Guidelines for Accounting and Reporting

Greenhouse Gas Emissions

Other Industrial Enterprises

(Trial)

April 2015

Instruction

I. Purpose and Significance of the Guidelines

The National Development and Reform Commission (NDRC) issued *Notification to Unfolding the Process of Greenhouse Gas Report for Key Enterprises and Public Institutions* (No.63 Document in 2014 of Department of Climate change, NDRC), and meanwhile organized the study of the development of the accounting methods and guidelines of greenhouse gas emissions for key enterprises, in order to meet demands of "establishing the statistical accounting system and building up carbon emissions trading market" put forward in the 12th Five-Year Plan Outline, and of "accelerating the establishment of national, local, enterprise three-level accounting system of greenhouse gas emission and system of requiring key enterprises to directly submit data of greenhouse gas emission and energy consumption" put forward in *12th Five-Year Plan Work Program to Control Greenhouse Gas Emission* (No. 41 Document in 2011 of the State Council). The *Guidelines for Accounting and Reporting Greenhouse Gas Emissions from Enterprises of Other Industries*(Trial)(the Guidelines) illustrates the general methods and rules of accounting and reporting greenhouse gas emissions for those industrial enterprises which so far do not have a specific accounting method and reporting guideline to follow under the current classification of industrial sectors of national economy. The Guidelines endeavor to help those enterprises (i) scientifically calculate and report their own greenhouse gas emissions, (ii) make control plans of greenhouse gas emissions, (iii) take active part in carbon emissions trading and (iv) strengthen enterprises' social responsibilities. Meanwhile, it provides technical support for authorities in charge of enterprises and public institutions, to better report greenhouse gas emissions, collect the emissions information of key enterprises and make relevant policies in line with climate change.

II. Preparation Process

The Guidelines are developed by the National Center for Climate Change Strategy and International Cooperation (NCSC), entrusted by the NDRC. The writing team completes the *Guidelines for Accounting and Reporting Greenhouse Gas Emissions from Other Industrial Enterprises* (Trial) after dedicated field researches and in-depth study, as well as reference to research achievements and practical experiences at home and abroad about accounting report on greenhouse gas emissions, *2006 IPCC Guidelines for National Greenhouse Gas Inventories* issued by Intergovernmental Panel on Climate Change (IPCC), and *Provincial Guidance on the Compilation of Greenhouse Gas Inventories* (Trial) issued by the General Office of the NDRC. The Guidelines strive to pursue a science-based, comprehensive, standardized and practical approach. China National Textile and Apparel Council, China Machinery Industry Federation and Zhejiang Center for Climate Change Strategy and Low-carbon Development Cooperation have made great contributions in the drafting.

III. Main Contents

The *Guidelines for Accounting and Reporting Greenhouse Gas Emissions from Other Industrial Enterprises* (Trial) include the main text and two appendixes. The main text is divided into six sections to introduce the scope of application, references, terminology and definitions, accounting methods of greenhouse gas emissions for other industrial enterprises, quality assurance and document filing, as well as reporting contents. The types of emission sources and gases covered in the Guidelines including: CO_2 emissions from fossil fuel burning and use of carbonate, CH_4 emissions from industrial anaerobic wastewater treatment, recycled and disposed CH_4, recycled and reused CO_2, as well as CO_2 emissions from net purchased electricity and heat. Those emission sources with high uncertainty which contribute little (less than 1%) to the enterprise total emissions and which are costly to monitor may be excluded from monitoring and reporting by reporting entities for the time being.

IV. Other Issues to Clarify

As the development of reporting greenhouse gas emissions by key enterprises and public institutions and national trading system of carbon emissions permit, the accounting methods and report guidelines of greenhouse gas emission for certain industries shall be complemented in due time and proper practical needs. Once a certain industry has more applicable guidelines for accounting and reporting greenhouse gas emissions, these Guidelines shall not apply to the aforesaid industries.

Enterprises applying the Guidelines should be limited to the lowest level of enterprise legal persons or independent accounting units regarded as legal persons. They shall identify, account and report the greenhouse gas emission from all the production facilities within the enterprise boundary. The reporting enterprises should provide corresponding activity data and emission factors for emission accounting and review. Enterprises should measure their own activity data and emission factors to the extent possible. For the convenience of users, the Guidelines provide characteristic parameters of common fossil fuels, as well as recommended values of emission factors of other emission sources for those enterprises that do not have conditions for field measuring, based on reference documents, such as, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories,* and *Provincial Guidance on the Compilation of Greenhouse Gas Inventories* (Trial).

In consideration of the fact that enterprises greenhouse gas accounting and reporting is a new endeavor, some inadequacies may be found in practical application of the Guidelines, and it is hoped that those application units may provide their individual feedbacks in a timely manner, all aimed at making further revision in the future.

The Guidelines are published by the National Development and Reform Commission, which is responsible for their interpretation and revision when appropriate.

Contents

1. Scope of Application

The Guidelines provide the industrial enterprises which so far do not have specific accounting methods and reporting guidelines to follow under the current classification of industrial sectors of the national economy, with related terminology of greenhouse gas emissions accounting and reporting, accounting boundary, accounting methods, data quality management, report content and forms.

The Guidelines apply to the industrial enterprises which so far do not have specific accounting methods and reporting guidelines to follow under the current classification of industrial sectors of the national economy. As reporting greenhouse gas emissions by key enterprises and public institutions, and national trading system of carbon emissions permits are under development, the accounting methods and report guidelines of greenhouse gas emissions for certain industrial sectors may be amended in due time to respond to changing needs. Once new guidelines are enacted, the Guidelines shall not cease to apply to these enterprises.

2. References

Documents cited in the Guidelines mainly include:

GB/T 213 Determination of Calorific Value Coal;

GB/T 384 Determination of Calorific Value of Petroleum Products;

GB/T 22723 Energy Determination for Natural Gas;

GB/T 476 Determination of Carbon and Hydrogen in Coal;

SH/T 0656 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen and Nitrogen in Petroleum Products and Lubricants;

GB/T 13610 Analysis of Natural Gas (Gas Chromatographic Method);

GB/T 8984 Determination of Carbon Monoxide, Carbon Dioxide and Hydrocarbon in Gases (Gas Chromatographic Method);

GB 17167 General Principle for Equipping and Managing of the Measuring Instrument of Energy in Organization of Energy Using;

GB/T 3286.1 Methods for Chemical Analysis of Limestone and Dolomite - The Determination of Calcium Oxide and Magnesium Oxide Content;

GB/T 3286.9 Methods for Chemical Analysis of Limestone and Dolomite - The Determination of Carbon Dioxide Content; and

General Principle of the Greenhouse Gas Emissions Accounting and Reporting for Industrial Enterprises.

3. Terminology and Definitions

For the purposes of the Guidelines, the following terminology and definitions apply.

3.1Greenhouse gases

A greenhouse gas is natural or man-made atmospheric component in gaseous state that absorbs and emits radiation within the thermal infrared range. The GHGs addressed in the Guidelines refer to the six types of GHGs which are listed in Annex A of the Kyoto Protocol, namely, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF^6).

3.2Reporting entity

A reporting entity shall be an enterprise with a legal person status or an independently accounted unit that can be deemed a legal person, which has performed as a GHG emissions actor and therefore should calculate and report its GHG emissions.

3.3Enterprise of other industries

Enterprise of other industries refers to those industrial enterprises which so far do not have specific accounting methods and reporting guidelines to follow under the current classification of industrial sectors of the national economy.

3.4 CO_2 emissions from fossil fuel burning

CO_2 emissions from fossil fuel burning refer to CO_2 emissions during the deliberate combustion of fossil fuel with oxygen for the purpose[1] of releasing energy for use.

3.5 CO_2 emissions from use of carbonate

CO_2 emissions from use of carbonate refer to CO_2 emissions during the decomposition that uses carbonate as raw material, fluxing agent, desulfurizing agent or for other purposes.

3.6 CH_4 emissions from anaerobic wastewater treatment

[1]The fuel combustion is for heat-providing or mechanical work.

Emissions of carbon dioxide, methane and nitrous oxide happen during anaerobic wastewater treatment. The Guidelines request the calculation of emissions of methane from anaerobic wastewater treatment only.

3.7Quantity of recycled and decomposedCH_4

Quantity of recycled and decomposedCH_4refers to the CH_4 kept from releasing to the atmosphere due to proper recycle and reuse or methods of torch decomposition by the reporting entities.

3.8Quantityof recycled and reusedCO_2

Quantity of recycled and reused CO_2 refers to the CO_2 generated by reporting entities, and recycled and reused as raw material or supplied to other enterprises instead of being released to the atmosphere.

3.9CO_2 emissions from net purchased electricity and heat

GHG emissions generated from enterprises' consumption of electricity and heat corresponding to the net purchased quantities of electricity and heat (steam and hot water).

3.10 Activity level

During the reporting period, quantification of deliberate activities causing or decreasing greenhouse gas emissions by reporting entities, including consumption of various fuels, use of raw materials, purchased electricity, purchased steam etc.

3.11 Emission factor

Emission factor refers to the quantified rate of GHG emissions per unit of activity. Emission factors are usually obtained through sampling measurement or statistical analysis, indicating the representative emissions or decrease ratio of a particular activity under given operating conditions.

3.12 Carbon oxygenation efficiency

Carbon oxidation rate is the percentage of total carbon in fuels containing carbon oxidized in the process of combustion.

4. Accounting Methodology of GHG Emissions for Other Industrial Enterprises

Reporting entities shall calculate GHG emissions by following the steps below:

a. Define the accounting boundary;

b. Identify the types of emissions sources and greenhouse gases involved;

c. Choose corresponding calculation formulas of GHG emissions;

d. Design the monitoring plan to collect activity data and emission factors;

e. Put the data into the calculation formulas to get the quantity of each GHG emissions source;

f. Sum up all the emissions and compose the enterprise GHG emissions report in line with the report content and template.

4.1Accounting Boundary

A reporting entity shall regard enterprise legal persons or independent accounting units as the enterprise boundary to report the greenhouse gas emissions from all the production facilities under its operational control[2]. Production facilities include direct production system, ancillary production system and affiliated production system. Ancillary system includes power, electricity supply, water supply, heating, refrigeration, machine maintenance, tests, instruments, warehouse (raw material storage), transportation etc. Affiliated production system includes production command and management system (factory headquarters) and departments and units that are serving production (staff canteen, workshop bathroom, health station).

4.2 Emission source and types of gas

Reporting entities shall identify their emissions sources and types of gas that should be calculated and reported according to the industrial activities and types of equipment. The calculation and reporting of emissions sources with high uncertainty which contribute little (less than 1%) to the enterprise total emissions and which are costly to monitor may be excluded from monitoring and reporting by reporting entities for the time being, but in the reports those reporting entities need to elaborate the reasons for not reporting and provide supporting material to explain the difficulty in doing so. According to the above principles, emissions sources and types of gas needed to be calculated by other industrial enterprises include but are not limited to:

4.2.1 CO_2 emissions from fossil fuel burning, which mainly refer to the CO_2

[2]If a reporting entity has complete authority of operation and disposition over an equipment or business, this enterprise has thus the operational control of this equipment or business.

emissions from fossil fuel burning for the purposes of power or heat, including CO_2emissions caused by oxy-acetylene welding or acetylene cutting or burning;

4.2.2 CO_2 emissions from use of carbonate, which refer to the CO_2 emissions from using carbonate, such as limestone and dolomite, as raw material, fluxing agent, desulfurizing agent or for other purposes;

4.2.3 CH_4 emissions caused by anaerobic wastewater treatment, which refer to CH_4 emissions from anaerobic process by reporting entities;

4.2.4Quantity of recycled and decomposedCH_4, which refers to the CH_4prevented from being released to the atmosphere due to proper recycling and reuse or methods of torch decomposition by the reporting entities. The recycling and reuse includes those reused as raw material by the reporting enterprise or supplied to other enterprises;

4.2.5Quantity of recycled and reusedCO_2 , which refers to the CO_2which, though generated by reporting entities, is recycled and reused as raw material or supplied to other enterprises instead of being released to the atmosphere.

4.2.6 CO_2 emissions from net purchased electricity and heat. Although this part of emissions actually takes place in the enterprises producing electric power or heating, it is triggered by consumption activities of the reporting entities. Thus this part of emissions shall be added to the total emissions of reporting entities pursuant to relevant regulations.

4.3 Total Greenhouse Gas Emissions of Reporting Entities

To calculate the total greenhouse gas emissions, enterprises of other industries shall refer to Figure 1 emissions source and types of gas and Equation (1). If an emission source is not included in Equation (1), reporting entities can delete this item in the right-hand side of the equation. If besides the above-mentioned emission sources, there are other sources which contribute more that 1% of the total greenhouse gas emissions, reporting entities should separately account these greenhouse gas emissions sources and list them in the right column of the formula. Because related methods can be found in the guidelines on accounting and reporting greenhouse gas emissions for the enterprises producing these other products, no further explanation will be provided in the present Guidelines.

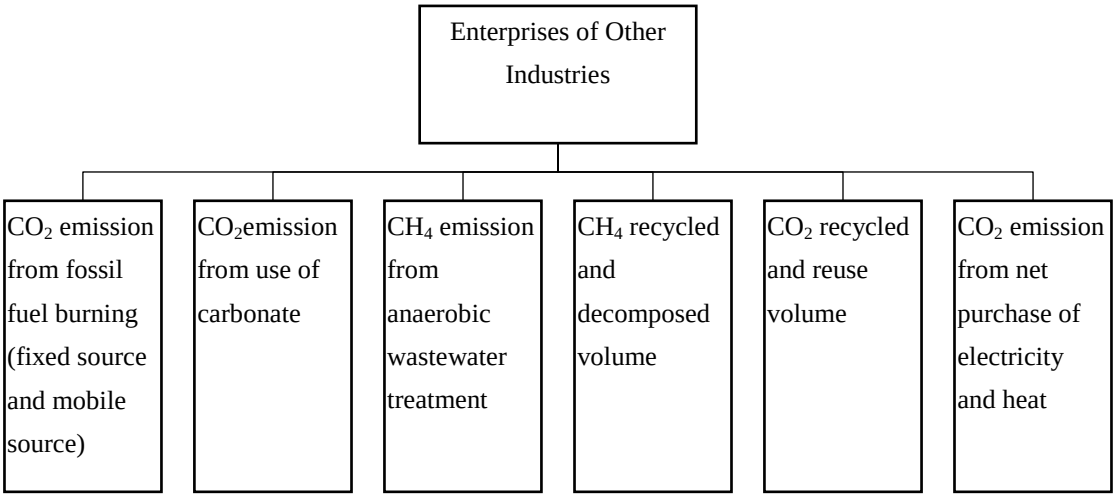

Figure 1 Greenhouse Gas Emission Sources and Types of Gas for Enterprises of Other Industries

$$E_{GHG} = E_{CO_2\_Burning} + E_{CO_2\_Carbonate} + (E_{CH_4\_Wastewater} - R_{CH_4\_Recycled\ and\ Decomposed})\_GWP_{CH_4} - R_{CO_2\_Recycled} + E_{CO_2\_Net\ Electricity} + E_{CO_2\_Net\ Heat} \quad \text{…（1）}$$

where，

E_{GHG} is the total greenhouse gas emissions (unit: tCO_2e);

$E_{CO_2\_Bu}$ is the CO_2 emissions from fossil fuel burning (unit: tCO_2);

$E_{CO_2\_Carb}$ is the CO_2 emissions from decomposition of carbonate (unit: tCO_2);

$E_{CH_4\_Waste}$ is the CH_4 emissions from anaerobic wastewater treatment (unit: tCH_4);

$R_{CH_4\_Recycled\ and\ Decom}$ is the CH_4 recycled and decomposed (unit: tCH_4);

GW is the Global Warming Potential (GWP) Value of methane compared to CO_2.According to the *Guidelines for Provincial Greenhouse Gas Inventories*, the value

is 21, for within 100 years, one ton of methane is equivalent to 21 tons of carbon dioxide;

$R_{CO_2\_Rec}$ is the CO_2 recycled and reused volume (unit: tCO_2);

$E_{CO_2\_Net\ Elec}$ is the CO_2 emissions caused by net purchased electricity (unit: tCO_2); and

$E_{CO_2\_Net}$ is the CO_2 emissions caused by net purchased heat (unit: tCO_2).

4.4 CO_2emissions from fossil fuel burning

4.4.1Calculation equation

The calculation equation of CO_2 emissions from fossil fuel burning is mainly based on the amount of fossil fuel, carbon content per unit of fuel and carbon oxygenation efficiency. The calculation equation is as following:

$$E_{CO_2\_Burning} = \sum_i \left(AD_i \times CC_i \times OF_i \times \frac{44}{12} \right) \quad \text{... (2)}$$

where,

$E_{CO_2\_B}$ is the CO_2 emissions from fossil fuel burning (unit: ton) ;

is the type of fossil fuel;

is the consumption volume of type i fossil fuel specifically used as fuel burning. For solid or liquid fuel, the unit is ton; for gas fuel, the unit is 10,000Nm^3;

is the carbon content of type i fossil fuel. For solid or liquid fuel, the unit is carbon content per ton of fossil fuel; for gas fuel, the unit is tCO_2/10,000Nm^3; and

is the carbon oxygenation efficiency of type i fossil fuel, ranging from 0 to 1.

4.4.2Obtaining activity level data

Different consumption volume of different types of fossil fuel for each equipment should be determined in accordance with the original consumption

record or the statistical book. This consumption volume refers to the fossil fuel that specifically used by each equipment as fuel burning, and should include the generated or recycled fossil energy by enterprises which is consumed by combustion equipment. The measurement of fuel consumption should be in line with the related regulations in *GB 17167-2006General Principles for Equipping and Managing of the Measuring Instrument of Energy in Organizations of Energy Consumption*.

4.4.3Obtaining emission factor data

4.4.3.1Carbon content in fossil fuel

If conditions permit, enterprises may entrust qualified professional organizations to regularly test carbon content of fuel; enterprises with qualified departments may test it themselves. Determination of carbon content should follow the standards in *GB/T 476 Determination of Carbon and Hydrogen in Coal, SH/T 0656 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen and Nitrogen in Petroleum Products and Lubricants, GB/T 13610 Analysis of Natural Gas (Gas Chromatographic Method) or GB/T 8984 Determination of Carbon Monoxide, Carbon Dioxide and Hydrocarbon in Gases (Gas Chromatographic Method)*. Coal should be measured when every batch is replenished to factory or at least one time per month, and the carbon content should be obtained according to the amount of replenishment or weighted average of monthly consumption. Oil products should be measured when every batch is replenished to factory or at least one time per quarter, and use the arithmetic average as its carbon content. Gas fuel such as natural gas should be measured when every batch replenished to factory or at least one time per half a year to determine gas composition; with regard to volume concentration of each type of composition and the carbon atom number in its chemical formula, calculate the carbon content:

$$CC_g = \sum_n \left(\frac{12 \times CN_n \times V\%_n}{22.4} \times 10 \right)$$

... (3)

where,

is gas *g* to be measured on carbon content (unit: ton/10,000Nm^3);

is volume concentration of each gas component *n* to be measured, ranging from 0 to 1. For example, 95% of volume concentration should be recorded;

is the number of carbon atom of the chemical formula of gas component *n*;

is the molar mass of carbon (unit: kg/kmol); and

is the ideal gas molar volume under standard condition (unit: Nm^3/kmol).

If not capable of measuring actual carbon content, enterprises could periodically test net calorific value and estimate the carbon content according to Equation(4):

$$CC_i = NCV_i >$$

... (4)

where,

is the carbon content of type *i* fossil fuel. For solid or liquid fuel, the unit is carbon content per ton of fossil fuel; for gas fuel, the unit is tC/10,000Nm^3;

is the net calorific value of type *i* fossil fuel. For solid or liquid fuel, the unit is GJ/ton; for gas fuel, the unit is GJ/10,000Nm^3; and

is the carbon content per calorific value of type *i* fuel (unit: tC/GJ) For carbon content per calorific value of common commercial energy, see Table 2.1 in Appendix II.

Determination of net calorific value should follow the standards in *GB/T 213 Determination of Carbon and Hydrogen in Coal, GB/T 384 Determination of Calorific Value of Petroleum Products, GB/T 22723 Analysis of Natural Gas (Gas Chromatographic Method)*. Coal should be measured when every batch is replenished to factory or at least one time per month, and the net calorific value should be obtained according to the amount of replenishment or weighted average of monthly consumption. Oil products should be measured when every batch is replenished to factory or at least one time per quarter, and use the arithmetic

average as its net calorific value. Gas fuel such as natural gas should be measured when every batch is replenished to factory or at least one time per half a year, and use the arithmetic average as its net calorific value.

If not capable of measuring actual net calorific value, after getting approval from the competent department, reporting entities could use the recommended value referring to Table 2.1 Net Calorific Value of Common Fossil Fuel in Appendix II.

4.4.3.2Carbon oxygenation efficiency

The carbon oxygenation efficiency of liquid fuel could refer to the recommended value, 0.98; that of gas fuel is 0.99; and that of solid fuel may refer to recommended value as in Table 2.1 Net calorific value of Common Fossil Fuel in Appendix II.

4.5 CO_2emissions from use of carbonate

4.5.1 Calculation equation

CO_2 emissions from use of carbonate are calculated according to the amounts of carbonate used and its CO_2 emission factors:

$$E_{CO_2\_Carbonate} = \sum_i (AD_i \times EF_i \times PUR_i) \quad \text{... (5)}$$

where,

$E_{CO_2_Carb}$is CO_2 emissions from use of carbonate (unit: tCO_2);

is the type of carbonate. If mixed carbonate is consumed in real terms, different types of carbonates should be calculated separately;

is the total amount of carbonate *i* used as raw material, fluxing agent and desulfurizing agent (unit: ton);

is CO_2 emission factors of carbonate *i* (unit: tCO_2/ton carbonate *i*); and

is the purity of carbonate *i* in form of mass percent.

4.5.2Obtaining activity level data

The total consumption amount of each carbonate should be the sum of carbonate used as raw material, fluxing agent and desulferizing agent, and should be

decided on respectively by the enterprise log book or statistic sheet accordingly. In the case of generating hydro carbonates or CO_3^{2-} transforming into other substances instead of CO_2 during use of carbonate, this part of carbonate shall not be counted as activity level.

4.5.3Obtaining data of emission factors

If possible, enterprises may entrust qualified professional organizations to periodically test the mass percent purity or chemical composition of carbonate, and then calculate the CO_2 emission factors of carbonate according to the chemical composition, chemical formula and the emission factor of CO_3^{2-}. The determination of carbonate composition should be in line with standards in *GB/T 3286.1* and *GB/T 3286.9 etc*. Enterprises with qualified departments may test it themselves.

If not capable of measuring carbonate in real terms, enterprises could use the data of commodity properties provided by suppliers. For the CO_2 emission factors of some common carbonate, enterprises may directly use the recommended value in Table 2.2 in Appendix II Relevant Default Values.

4.6 CH_4Emission from Anaerobic Wastewater Treatment

4.6.1 Calculation equation

Reporting entities should calculate CH4 emissions from anaerobic wastewater treatment for themselves or other enterprises according to the equation below:

$$E_{CH_4\_\text{Wastewater}} = (TOW - S) \times EF_{CH_4\_\text{Wastewater}} \times 10^{-3} \quad \text{... (6)}$$

where,

$\mathbf{E_{CH_4_Waste}}$isCH_4 emission from anaerobic wastewater treatment (unit: ton);

$T$is the total amount of biodegradable organics in anaerobic wastewater, using COD as measuring index (unit: kg COD);

S is the total amount of biodegradable organics removed by the method of sludge, using COD as measuring index (unit: kg COD); and

$EF_{CH_4\_Waste}$ is CH_4 emission factors from anaerobic wastewater treatment (unit: kg CH_4/ kg COD).

If an enterprise has the statistics of chemical oxygen demand (COD) removed byanaerobic wastewater treatment system, it can be used directly as total organic matter removed by anaerobic wastewater treatment. If COD statistics are not available, the equation below can be used for calculation:

$$TOW = W \times (COD_{in} - COD_{out})$$

... (7)

where,

is the amount of wastewater processed by anaerobic treatment (unit: m^3/year);

Cis the COD concentration of wastewater before processed by anaerobic treatment (unit: kg COD/m^3);

$CO$is the COD concentration of wastewater after processed by anaerobic treatment (unit: kg COD/m^3).

$$EF_{CH4\_Wastewater} = B_0 \times MCF$$

... (8)

is maximum production capacity of methane of anaerobic wastewater treatment system (kg CH_4/ kg COD); and

,isa methane correction factor, which represents maximum methane generation capacity (Bo) by different approaches or treatments and disposal system, reflecting the anaerobic degree of the system.

4.6.2Monitoring and obtaining activity level data

Enterprises should determine the amount of wastewater processed by way of anaerobic treatment, COD removed by anaerobic wastewater treatment system, COD removed by the method of sludge by enterprise original record or log book. If the

COD removed by the method of sludge is not recorded, zero should be assumed.

The determination of COD concentration in wastewater should take into account the average of periodical measurement, and the test method should meet the requirements of the monitoring and test method of COD issued by Ministry of Environmental Protection of the People's Republic of China. Water sample should be collected at least every two hours, and data is determined by the mixed sample of 24 consecutive hours.

4.6.3Monitoring and obtaining emission factor data

Mass methane productive capacity in the anaerobic wastewater treatment system should be the recommended value, which is 0.25kg CH_4/kg COD for the time being. In the future, it will be updated by official data of the competent department.

4.7Quantity of Recycled and Decomposed CH_4

4.7.1 Calculation equation

CH_4 recycled and decomposed should be calculated according to the equation below:

$$R_{CH_4\,\text{Recycled and Decomposed}} = R_{CH_4\_\text{Self-use}} + R_{CH_4\_\text{Supply}} + R_{CH_4\_\text{Torch}} \quad \text{... (9)}$$

where,

$R_{CH_4\_Se}$ is the amount of CH_4 recycled that reused by its own (unit: tCH_4);

$R_{CH_4\_S}$ is the amount of CH_4 recycled that supply to others (unit: tCH_4);

$R_{CH_4\_}$ is the amount of CH_4 decomposed by torch (unit: tCH_4); Among others,

$$R_{CH_4\,\text{Self-use}} = \eta_{Self-use} \times Q_{\text{Self-use}} \times PUR_{CH_4} \times 7.17 \quad \text{... (10)}$$

where,

η_{Sel} is the oxygenation index(%) of CH_4 consumed on-site;

Q_{Sel} is the volume of CH_4 that recycled and reused by reporting entities (unit: 10,000Nm^3);

PUR_{CH_4} is the average volume concentration of CH_4 in the recycled methane gas which is reused by reporting entities;

7.17 is density of CH_4 under standard condition (unit: ton/10,000Nm^3);

$$R_{CH_4\_Supply} = Q_{Supply} \times PUR_{CH_4} \times 7.17$$

... (11)

Q_S is the volume of CH_4 that supplies to third party (unit: 10,000Nm^3);

PUR_{CH_4} is the average volume concentration of CH_4 in the recycled methane gas which is supplied to others;

$R_{CH_4\_}$ should be obtained through monitoring the airflow of methane and the concentration of CH_4 entering the torch. And the efficiency of decomposition should be taken into account. The equation is:

$$R_{CH4\_Torch} = \bar{\eta} \times \sum_{h=1}^{H} \left(\frac{FR_h \times V\%_h}{22.4} \times 16 \times 10^{-3} \right)$$

... (12)

where,

is the average decomposition rate (%) of CH_4 torch system;

is the operating time of the torch system (unit: hour);

is the sequence number of operation;

is the airflow of methane entering into torch system (unit: Nm^3/h). The

airflow under special condition should be converted into that under standard condition (0℃、101.325 KPa) according to temperature and pressure;

is the average volume concentration (%) of methane per hour entering into torch system.

is the ideal gas molar volume under standard condition (unit: Nm^3/kmol); and

is the molecular weight of CH_4.

4.7.2 Monitoring and obtaining activity level data

The quantity of methane gas recycled and reused by reporting entities or supplied to a third party should be determined by enterprise log book or statistic sheet.

Reporting entities should set flow gauge at the entrance of the torch system continually or at least by every hour monitor the airflow of methane, and convert the data into the right number under standard condition.

4.7.3 Monitoring and obtaining emission factor data

Reporting entities should periodically measure the CH4 volume concentration entering into the torch system, whether reused by themselves or supplied to third party, in line with the standards in GB/T 8984. The number should be tested at least every month, and taken as the average volume concentration since last time testing.

Reporting entities should periodically measure the mass change of CH_4 of the airflow at the entrance and the outlet of the torch system by mass flow gauge or other means, in order to estimate the average decomposition rate of the torch system. The frequency of testing should be at least one time a month, and the data should be used as the average decomposition rate since last testing. The on-site oxygenation efficiency of methane burning could be measured as the same way; if used as fuel, reporting entities may directly use the recommended value, which is 0.99.

4.8Quantity of Recycled and ReusedCO_2

4.8.1Calculation equation

CO_2recycled and reused should be calculated according to the equation below:

$$R_{CO_2\_Recycled} = (Q_{\text{Supply}} \times PUR_{CO_2\_\text{Supply}} + Q_{\text{Self-use}} \times PUR_{CO_2\_\text{Self-use}})elf - us$$

……（13）

where，

$R_{CO_2_Rec}$is CO_2 recycled and reused volume (unit: tCO_2);

$Q_S$is the volume of CO_2that is recycled by reporting entities and supplied to other enterprises (unit: 10,000Nm^3);

$PUR_{CO_2_S}$is the purity (volume concentration) of CO_2 for external supply, ranging from 0 to 1;

$Q_{Sel}$is the volume of CO_2 that recycled and reused by reporting entities (unit: 10,000Nm^3);

$PUR_{CO_2_Se}$is the purity (volume concentration) of CO_2 reused by reporting entities, ranging from 0 to 1; and

1is the density of CO_2 under standard condition (unit: tCO_2 /10,000Nm^3).

4.8.2Obtaining activity level data

The amount of recycled CO_2, reused or supplied to others, should be determined by enterprise log book or statistic sheet.

4.8.3Obtaining data of emission factors

Reporting entities should periodically measure the CO_2 volume concentration of recycled CO_2 gas both for reuse and external supply respectively. Regular measurement should be conducted at least once a week, and the data should be used as the data for average purity since last testing.

4.9 CO_2Emissions from Net Purchased Electricity and Heat

4.9.1Calculation equation

CO_2 emission from net purchased electricity and heat should be calculated respectively according to Equation(14) and Equation(15):

$$E_{CO_2\_Net\ Electricity} = AD_{Electricity} \times EF_{Elec}$$

... (14)

$$E_{CO_2\_Net\ Heat} = AD_{Heat} \times EI$$

... (15)

where,

$E_{CO_2_Net\ Elec}$is CO_2 emission from net purchased electricity (unit: tCO_2);

$E_{CO_2_Net}$is CO_2 emission from net purchased heat (unit: tCO_2);

$AD_{Elec}$is the consumption of net purchased electricity (unit: MWh);

AIis the heat consumption of net purchased heat (unit: GJ);

$EF_{Elec}$is CO_2emission factors of electricity supply (unit: tCO_2/MWh); and

Eis CO_2emission factors of heat supply (unit: tCO_2/GJ).

4.9.2 Monitoring and obtaining activity level data

The consumption of net purchased electricity should be determined by the number of electricity meter by which the enterprise settles with the grid company, or the log book or statistic sheet of enterprise energy consumption. Electricity net purchase equals to purchase minus external supply.

The consumption of net purchased heat should be determined by the voucher of clearing of heat, or the log book or statistic sheet of enterprise energy consumption. Heat net purchase equals to total purchase of steam and hot water minus that of external supply.

The hot water measured in form of mass could be converted to heat according to Equation(16):

$$AD_{Hot\,Water} = Ma_w \times (T_w - 20) \times 4.1868 \times \text{....(16)}$$

where,

AD_{Hot} is the heat of hot water (unit: GJ);

is the mass of hot water (unit: ton);

is the temperature of hot water (unit: ℃); and

4.1is the specific heat of water under standard temperature and pressure (unit: kJ/(kg·℃)).

The steam measured in form of mass could be converted to heat according to Equation(17):

$$AD_{Steam} = Ma_{st} \times (En_{st} - 83.74) \times 10^{-3}$$

... (17)

where,

AD is the heat of steam (unit: GJ);

is the mass of steam (unit: ton); and

is the enthalpy per kilogram of steam under certain temperature and pressure (unit: kJ/kg). To identify saturated steam, steam and superheated steam, Table2.4 and Table 2.5 in Appendix II could be referred to.

4.9.3Monitoring and obtaining emission factor data

CO_2 emission factors of electricity supply equal to that of the power grid to which the enterprise belongs. The number should be in line with the updated official data.

The CO_2 emission factors of heat supply should be assumed to be 0.11 ton CO_2/GJ for the time being; in the future, it will be updated by official data released by the authorities in charge.

5. Quality Assurance and Documentation

Reporting entities should set up a quality management, guarantee filing system for annual report, including:

- Set up a system for enterprise greenhouse gas emission quantification and reporting, including organizations, responsible team and workflow etc.
- Establish list of main emission sources of greenhouse gas, decide on the proper way of quantification and document filing.
- Design feasible monitoring plan for every index requiring calculation, which should include: index to be measured, sample spot or specific site of meters, sampling method and procedures, monitoring method and procedures, monitoring frequency or schedule, data obtaining and delivery procedures, responsible team, quality assurance/quality control system etc. Enterprises should appoint relevant department to be responsible for sampling, monitoring, analyzing, recording, collecting and filing. If some calculated indices of emission factors use default values, the source of the default value should be provided.
- Design scheduled calibration plan for metering equipment, pursuant to corresponding rules. If some equipment does not meeting the relating standards, enterprises should take necessary measures of correction and calibration.
- Develop solutions to accidents such as data missing, change of production activities or reporting. If non-functioning meters lead to data missing, for example activity level data or emission factors data needed for some emission sources calculations, enterprises ought to take proper estimation methods to obtain the conservative data to replace the missing data at corresponding period.
- Build up standard rules for document filing, to save and maintain annual

greenhouse gas emission report documents and data records, which could be presented upon third party checking and reporting to the competent department.

- Establish internal data review and verification procedures. Assure the integrity and accuracy of activity data by cross-validation of different data sources, taking into account the data fluctuation during calculation period, conduct review of main logic audit such as vertical comparison with operational data of past years etc.

6. Report Content and Format

Reports should include the following contents according to format specified in Appendix I:

6.1 Basic information of the reporting entity

The basic information of reporting entities should include the name of the reporting entity, the annual report, nature of enterprise, involved industries, organizations or branches; location (incorporating registered address and operational address), date of establishment, development, legal persons, responsible reporter and his/her contact information and so on.

Reporting entities should provide explicit explanation of legal person boundary, products and production procedures, identification process and the result of emission sources.

6.2Greenhouse gas emissions

Reporting entities should report the total amount of greenhouse gas emissions throughout the reporting period in form of CO_2 equivalent (CO_2e); and adopt the unit of mass, report CO_2 emissions from fossil fuel burning, CO_2 emissions from use of carbonate, CH_4 emissions for anaerobic wastewater treatment, the amount of CH_4 recycled and decomposed, the amount of CO_2 recycled and reused, CO_2 emissions from net purchased electricity and heat as well as other emission sources though not stipulated, of which the CO_2 equivalent comprises more than 1% of the total greenhouse gas emission of the reporting entity.

6.3 Introduction of activity level data and source

Reporting entities should report the activity data of each emission sources that calculated respectively, combining accounting boundary and classification of emission sources, and elaborate their monitoring plan and executive condition, incorporating data source or test spots, methods and recording frequency etc.

6.4 Introduction of emission factor data and sources

Reporting entities should report the carbon content of each activity level or

other calculation index of emission factors separately. If tested in real terms, a monitoring plan and executive condition should be introduced; otherwise their data source, reference, relating assumption and principles should be provided.

6.5 Other issues to clarify

Enterprises may itemize other issues that need to explained or offer suggestions to the Guidelines in reports.

Appendix I: Report Format and Template

Report of Greenhouse Gas Emissions for Other Industrial Enterprises

Reporting Entity (Seal):

Reporting Year:

Date: Day/Month/Year

Based on Guidelines for Accounting and Reporting Greenhouse Gas Emissions from Enterprises of other Industries (Trial) issued by National Development and Reform Commission, the entity has checked the amount of greenhouse gas emissions in the year of ____ and completed related data tables. Relevant facts are listed as follows:

I. Basic Information of the Company

II. Greenhouse Gas Emissions

III. Activity Data and Source

IV. Data of Emission Factors and Sources

V. Other Issues to Clarify

This report is true and reliable. If the information provided in this report fails to reflect the reality, this enterprise represented by its legal person will bear the corresponding legal responsibility.

Legal Person (Signature):
Day/Month/Year

Attachments:

Table 1-1: Carbon Dioxide Emissions Summary Sheet of the Reporting Entity for the year __

Table 1-2: List of Activity Data and Emission factors of Fossil Fuel Burning for Reporting Entity

Table 1-3: List of Activity Data and Emission factors of Use of carbonate

Table 1-4: List of Activity Data and Emission factors of Anaerobic Wastewater Treatment

Table 1-5: List of CH_4 Recycled and Decomposed Volume

Table 1-6: List of CO_2 recycled and reused Volume

Table 1-7: List of Activity Data and Emission factors of Net purchased Electricity and Heat

Table 1-1: Carbon Dioxide Emissions Summary Sheet of the Reporting Entity for the year __

Type of sources		**Emission Volume** (unit: ton)	**Greenhouse Gas Emissions** (unit: tCO_2e)
CO_2 emissions from fossil fuel burning			
CO_2 emissions from use of carbonate			
CH_4 emissions from anaerobic wastewater treatment			
CH_4 recycled and decomposed volume	Recycled CH_4 by self-use		
	Recycled CH_4 supplied to third party		
	CH_4 decomposition volume by torch		
CO_2 recycled and reused volume			
CO_2 emissions from net purchased electricity			

CO_2 emissions from net purchased heat		
Other prominent emission sources (if exists)		
Total Greenhouse gas emissions (unit: tCO2e)	Excluding CO_2 emissions from net purchased electricity and heat power	
	Including CO_2 emissions from net purchased electricity and heat power	

Table 1-2:List of Activity Data and Emission factors of Fossil Fuel Burning for Reporting Entity

Type of fuel	**The amount of burning** (ton or 10,000Nm$^{3)}$	**Carbon content** (ton carbon/ton or ton carbon/10,000Nm^3)	**Data source**	Net calorific value (GJ/ton or GJ/10,000Nm^3)	**Data source**	Carbon per calorific value[1] (ton carbon/GJ)	**Carbon oxygenation efficiency** (%)	**Data source**
blind coal			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Soft coal			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Brown coal			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Cleaned coal			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Other washed coal			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐

Table 1-2:List of Activity Data and Emission factors of Fossil Fuel Burning for Reporting Entity

Type of fuel	**The amount of burning** (ton or 10,000Nm$^{3)}$	**Carbon content** (ton carbon/ton or ton carbon/10,000Nm^3)	**Data source**	Net calorific value (GJ/ton or GJ/10,000Nm^3)	**Data source**	Carbon per calorific value[1] (ton carbon/GJ)	**Carbon oxygenation efficiency** (%)	**Data source**
								calculation
Briquette coal			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Coke			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Crude oil			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Fuel oil			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Gasoline			☐measured value		☐measured value			☐measured

Table 1-2:List of Activity Data and Emission factors of Fossil Fuel Burning for Reporting Entity

Type of fuel	**The amount of burning** (ton or 10,000Nm$^{3)}$	**Carbon content** (ton carbon/ton or ton carbon/10,000Nm^3)					**Carbon oxygenation efficiency** (%)	
			Data source	Net calorific value (GJ/ton or GJ/10,000Nm^3)	**Data source**	Carbon per calorific value[1] (ton carbon/GJ)		**Data source**
			☐calculation		☐calculation			value☐ calculation
Diesel			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Aviation kerosene			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Ordinary kerosene			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Naphtha			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation

Table 1-2:List of Activity Data and Emission factors of Fossil Fuel Burning for Reporting Entity

Type of fuel	**The amount of burning** (ton or 10,000Nm$^{3)}$	**Carbon content** (ton carbon/ton or ton carbon/10,000Nm^3)	**Data source**	Net calorific value (GJ/ton or GJ/10,000Nm^3)	**Data source**	Carbon per calorific value[1] (ton carbon/GJ)	**Carbon oxygenation efficiency** (%)	**Data source**
Petroleum coke			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Liquefied natural gas			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Liquefied petroleum gas			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value ☐calculation
Other petroleum products			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Coke oven gas			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐

Table 1-2:List of Activity Data and Emission factors of Fossil Fuel Burning for Reporting Entity

Type of fuel	**The amount of burning** (ton or 10,000Nm$^{3)}$	**Carbon content** (ton carbon/ton or ton carbon/10,000Nm^3)	**Data source**	Net calorific value (GJ/ton or GJ/10,000Nm^3)	**Data source**	Carbon per calorific value[1] (ton carbon/GJ)	**Carbon oxygenation efficiency** (%)	**Data source**
								calculation
Blast furnace gas			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Converter gas			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Other coal gas			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Natural gas			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation
Refinery dry gas			☐measured value		☐measured value			☐measured

Table 1-2:List of Activity Data and Emission factors of Fossil Fuel Burning for Reporting Entity

Type of fuel	**The amount of burning** (ton or 10,000Nm$^{3)}$	**Carbon content** (ton carbon/ton or ton carbon/10,000Nm^3)	**Data source**	Net calorific value (GJ/ton or GJ/10,000Nm^3)	**Data source**	Carbon per calorific value[1] (ton carbon/GJ)	**Carbon oxygenation efficiency** (%)	**Data source**
			☐calculation		☐calculation			value ☐calculation
other types of fuel[2]			☐measured value ☐calculation		☐measured value ☐calculation			☐measured value☐ calculation

Note: [1]If carbon content is estimated by net calorific value and carbon content per calorific value, please fill in this column.

[2] If type of fuel actually used is not in this chart, please add.

Table 1-3:List of Activity Data and Emission factors for the Use of Carbonate

Type of carbonate	**Net consumption** (unit: ton/year)	**Purity of carbonate in mass percent** (%)	**CO_2 Emission factors** (tCO_2/ton carbonate)
limestone			
dolomite			
magnesite			
clay			
... [1]			

Note: [1]Please add type of carbonate that was actually used

Table 1-4:List of Activity Data and Emission factors of Anaerobic Wastewater Treatment

The amount of wastewater processed by anaerobic treatment (m^3/year)	**COD volume removed by anaerobic system** (kg COD)	**COD volume removed by clay** (kg COD)	**Maximum productivity of methane** (kg CH_4/ kg COD)	**Methane correction factors** -

Table 1-5: List of CH_4 Recycled and Decomposed Volume

Recycled methane gas by self-use on site (Nm^3)	**The volume concentration of CH_4 in the recycled methane gas (%)**	**The oxygenation efficiency of recycled methane gas during self-use** (%)	**Recycled CH_4 supplied to third party** (Nm^3)	**The volume concentration of CH_4 in the recycled methane gas for external supply** (%)	**The volume of methane gas decomposed by torch** (Nm^3)	**The average concentration of CH_4 in torch system** (%)	**The volume of methane gas decomposed by torch** (%)

Table 1-6: List of CO_2Recycled and Reused Volume

The volume of recycled CO_2 for external supply (10,000Nm^3)	**The volume concentration of CO_2 for external supply** (%)	**The volume of recycled CO_2 used as raw material** (10,000Nm^3)	**The volume concentration of CO_2 used as raw material** (%)

Table 1-7:List of Activity Data and Emission Factors of Net purchased Electricity and Heat

Type	**Net purchase** (MWh or GJ)		**CO_2 Emission factors** (t CO_2/MWh or t CO_2/GJ)
	Purchased Volume	**Supplied Volume**	

		(MWh or GJ)	(MWh or GJ)	
Electricity				
Steam				
Heated water				

Appendix II: Relevant Default Values

Table 2-1: Default values of characteristic parameters of ordinary fossil fuels

Type of fuel		Net calorific value		Carbon per calorific value (ton carbon/GJ)	Carbon oxygenation efficiency
		recommended value	unit		
solid fuel	blind coal	24.515	GJ/ton	27.49	94%
	Soft coal	23.204	GJ/ton	26.18	93%
	Brown coal	14.449	GJ/ton	28.00	96%
	Cleaned coal	26.344	GJ/ton	25.40	93%
	Other washed coal	15.373	GJ/ton	25.40	90%
	Briquette coal	17.46	GJ/ton	33.60	90%
	Coke	28.446	GJ/ton	29.40	93%
liquid fuel	Crude oil	42.62	GJ/ton	20.10	98%
	Fuel oil	40.19	GJ/ton	21.10	98%
	Gasoline	44.80	GJ/ton	18.90	98%
	Diesel	43.33	GJ/ton	20.20	98%
	Ordinary kerosene	44.75	GJ/ton	19.60	98%
	Petroleum coke	31.00	GJ/ton	27.50	98%
	Other petroleum products	40.19	GJ/ton	20.00	98%
	Tar	33.453	GJ/ton	22.00	98%
	Crude benzene	41.816	GJ/ton	22.70	98%
gas fuel	Refinery dry gas	46.05	GJ/ton	18.20	99%
	Liquefied petroleum gas	47.31	GJ/ton	17.20	99%
	Liquefied natural gas	41.868	GJ/ton	15.30	99%
	Natural gas	389.31	GJ/10,000Nm^3	15.30	99%
	Coke oven gas	173.854	GJ/10,0	13.60	99%

			00Nm^3		
	Blast furnace gas	37.69	GJ/10,000Nm^3	70.80	99%
	Converter gas	79.54	GJ/10,000Nm^3	49.60	99%
	Gas fuel for sealed calcium carbide furnace	111.19	GJ/10,000Nm^3	39.51	99%
	Other coal gas	52.34	GJ/10,000Nm^3	12.20	99%

Data Source:

a. for low caloric value: refer to *2005 National Greenhouse Gas Inventory of The People's Republic of China*

b. for carbon content per caloric unit: refer to *2006 IPCC Guidelines for National Greenhouse Gas Inventories; Provincial Guidance on the Compilation of Greenhouse Gas Inventories (Trial)*etc.

c. for carbon oxygenation efficiency: refer to *Provincial Guidance on the Compilation of Greenhouse Gas Inventories (Trial)*

Table 2-2: Default values of CO_2 emission factors of common carbonate

Carbonate	**Emission factors (tCO_2/ton Carbonate)**
$CaCO_3$	0.4397
$MgCO_3$	0.5220
Na_2CO_3	0.4149
$NaHCO_3$	0.5237
$FeCO_3$	0.3799
$MnCO_3$	0.3829
$BaCO_3$	0.2230
Li_2CO_3	0.5955
K_2CO_3	0.3184
$SrCO_3$	0.2980
$CaMg(CO_3)_2$	0.4773

Table 2-3: MCF default values of each industrial wastewater treatment system

Type of system or tunnel of treatment or discharge	**MCF**	**Range**	**Remarks**
Discharge into river, lake or ocean	0.1	0 - 0.2	If wastewater with high content of organics is discharged into rivers, anaerobic reaction my happen.
Aerobic equipment	0	0 - 0.1	Management improvement
Aerobic equipment	0.3	0.2 – 0.4	Defective management, overloaded
Anaerobic sludge digester	0.8	0.8 – 1.0	Without consideration of CH_4
Anaerobic reactor	0.8	0.8 – 1.0	Without consideration of CH_4
Shallow anaerobic pond	0.2	0 – 0.3	Within 2 meters
Deep anaerobic pond	0.8	0.8 – 1.0	More than 2 meters

Table 2.4 Caloric Sheet of Saturated Steam

Pressure	Temperature	Enthalpy	Pressure	Temperature	Enthalpy
0.001	6.98	2513.8	1.00	179.88	2777.0
0.002	17.51	2533.2	1.10	184.06	2780.4
0.003	24.10	2545.2	1.20	187.96	2783.4
0.004	28.98	2554.1	1.30	191.6	2786.0
0.005	32.90	2561.2	1.40	195.04	2788.4
0.006	36.18	2567.1	1.50	198.28	2790.4
0.007	39.02	2572.2	1.60	201.37	2792.2
0.008	41.53	2576.7	1.40	204.3	2793.8
0.009	43.79	2580.8	1.50	207.1	2795.1
0.010	45.83	2584.4	1.90	209.79	2796.4
0.015	54.00	2598.9	2.00	212.37	2797.4
0.020	60.09	2609.6	2.20	217.24	2799.1
0.025	64.99	2618.1	2.40	221.78	2800.4
0.030	69.12	2625.3	2.60	226.03	2801.2
0.040	75.89	2636.8	2.80	230.04	2801.7
0.050	81.35	2645.0	3.00	233.84	2801.9
0.060	85.95	2653.6	3.50	242.54	2801.3
0.070	89.96	2660.2	4.00	250.33	2799.4
0.080	93.51	2666.0	5.00	263.92	2792.8
0.090	96.71	2671.1	6.00	275.56	2783.3
0.10	99.63	2675.7	7.00	285.8	2771.4
0.12	104.81	2683.8	8.00	294.98	2757.5
0.14	109.32	2690.8	9.00	303.31	2741.8
0.16	113.32	2696.8	10.0	310.96	2724.4
0.18	116.93	2702.1	11.0	318.04	2705.4
0.20	120.23	2706.9	12.0	324.64	2684.8
0.25	127.43	2717.2	13.0	330.81	2662.4
0.30	133.54	2725.5	14.0	336.63	2638.3
0.35	138.88	2732.5	15.0	342.12	2611.6
0.40	143.62	2738.5	16.0	347.32	2582.7
0.45	147.92	2743.8	17.0	352.26	2550.8
0.50	151.85	2748.5	18.0	356.96	2514.4
0.60	158.84	2756.4	19.0	361.44	2470.1
0.70	164.96	2762.9	20.0	365.71	2413.9
0.80	170.42	2768.4	21.0	369.79	2340.2
0.90	175.36	2773.0	22.0	373.68	2192.5

Table 2-5: Caloric Sheet of Superheated Steam

(unit: kJ/kg)

Temperature	Pressure											
	0.01 MPa	0.1 MPa	0.5 MPa	1 MPa	3 MPa	5 MPa	7 MPa	10 MPa	14 MPa	20 MPa	25 MPa	30 MPa
0℃	0	0.1	0.5	1	3	5	7.1	10.1	14.1	20.1	25.1	30
10℃	42	42.1	42.5	43	44.9	46.9	48.8	51.7	55.6	61.3	66.1	70.8
20℃	83.9	84	84.3	84.8	86.7	88.6	90.4	93.2	97	102.5	107.1	111.7
40℃	167.4	167.5	167.9	168.3	170.1	171.9	173.6	176.3	179.8	185.1	189.4	193.8
60℃	2611.3	251.2	251.2	251.9	253.6	255.3	256.9	259.4	262.8	267.8	272	276.1
80℃	2649.3	335	335.3	335.7	337.3	338.8	340.4	342.8	346	350.8	354.8	358.7
100℃	2687.3	2676.5	419.4	419.7	421.2	422.7	424.2	426.5	429.5	434	437.8	441.6
120℃	2725.4	2716.8	503.9	504.3	505.7	507.1	508.5	510.6	513.5	517.7	521.3	524.9
140℃	2763.6	2756.6	589.2	589.5	590.8	592.1	593.4	595.4	598	602	605.4	603.1
160℃	2802	2796.2	2767.3	675.7	676.9	678	679.2	681	683.4	687.1	690.2	693.3
180℃	2840.6	2835.7	2812.1	2777.3	764.1	765.2	766.2	767.8	769.9	773.1	775.9	778.7
200℃	2879.3	2875.2	2855.5	2827.5	853	853.8	854.6	855.9	857.7	860.4	862.8	856.2
220℃	2918.3	2914.7	2898	2874.9	943.9	944.4	945.0	946	947.2	949.3	951.2	953.1
240℃	2957.4	2954.3	2939.9	2920.5	2823	1037.8	1038.0	1038.4	1039.1	1040.3	1041.5	1024.8
260℃	2996.8	2994.1	2981.5	2964.8	2885.5	1135	1134.7	1134.3	1134.1	1134	1134.3	1134.8
280℃	3036.5	3034	3022.9	3008.3	2941.8	2857	1236.7	1235.2	1233.5	1231.6	1230.5	1229.9
300℃	3076.3	3074.1	3064.2	3051.3	2994.2	2925.4	2839.2	1343.7	1339.5	1334.6	1331.5	1329
350℃	3177	3175.3	3167.6	3157.7	3115.7	3069.2	3017.0	2924.2	2753.5	1648.4	1626.4	1611.3
400℃	3279.4	3278	3217.8	3264	3231.6	3196.9	3159.7	3098.5	3004	2820.1	2583.2	2159.1
420℃	3320.96	3319.68	3313.8	3306.6	3276.9	3245.4	3211.0	3155.98	3072.72	2917.02	2730.76	2424.7
440℃	3362.52	3361.36	3355.9	3349.3	3321.9	3293.2	3262.3	3213.46	3141.44	3013.94	2878.32	2690.3
450℃	3383.3	3382.2	3377.1	3370.7	3344.4	3316.8	3288.0	3242.2	3175.8	3062.4	2952.1	2823.1

Table 2-5: Caloric Sheet of Superheated Steam (continued)

(unit: kJ/kg)

Temperature	Pressure											
	0.01 MPa	0.1 MPa	0.5 MPa	1 MPa	3 MPa	5 MPa	7 MPa	10 MPa	14 MPa	20 MPa	25 MPa	30 MPa
460℃	3404.42	3403.34	3398.3	3392.1	3366.8	3340.4	3312.4	3268.58	3205.24	3097.96	2994.68	2875.26
480℃	3446.66	3445.62	3440.9	3435.1	3411.6	3387.2	3361.3	3321.34	3264.12	3169.08	3079.84	2979.58
500℃	3488.9	3487.9	3483.7	3478.3	3456.4	3433.8	3410.2	3374.1	3323	3240.2	3165	3083.9
520℃	3531.82	3530.9	3526.9	3521.86	3501.28	3480.12	3458.6	3425.1	3378.4	3303.7	3237	3166.1
540℃	3574.74	3573.9	3570.1	3565.42	3546.16	3526.44	3506.4	3475.4	3432.5	3364.6	3304.7	3241.7
550℃	3593.2	3595.4	3591.7	3587.2	3568.6	3549.6	3530.2	3500.4	3459.2	3394.3	3337.3	3277.7
560℃	3618	3617.22	3613.64	3609.24	3591.18	3572.76	3554.1	3525.4	3485.8	3423.6	3369.2	3312.6
580℃	3661.6	3660.86	3657.52	3653.32	3636.34	3619.08	3601.6	3574.9	3538.2	3480.9	3431.2	3379.8
600℃	3705.2	3704.5	3701.4	3697.4	3681.5	3665.4	3649.0	3624	3589.8	3536.9	3491.2	3444.2