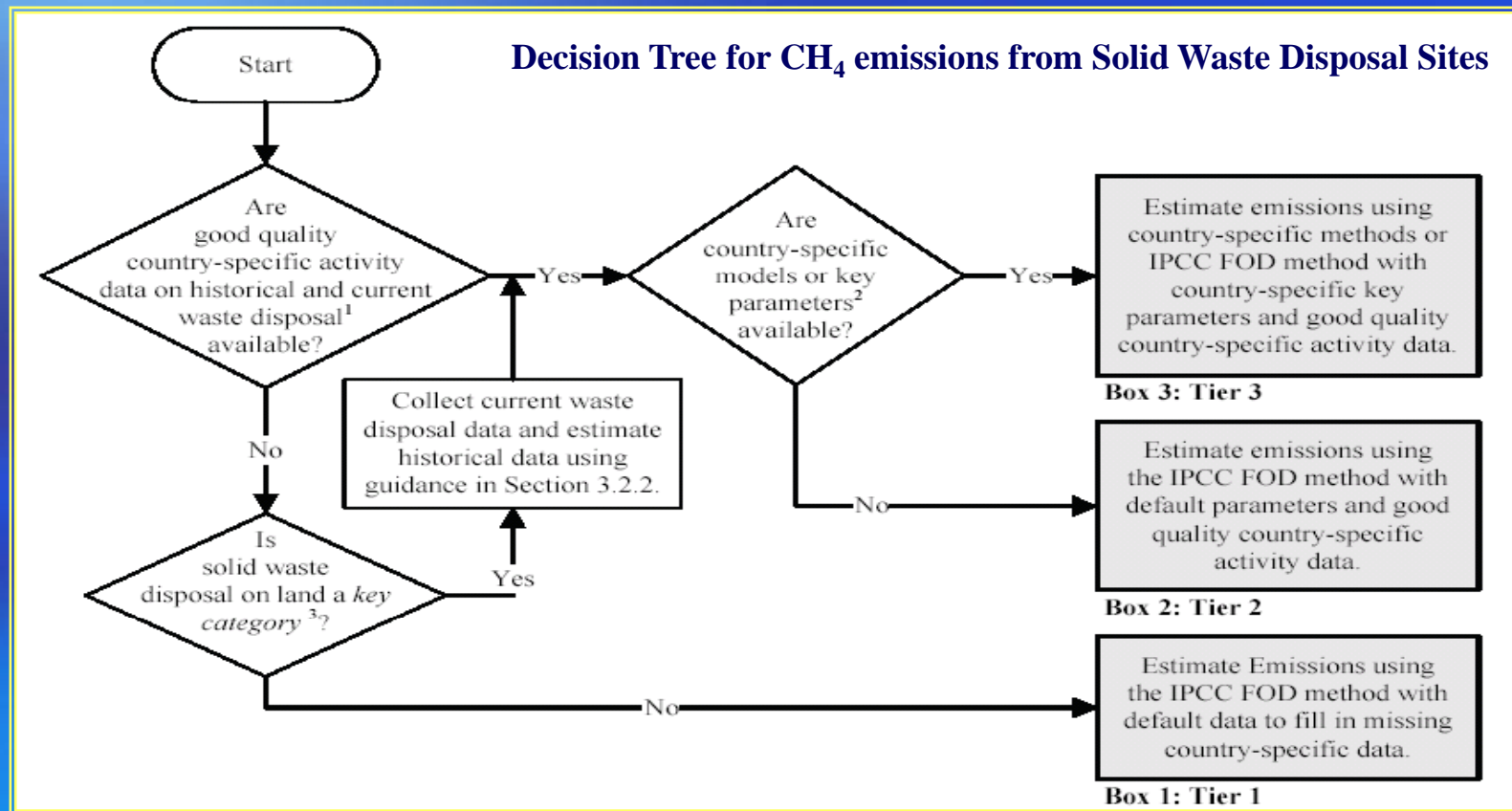
UNCERTAINTY ASSESSMENT

There are two areas of uncertainty in the estimate of CH₄ emissions from SWDS:

- ❑ the uncertainty attributable to the method;
- ❑ the uncertainty attributable to the data
(activity data and parameters)

UNCERTAINTY ASSESSMENT

- ◆ the uncertainty attributable to the method



UNCERTAINTY ASSESSMENT

◇ the uncertainty attributable to the data how the data is obtained ?

□ activity data

weighed

▣ **waste generation data** (total municipal solid waste, total industrial waste)

City 662 √

Counties 2861

village and town 44821

▣ **composition data**

based on the survey in typical cities or region

▣ **management data** (the fraction of solid waste sent to SDWS)

UNCERTAINTY ASSESSMENT

◇ the uncertainty attributable to the data

□ parameters

- ❖ Methane correction factor (MCF)----- →*Expert judgments*
- ❖ Degradable organic carbon (DOC)----- →*country specific*
- ❖ Fraction of degradable organic carbon which decomposes
(DOCf)
- ❖ Fraction of CH₄ in landfill gas (F)
- ❖ Methane recovery (R)
- ❖ Oxidation factor (OX)
- ❖ The half-life